

Agritech

Greenhouses make agriculture more efficient

Cultivation in vertical farms is independent of climate and It also saves space, water and fertilizer. But is this energy-intensive technology really profitable?

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Where coal was once mined, strawberries now ripen on walls a good six meters high. In the climate-controlled, three-metre wide planting modules have the same conditions as on a sunny May day - in the middle of an icy winter. The temperature drops at night so that the fruit develops plenty of juice. Maximilian Hartmann calls the vertical farm "our five-star hotel for strawberries". He is one of the founders of VGreens. The agritech is working on the future of agriculture in the Ruhr region near the Zollverein colliery in Essen.

200 plants grow per meter in VGreens' vertical farm, compared to eight in the field. Sensors and cameras determine the optimum amount of light, water, heat and nutrients for the plants, and everything is then fed automatically. One tonne of strawberries can be harvested per module per year, in the field it is only around 40 kilos - an increase in

increase to 2500 percent. In 2026, the first strawberries will be available year-round in the German trade.

In times of failed harvests due to climate change and global water shortages, agricultural experts see vertical farming as a way of feeding the world's growing population. Because vertical farming in "Greenhouses" save space, water and fertilizer and are independent of climate zone and season. At the same time, however, it requires high investments and is on affordable energy prices. And insolvencies in several countries cast doubt on the viability of the technology.

Vertical farming is still in its infancy, but experts are a lot of enthusiasm. "Vertical farming is one of the most promising technologies of our time," says Mohied-

dine Jelali, Director of the Institute for

Product Development and Design Engineering at TH Köln. It could play a key role in solving the trilemma of food, resources and the environment. This is because climate change is exacerbating weather extremes and crop failures. According to the Federal Environment Agency, ten million hectares of arable land worldwide become infertile every year - partly due to overuse of the soil in monocultures.

At the same time, demand is growing: According to the United Nations, 9.7 billion people will live on Earth in 2050, two thirds of them in cities. Because vertical farms can be built close to consumers, they help to avoid long transportation routes. The farms manage without fertile soil and with little water. According to the environmental organization WWF, agriculture uses 70 percent of the world's drinking water. Vertical farming, on the other hand, uses minimal water. VGreens, for example, uses rain-

water, which drips from top to bottom onto the roots under software control. VGreens only needs four to five liters for one kilo of strawberries, compared to up to 300 liters in the field.

Not only plants, but also animals are bred in vertical farms. In China, there are 13-storey, fully automated "pig towers" with 30,000 animals. An eight-storey fish farm was built in Singapore. However, it ceased operations in 2023 due to financial problems.

Large vertical vegetable farms such as Infarm from Berlin or Aerofarms and Appharvest from the USA have also recently gone bankrupt. Berlin-based food tech Infarm grows freshly harvested salads and herbs directly in supermarkets. Infarm was the first German food tech to achieve "unicorn status" in 2021 with a valuation of over one billion dollars, it attracted well-known investors and expanded worldwide with almost 1,000 employees. But then came the crash

increased. Infarm first withdrew from Europe on the grounds that energy prices had risen too sharply, followed by global insolvency in 2023. Operations were almost completely shut down.

"Light and air conditioning are the main cost drivers," explains Marc Stift, vertical farming expert from the Fraunhofer Institute for Molecular Biology and Applied Ecology IME. But the investment costs for cultivation systems, sensors, cameras and software are also high for vertical farming. Some farms also use harvesting robots.

The founders of VGreens say they have learned from the mistakes of the pioneers. "Vertical farming can only succeed in Europe with products that are higher-margin than seeds," Hartmann is convinced. In addition to strawberries, VGreens is therefore also researching the vertical cultivation of melons and blueberries. Other researchers are working on wheat and peas.



Greentech

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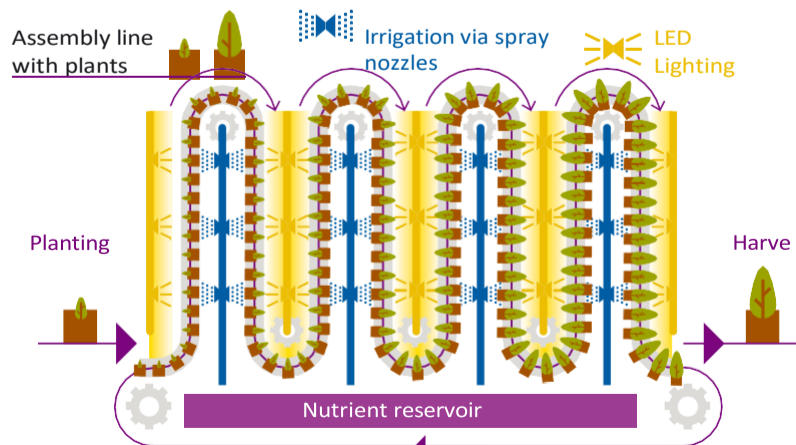
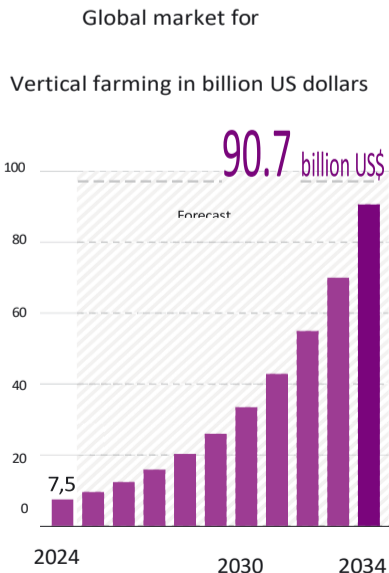
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Plant breeding non-stop

Schematic representation of a mobile vertical farm from Orbiplant



Sources: Precedence Research, Orbiplant/Fraunhofer IM

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The harvest quantity and quality could also be controlled more precisely. VGreens is working with partners on tools that use artificial intelligence to predict current demand. "If demand falls, the temperature in our farms drops. This means that fewer strawberries ripen," explains Claas Ahrens, co-founder of VGreens. This can reduce overproduction and food waste - a major problem in agriculture.

