THE INDOOR FARMER WHO WANTS TO REMAKE APPALACHIA'S AGRICULTURE

A startup called AppHarvest is building a 60-acre greenhouse in an economically distressed part of Kentucky. Will its high-tech approach help fix the U.S. food system?

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Jonathan Webb's farm doesn't look like much: tawny soil stretching to a line of trees, a trailer with a few makeshift desks. But if Mr. Webb gets his way, by mid-2020, the Morehead, Ky., property will house a 60-acre greenhouse—the first in a series of multi-acre, technology-augmented indoor farms meant to bring jobs to Appalachia and fresh-picked tomatoes to surrounding states.

"If we had 500 acres of supply tomorrow, we could sell all of that supply to U.S. grocers," said Mr. Webb, 34, who wears a uniform of dark jeans, a light denim shirt, round glasses and a Kentucky ball cap. "We cannot build fast enough or grow fast enough to meet the demand of grocers or consumers."

Mr. Webb's vision is to turn economically distressed eastern Kentucky into the high-tech agriculture capital of the country. He has no prior experience in farming, but he has managed to attract $97 million in project financing and a list of noteworthy partners. Ultimately, he plans to spend $1 billion to $2 billion on greenhouses—even if it takes a decade or two.

Mr. Webb's vision is to turn an economically distressed part of Kentucky into the country's agriculture-technology hub. **PHOTO:** JESSICA TEZAK FOR THE WALL STREET JOURNAL

His startup, AppHarvest, is one of a growing number of technology-focused agricultural companies seeking to solve the problems of the U.S. food system—among them opaque supply chains, labor shortages, food waste, health and safety issues, higher import costs and an increasingly unpredictable climate—by growing food indoors.

Compared with traditional farms, indoor farms offset weather-related risks, reduce food waste, use drastically less water and produce more consistent crops. A modern, acre-size greenhouse can yield the same amount of produce as 40 to 50 acres of soil, said Viraj Puri, co-founder and chief executive of Gotham Greens, which distributes leafy greens and herbs from its 180,000 square feet of rooftop greenhouses in Brooklyn and Chicago. Produce grown indoors also appeals to changing consumer preferences, as more Americans seek to reduce sugar and processed foods in their diets, eat more locally grown, chemical-free produce, and track the origins of their food, said Fernando Martins, a Bain & Co. partner who specializes in agriculture, food and sustainability.

A handful of startups, including Plenty Unlimited Inc., AeroFarms LLC and Bowery Farming, have converted urban warehouses into vertical farms, where plants grow hydroponically in vertical rows. These companies use advanced technology, including energy-efficient LEDs, sensors, robots and software, to cultivate produce for maximum yield and flavor. Meanwhile, Boston-based Freight Farms sells a 320-square-foot shipping-container farm to schools and corporate campuses; the latest version yields four to eight tons of produce a year.

The startup Plenty Unlimited recently unveiled its latest vertical farm in a converted warehouse in South San Francisco. PHOTO: SPENCER LOWELL/PLENTY UNLIMITED

Companies building "novel farming systems" raised $596 million from investors in 2018, according to a report from AgFunder, an investment firm.

Still, some agriculture-technology watchers have raised concerns about the venture capital flowing into the industry. Vertical farms in particular have (so far) failed to deliver on their promise of widespread urban farms, they say. Some are spending years to build bespoke technology—a secretive and costly approach that some insiders say holds back the industry. (Plenty's chief science officer, Nate Storey, said that the company is on a longer initial timeline because of its technology investments, but that it has built "a farm that is as precise and controlled as a farm can be," and will eventually be more cost-efficient.)

Others think the best approach is to use existing technology—much of it first developed in the Netherlands, the undisputed leader in controlled environment agriculture—and augment it for largescale projects in the U.S., including on urban rooftops.

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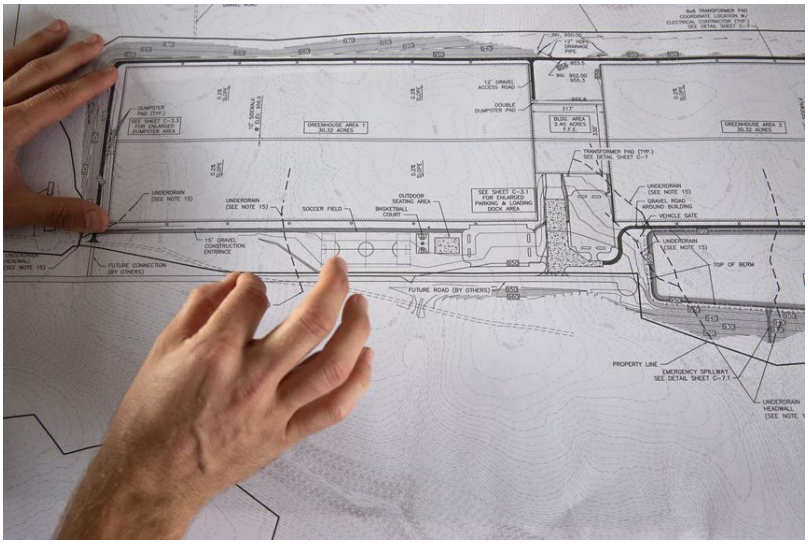
By the end of 2019, Gotham Greens plans to open a second Dutch-style greenhouse in Chicago, plus one in a former General Electric Co. light bulb factory in Providence, R.I., and another in a vacant Bethlehem Steel Corp. site in Baltimore. The idea is to create a network of urban farms to serve major U.S. population centers with year-round leafy greens, Mr. Puri said.

