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The Future of Farming

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Selina Wang
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Is Looking Up

Plenty says its vegetable warehouse has the technology and cash to pump out Whole Foods-quality produce at Walmart prices. Now it just has to deliver

Before stepping into Plenty Inc.'s indoor farm on the banks of San Francisco Bay, make sure you're wearing pants and closed-toe shoes. Heels aren't allowed. If you have long hair, you should probably tie it back.

Your first stop is the cleaning room. Open the door and air will whoosh behind you, removing stray dust and contaminants as the door slams shut. Slide into a white bodysuit, pull on disposable shoe covers, and don a pair of glasses with colored lenses. Wash your hands in the sink before slipping on food-safety gloves. Step into a shallow pool of clear, sterilized liquid, then open the door to what the company calls its indoor growing room, where another air bath eliminates any stray particles that collected in the cleaning room.

The growing room looks like a strange forest, with pink and purple LEDs illuminating 20-foot-tall towers of leafy vegetables that stretch as far as you can see. It smells like a forest, too, but there's no damp earth or moss. The plants are growing sideways out of the columns, which bloom with Celtic crunch lettuce, red oak kale, sweet summer basil, or 15 other heirloom munchables. The 50,000-square-foot room, a little more than an acre, can produce some 664 tons of lettuce in less than a month.

Step closer to the veggie columns, and you'll spot one of the roughly 7,500 infrared cameras or 35,000 sensors hidden among the leaves. The sensors monitor the room's temperature, humidity, and level of carbon dioxide, while the cameras record the plants' growing phases. The data stream to Plenty's botanists and artificial intelligence experts, who regularly tweak the environment to increase the farm's productivity and enhance the food's taste. Step even closer to the produce, and you may see a ladybug or two. They're there to eat any pests that somehow make it past the cleaning room. "They work for free so we don't have to eat pesticides," says Matt Barnard, Plenty's chief executive officer.

Barnard, 44, grew up on a 160-acre apple and cherry orchard in bucolic Door County, Wis., a place that attracts a steady stream of fruit-picking tourists. Now he and his four-year-old startup aim to radically change how we grow and eat produce. The world's supply of fruits and vegetables falls 22 percent short of global nutritional needs, according to public-health researchers at Emory University, and that shortfall is expected to worsen. While the field is littered with the remains of companies that tried to narrow the gap over the past few years, Plenty seems the most promising of any so far, for two reasons. First is its technology, which vastly increases its farming efficiency—and, early tasters say, the quality of its food—relative to traditional farms and its venture-backed rivals. Second, but not least, is the $200 million it collected in July from Japanese telecom giant SoftBank Group, the largest agriculture technology investment in history.

With the backing of SoftBank CEO Masayoshi Son, Plenty has the capital and connections to accelerate its endgame: building massive indoor farms on the outskirts of every major city on Earth, some 500 in all. In that world, food could go from farm to table in hours rather than days or weeks. Barnard says he's been meeting with officials from some 15 governments on four continents, as well as executives from Wal-Mart Stores Inc. and Amazon.com Inc., while he plans his expansion. (Bezos Expeditions, the Amazon CEO's personal venture fund, has also invested.) He intends to open farms abroad next year, starting with Tokyo, Shanghai, and Riyadh; this first one, in the Bay Area, is on track to begin making deliveries to San Francisco grocers by the end of 2017. "We're giving people food that tastes better and is better for them," Barnard says. He says that a lot.