VGreens would also like to significantly reduce the electricity requirements of the indoor farms. Currently, one kilo of strawberries in a closed vertical farm requires 25 kilowatt hours of electricity, Hartmann calculates. This means that a punnet in Germany costs two to three euros in electricity. In the long term, VGreens would like to reduce the electricity costs for a kilo of strawberries to less than 50 cents.

Hartmann assures us that this is possible with glass farms that also use sunlight. Or by changing the planting.

That's why VGreens cultivates on slender plant walls instead of wide tiered beds. "This allows the moist air to escape upwards better," explains Ahrens. This reduces the need for energy-intensive ventilation to prevent waterlogging, which promotes disease.

Pests are eaten away by beneficial insects such as ladybugs or predatory mites in the plant walls. VGreens and most other vertical plants do not use pesticides.

farms.

Plants on the assembly line

The Bowery Farm in the USA experienced just how much damage could be caused by poor ventilation. Harmful microorganisms colonized the farm and the harvest had to be destroyed. In November 2024, the former unicorn ceased operations with prominent investors such as Google Ventures and Lewis Hamilton.

With its Orbiplant system, the Fraunhofer Institute IME in Aachen practices another type of cultivation: the plants move up and down on an undulating conveyor belt. Because warm air can escape upwards, the energy required for air conditioning is also saved. In addition, fewer sensors and cameras are needed because the plants move past them. Lighting and spraying are also more evenly distributed on flying belts. The roots hang freely in the interior and are sprayed with a nutrient solution of water and fertilizer to save resources.

The meat and milk substitute pro The Berlin-based company Veganz has acquired the global license to build and operate these orbi-plant facilities. The Berlin-based company manufactures many products from peas, which are particularly suitable growing on air-trays. "Our system has made it to cultivate peas indoors for the first time," says Fraunhofer expert Stift.

Due to the movement, the climbing plant grows very compactly. Six harvests a year are possible, compared to just one on a field. "Extrapolated to plants with twelve-metre-high loops, 25 kilos of peas can be harvested per year on one square meter. On a German field, it's 400 grams," explains Stift.

Industry experts such as Stéphane Roussel, partner at the European Circular Bioeconomy Fund, generally consider countries with low energy costs to be the most suitable for vertical Indian farms. In the Middle East, for example

9,7

billion people will live earth in 2050, two thirds of them in cities.

Source: United Nations

a kilowatt hour of electricity costs less than a cent in some cases. Veganz CEO Jan Bredack also thinks of "countries with a lot of sunshine" when it comes to locations for conveyor belt farms. For countries with extreme climates, a vertical farm also pays off more quickly because it reduces their high dependency on food imports, says Roussel.

The world's largest vertical farm is logically located in sun-drenched Dubai. Today, Bustanica belongs to the caterer of the Emirates airline. Up to three tons of lettuce, herbs and rocket are harvested every day. Siemens supplied the automation and building technology for the 31,000 square meter facility, which cost 40 million dollars. A Giga Farm is also currently being built in Dubai's "Food Tech Valley". It will grow 3,000 tons of vegetables per year on 87,000 square metres and a height of twelve meters. Food waste will be composted into fertilizer there.

tated. Waste is incinerated to generate energy. Operator Refarm wants to open it in 2026 and replace one percent of the United Arab Emirates' food imports.

In temperate climates, renewable energy can make a vertical farm more economical. Europe's largest vertical farm in Denmark, for example, uses low-cost offshore wind power. On 14 floors and 7000 square meters, the Nordic Harvest farm near Copenhagen ripens around 1000 tons of vegetables per year. The Danes want to build a farm in Mecklenburg-Vorpommern in 2027. CEO Anders Riemann reports that wind and solar energy should make it possible to harvest 5,000 tons a year. In Germany, the cost also through cooperation with the reduce industry. "A vertical farm could use waste heat and CO₂ waste gas from a neighboring industrial plant,

then the plants grow better," says Hartmann from VGreens. The production company can also improve its environmental balance as a result.

"Over the next two years, we want to roll out our vertical farms worldwide," Hartmann. VGreens has its sights set on Singapore and the Arab region for its expansion. The Essen-based company is already testing its system in South Africa. Large German plant manufacturers such as Körber Technologies are building the industrial farms, while VGreens is providing the knowledge about the plants using software. In principle, vertical farms are conceivable anywhere. "Even in space and on Mars," says Stift from the Fraunhofer Institute. On Earth, the breakthrough is still a long way off. Market researchers expect global sales of vertical farming to rise from the current 7.5 billion dollars to 90 billion dollars in 2034.