Kingsville, Ontario-based Mastronardi Produce is constructing a 70-acre greenhouse to grow strawberries and tomatoes in Oneida, N.Y.—the largest such facility to grow the berry in the U.S., according to President and Chief Executive Paul Mastronardi. Founded in 1954, the company sells tomatoes under the Sunset brand. It also has a 100-acre greenhouse in Coldwater, Mich., though it built that in stages.

Houweling's Group, based outside Vancouver, Canada, is adding 30 acres to its 28-acre greenhouse in Mona, Utah. The facility runs off heat and carbon dioxide generated by an adjacent natural-gas power plant, said Chief Marketing Officer David Bell. The company also built a 125-acre greenhouse in Camarillo, Calif., in six phases.

AppHarvest started construction on its greenhouse in May. Some in the protected agriculture field characterize Mr. Webb as a newcomer dressing up existing technology with good marketing. But supporters say his vision is unique in the breadth of his ambitions and in his desire to turn a poverty-stricken part of the country into an agriculture-technology hub.

"The scale with which they're attacking the problem and taking it to market is required," said Brad McNamara, chief executive of Freight Farms. "To build a national, retail-grocer-type brand



Mr. Webb plans to run the greenhouse entirely on rainwater. **PHOTO:** JESSICA TEZAK FOR THE WALL STREET JOURNAL

that's competing with everything coming out of Canada and Mexico—that approach is really important."

AppHarvest is working with high-profile partners. Dalsem, a well-known Dutch greenhouse provider, is building the structure. Mastronardi will distribute AppHarvest produce to 25 of the largest U.S. grocers. Philips Lighting is manufacturing the $15 million LED system—what appears to be the largest such installation in the U.S.

AppHarvest's financial backers include the Rise of the Rest Seed Fund at Revolution, the Washington, D.C., investment firm co-founded by AOL co-founder Steve Case and managed by author J.D. Vance. Jeffrey Ubben, founder and chief executive of ValueAct Capital Management LP and co-portfolio manager of its ValueAct Spring Fund, invested in part because AppHarvest is using the changing climate to its advantage. "The planet is just going to start shutting down businesses all over the place," he said. "Those that are using the constrained resources, well, less, will have the most amazing cost advantage you can imagine. And that is a return."

Mr. Webb plans to run the greenhouse entirely on rainwater, making it the largest facility of its kind to do so, according to industry experts. Water would be collected on the roof and in a 10-acre pond on site. (Some experts remained skeptical that it would work, given the size of AppHarvest's operations, though they said it is technically feasible.)

Mr. Webb anticipates the greenhouse will cost $97 million to build, generate roughly $50 million in revenue and be profitable in the first year. Kentucky lies within a day's drive of 70% of the U.S. population, and the state recorded record rainfall last year, Mr. Webb said.

A view of the site of AppHarvest's future greenhouse **PHOTO:** JESSICA TEZAK FOR THE WALL STREET JOURNAL

Kentucky has also been wracked by the collapse of the coal industry. Rowan County, which includes Morehead, had a per capita income of $28,775, or 58.4% of the U.S. average, in 2016, according to Appalachian Regional Commission data. AppHarvest is aiming to build a local talent pipeline, beginning with 285 jobs starting at $13 per hour with benefits. The company paid to install a Freight Farm at Shelby Valley High School to teach students, a program it plans to expand to 20 schools. AppHarvest is also developing an agricultural-technology certificate and degree program for the nearby University of Pikeville.

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"You have to develop an entirely new labor pool that really doesn't exist, arguably anywhere in the United States," Mr. Vance said. "You have to build, in some ways, a modern logistical pipeline to get millions of tomatoes in Eastern Kentucky to markets all over the country."

It's an uphill battle. More than 250,000 acres of tomatoes were harvested in California in 2017—representing 75.5% of the nationwide total—versus 857 in Kentucky, according to U. S. Department of Agriculture figures. Mexico supplies about half the fresh tomatoes consumed in the U.S. And this is not Mr. Webb's first attempt to break ground on the project. AppHarvest had planned to build on a reclaimed surface mine in Pikeville, but it proved too costly, Mr. Webb said.

His goal is to start shipping tomatoes—roughly 50 million pounds annually, under the AppHarvest brand—in late 2020. Mr. Webb appreciates the scope of the challenge in front of him. "Our food system in this country right now is a house of cards," Mr. Webb said. "Sixty acres, as big as it is, is a dent in the real, overall market."