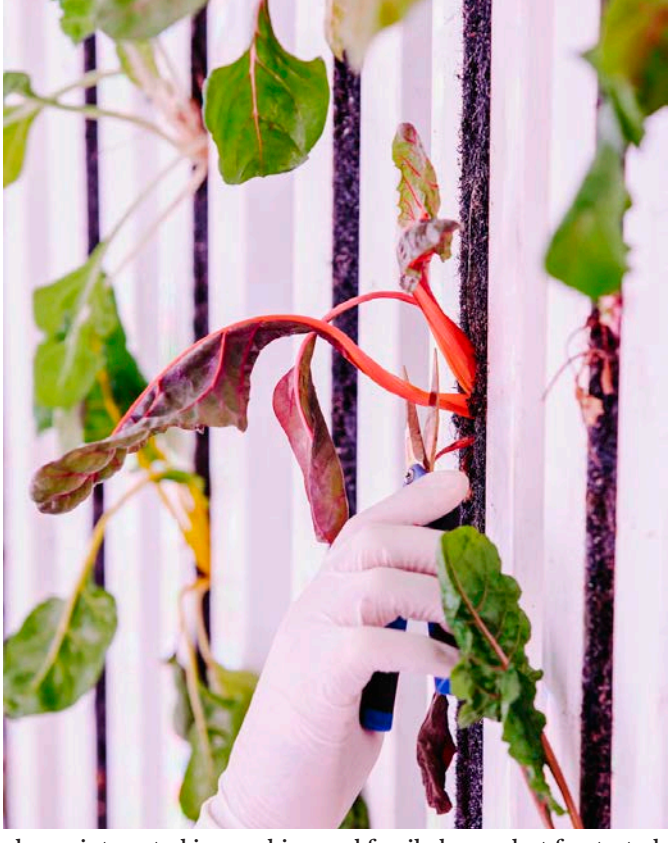
Plenty acknowledges that its model is only part of the solution to the global nutrition gap, that other novel methods and conventional farming will still be needed. Barnard is careful not to frame his crusade in opposition to anyone, including the industrial farms and complex supply chain he's trying to circumvent. He's focused on proving that growing rooms such as the one in South San Francisco can reliably deliver Whole Foods quality at Wal-Mart prices. Even with $200 million in hand, it won't be easy. "You're talking about seriously scaling," says Sonny Ramaswamy, director of the National Institute of Food and Agriculture, the investment arm of the U.S. Department of Agriculture. "The question then becomes, are things going to fall apart? Are you going to be able to maintain quality control?"

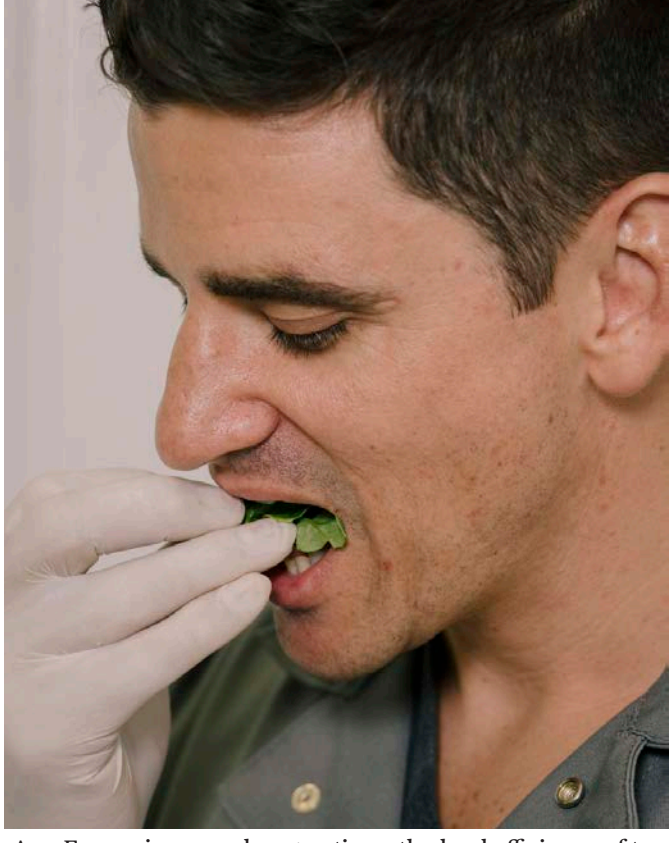
The idea of growing food indoors in unlikely places such as warehouses and rooftops has been hyped for decades. It presents a compelling solution to a series of intractable problems, including water shortages, the scarcity of arable land, and a farming population that's graying as young people eschew the agriculture industry in greater numbers. It also promises to reduce the absurd waste built into international grocery routes. The U.S. imports some 35 percent of fruits and vegetables, according to Bain & Co., and even leafy greens produced in California or Arizona travel an average of 2,000 miles before reaching a retailer. In other words, vegetables that are going to be appealing and edible for two weeks or less spend an awful lot of that time in transit.

So far, though, vertical farms haven't been able to break through. Over the past few years, early leaders in the field, including PodPonics in Atlanta, FarmedHere in Chicago, and Local Garden in Vancouver have shut down operations. Some had design issues, while others started too early, when hardware costs were much higher. Gotham Greens in Brooklyn, N.Y., and AeroFarms in Newark, N.J., look promising, but they haven't raised anywhere near Plenty's cash hoard and aren't planning a global footprint.

While more than one of these companies was felled by a lack of expertise in either farming or finance, Barnard's unusual path to his Bay Area warehouse makes him especially suited for the project. He left the family orchard at 18, frustrated with the degree to which his life could be upended by an unexpected freeze or a broken-down tractor-trailer. Eventually he became a telecommunications executive, then a partner at a private equity firm. In 2007, two decades into his white-collar life, he started his own company, one that concentrated on investing in technologies to treat and conserve water. After an investor suggested he consider putting money into vertical farming, Barnard began to research the subject and quickly found himself obsessed with shortages of food and arable land. "The length of the supply chain, the time and distance it takes," he says, meant "we were throwing away half of the calories we grow." He spent months chatting with farmers, distributors, grocers, and, eventually, Nate Storey.

The grandson of Montana ranchers, 36-year-old Storey spent much of his childhood planting and tending gardens with his six siblings. Their Air Force dad, who eventually retired as a lieutenant colonel, moved them to another base every few years, and the family gardened to save money on groceries. "I was





always interested in ranching and family legacy but frustrated on how to do it," Storey says. "If you're an 18-year-old kid and you want to farm or ranch, most can't raise $3 million to buy a farm or a ranch."

A decade ago, as a student at the University of Wyoming, he learned about the same industry-level inefficiencies Barnard observed. He began experimenting with vertical farming for his doctoral dissertation in agronomy and crop science, and in 2009 patented a growing tower that would pack the plants more densely than other designs. He spent $13,000, then a sizable chunk of his life savings, to buy materials for the towers and started building them in a nearby garage. By the time he met Barnard in 2013, the group had sold a few thousand to hobbyist farmers and the odd commercial grower.

Storey became Barnard's co-founder and Plenty's chief strategy officer, splitting his time between Wyoming and San Francisco. Together they made Storey's designs bigger, more efficient, and more readily automated. By 2014 they were ready to start building the farm.

Most vertical farms grow plants on horizontal shelves stacked like a tall dresser. Plenty uses tall poles from which the plants jut out horizontally. The poles are lined up about 4 inches from one another, allowing crops to grow so densely they look like a solid wall. Plenty's setups don't use any soil. Instead, its team feeds nutrients and water into the top of the poles, and gravity does much of the rest of the work. Without horizontal shelves, excess heat from the grow lights rises naturally to vents in the ceiling. "Because we work with physics, not against it, we save a lot of money," Barnard says.

Water, too. Excess drips to the bottom of the plant towers and collects in a recyclable indoor stream, and a dehumidifier system captures the condensation produced from the cooling hardware, along with moisture released into the air by plants as they grow. All that accumulated H_2O is filtered and fed back into the farm. All told, Plenty says, its technology can yield as much as 350 times more produce in a given area as conventional farms, with 1 percent of the water. (The next-highest claim, from AeroFarms, is as much as 130 times the land efficiency of traditional models.)

Based on readings from the tens of thousands of wireless cameras and sensors, and depending on which crop it's dealing with, Plenty's system adjusts the LED lights, air composition, humidity, and nutrition. Along with that hardware, the company is using software to try to predict when plants should get certain resources. If a plant is wilting or dehydrated, for example, the software should be able to alter its lighting or water regimen to help.

Barnard, tall and lanky with a smile that crinkles his entire face, becomes giddy when he recounts the first time Plenty built an entire growing room. "It had gone from pretty sparse to a forest in about a week," he says. "I had never seen anything like that before."

When he and Storey started collaborating, their plan was to sell their equipment to small growers across the country. But to make a dent in the produce gap, they realized they'd need to reproduce their model farm with consistency and speed. "If it takes you two or three years to build a facility, forget about it," Storey says. "That's just not a pace that's going to have any impact." That meant they'd have to engineer the farms themselves. And that meant two things: They'd need more than their 40 staffers, and they'd need way more money.

It wasn't easy for Barnard to get his first meeting with Son, in March. One of Plenty's early investors had to beg the SoftBank CEO, who allotted Barnard 15 minutes. He and the investor, David Chao of DCM Ventures, jammed one of the 20-foot grow towers into Chao's Mercedes sedan and took off for Son's mansion in Woodside, Calif., some 30 miles from San Francisco. Son looked bewildered as they unloaded the tower, but the meeting stretched to 45 minutes, and two weeks later they flew to Tokyo for a more official discussion in SoftBank's boardroom. The $200 million investment, announced in late July, will help Plenty put a farm in every major metro area with more than 1 million residents, according to Barnard. He says each can be constructed in 30 days or less.

Chao says SoftBank wants "to help Plenty expand very

quickly, particularly in China, Japan, and the Middle East," which all struggle with a lack of arable land. Other places on the 2018 list include Canada, Denmark, and Ireland. Plenty is also in talks with insurers and institutional investors such as pension funds to bankroll its farm-building with debt. Barnard says the farms would be able to pay off investors in three to five years, vs. 20 to 40 years for traditional farms. Think of it more like a utility, he says.

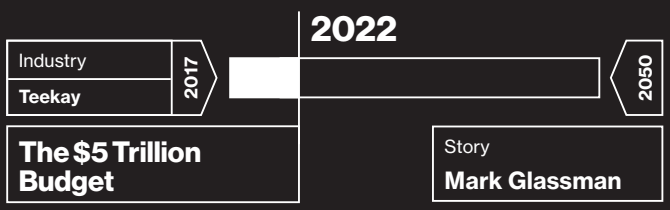
Plenty, of course, isn't as sure a bet as Consolidated Edison Inc. or Italy's Enel SpA. The higher costs of urban real estate, and the electricity needed to run all of the company's equipment, cut into its efficiency gains. While it's adapting its technology for foods including strawberries and cucumbers, the complications of tree-borne fruits and rooting crops likewise neutralize the value of its technology. And Plenty has to contend with commercial farms that have spent decades building their relationships with grocers and suppliers and a system that already offers many people extremely low prices for a much wider variety of goods. "What I haven't seen so far in vertical farm technologies is these entities getting very far beyond greens," says Michael Hamm, a professor of sustainable agriculture at Michigan State University. "People only eat so many greens."

Barnard says he's saving way more on truck fuel and other logistical costs, which account for more than one-third of the retail price of produce, than he's spending on warehousing or power. He's also promising that the company's farms will require long-term labor from skilled, full-time workers with benefits. About 30 people can run the South San Francisco warehouse; future models, which will be about two to five times its size, may require several hundred apiece, he says. While robots can handle some of the harvesting, planting, and logistics, experts will oversee the crop development and grocer relationships on-site.

Retailers shouldn't need much convincing, says Mikey Vu, a partner at Bain who studies the grocery business. "Grocers would love to get another four to five days of shelf life for leafy greens," he says. "I think it's an attractive proposition."

Gourmets like Plenty's results, too. Anthony Secviar, a former sous-chef at French Laundry, a Michelin-starred restaurant in the Napa town of Yountville, where Secviar cooked with vegetables grown across the street, says he wasn't expecting much when he received a box of Plenty's produce at his home in Mountain View, Calif. The deep green of the basil and chives hit him first. Each was equally lush, crisp, flavorful, and blemish-free. "I've never had anything of this quality," Secviar says. He's now on Plenty's culinary council and is basing his next restaurant's menu around the startup's heirloom vegetables. "It checks every box from a chef's perspective: quality, appearance, texture, flavor, sustainability, price," he says.

At the South San Francisco farm, the greens are fragrant and sweet, the kale is free of store-bought bitterness, and the purple rose lettuce carries a strong kick. There's enough spice and crunch that the veggies won't need a ton of dressing. Although Plenty bears little resemblance to a quaint family farm, the tastes bring me back to the tiny vegetable patch my grandparents planted in my childhood backyard. It's tough to believe these spicy mustard greens and fragrant chives have been re-created in a sterile room, without soil or sun. Ⓑ



Thirty years ago, the federal government did something it had never done before: spend a trillion dollars in a single year. For a variety of reasons—inflation, entitlements, Boomers—that number now feels quaint. According to the Congressional Budget Office's latest projections, which are based on current law, Washington will spend more than $5 trillion in 2022. That's more than the 2016 gross