

VERTICAL FARMING

Agri, Food & Beverages Sector

INDUSTRY REPORT 2021

TABLE OF CONTENTS

- 01. Executive Summary
- 02. Introduction to Vertical Farming
- 03. Key Drivers
- 04. Vertical Farming Worldwide
- 05. The Market
- 06. M&A Activity
- 07. Case Studies

01. Executive Summary

This report has been produced by the Agri, Food & Beverages Industry Group of M&A Worldwide on the vertical farming market. M&A Worldwide is a global network of M&A advisory member firms which includes 400+ individual members.

The global vertical farming market was worth €13,3bn in 2019 and is expected to reach €13.5bn by 2027 (CAGR of 20.1%)(1). Whilst vertical farming is still in the relatively early stages, it is becoming increasingly popular amongst farmers worldwide and there has been a significant rise in capital invested in vertical farming, particularly in the last 5 years (2015: €89m; 2020: €677m)(2).

The market is predominantly driven by the following key factors, which are discussed in greater detail throughout this report:

- Increasing demand for organic food products
- Growing population
- Increasing pressure to create more sustainable farming methods
- Scarcity of land suitable for growing crops

Advancements in technology and a significant reduction in the cost of light-emitting diodes (LEDs) has led to the increased uptake in vertical farming in recent years.

The Covid-19 pandemic has also resulted in a significant rise in the level of food wastage. This in turn has exposed vulnerabilities in the global food supply chain and has further strengthened the need for indoor, or vertical, farming(2).

(1) Emergen Research, October 2020

(2) Pitchbook Data, Inc, January 2021

02. Introduction to Vertical Farming

Vertical Farming is the practice of growing crops on vertically inclined surfaces and in vertically stacked layers. Instead of farming crops on a single level, such as in a field or a greenhouse, vertical farming enables growers to produce crops in vertically stacked layers often integrated into existing structures, such as office buildings and repurposed warehouses or in purpose-built facilities from shipping containers to larger purpose-built buildings(1).

The introduction of Controlled Environment Agriculture (“CEA”) technology has helped to accelerate the vertical farming market. Using the artificial control of temperature, humidity, gases and light (and in some cases supported by natural light), crops can be grown in indoor controlled environments(2).

There are four major areas to vertical farming(3):

1. **Physical layout:** crops are cultivated in stacked layers in a tower structure.
2. **Lighting:** a combination of natural and artificial lighting is used to create the appropriate balance of light. Rotating beds are often used to improve lighting efficiency and ensure the required level of light is able to reach all crops. The technological advancements and reduction in the price of LEDs has been a significant driver in the development of vertical farming.
3. **Growing medium:** aeroponics, aquaponics and hydroponic growing mediums replace soil which is used in standard cultivation.
4. **Sustainability features:** approximately 95% less water is used in vertical farming than in normal cultivation and controlled environments can eliminate the use of chemicals such as pesticides.

The plants and crops most suited to vertical farming are those that grow well in relatively low light environments, have a short growth cycle, and grow well at a high planting density. Typically, these plants are less than 30cm in height, such as leafy greens, herbs or medicinal plants(3).

(1) Future Farming Hub, July 2020

(2) The Balance Small Business, December 2020

(3) Agri Farming, August 2019

Growing Mediums

Hydroponics

Hydroponics is the most commonly used system in vertical farming. It involves growing plants in nutrient solutions without using any soil. The roots of the plant are immersed in the solution, which is monitored by computer systems and circulated to ensure that the correct chemical composition is maintained⁽¹⁾.

Aquaponics

An aquaponics system combines plants and fish in the same environment. Fish are grown in ponds, producing nutrient-rich waste that is used to feed crops within the vertical farm. The plants filter and clean the wastewater, which is reused within the fishponds⁽¹⁾ making it an extremely eco-friendly system to use.

Aeroponics

Aeroponics was first introduced by NASA during the 1990s. They explored efficient techniques to grow plants in space and labelled the term “aeroponics,” defined as “growing plants in an air or mist environment with no soil and very little water”⁽¹⁾.

Aeroponics is widely considered to be the most efficient plant-growing setting in vertical farming, using up to 90% less water than hydroponic systems. Crops that are grown through aeroponics take up higher levels of minerals and vitamins, resulting in healthier and potentially more nutritious plants⁽¹⁾. This is however a less commonly used growing medium when compared to hydroponics and aquaponics.



Hydroponics – Source: Fresh Water Systems



Aquaponics – Source: Forbes

Advantages

CEA technology enables [control over growing conditions](#) including temperature, humidity, light, water and plant nutrients. By controlling these factors, operators can better align their harvest to meet market demand. CEA farms also help to alleviate food wastage, which has risen significantly since the start of the Covid-19 pandemic, as they are more adaptable to food chain disruptions (such as Covid-19) by limiting the supply chain and accelerating production cycles(1).

The physical layout of vertical farms by way of stacking enables [increased production](#) of crops per square metre(2). Currently, vertical farming occupies around 30 hectares of land worldwide, compared to outdoor cultivation of approximately 50 million hectares, and 500,000 hectares for greenhouses(3).

Vertical farming [supports year-round production](#), particularly in geographies where standard outdoor cultivation can be affected by adverse weather conditions.

[Pesticide and chemical free](#) which helps to improve taste and allow organic crops to be produced, which are becoming increasingly popular amongst consumers(4).

Resource efficient: up to [95% less water](#) is required compared to standard cultivation(5).

Colocation: some operators have introduced vertical farming within, or nearby to, supermarkets therefore helping to [reduce transportation](#) requirements and become a more environmentally friendly way of growing.

Disadvantages

[High initial capital](#) outlay in facilities and ongoing running costs, including high energy costs and labour costs where automation is less frequently used(1).

Not all crops are suited to vertical farming, and high operational costs means that farmers often produce only high-revenue-generating crops(1).

[Heavily reliant on technology](#) which could be extremely disruptive to a business in situations where power is lost(2). Relatively new application of technology in a [highly regulated market](#).

(1) Pitchbook Data, Inc, January 2021

(2) The Balance Small Business, December 2020

(3) Financial Times, October 2020

(4) Research and Markets, December 2020

(5) Vertical Farm Institute

03. Key Drivers

There are several key drivers which are contributing towards the rising adoption of vertical farming. These are discussed in further detail below:



INCREASED DEMAND FOR ORGANIC FOODS

- Rising demand for organic foods⁽¹⁾ that have been produced without the use of chemicals or pesticides.
- Consumers are seeking more nutritious, healthier and safer foods which are provided from organic produce.⁽¹⁾



GROWING POPULATION

- Vertical farming will help to alleviate the concerns of a growing global population which is predicted to exceed 9 billion by 2050.⁽²⁾
- This method of farming allows an extended growing season enabling businesses to grow crops throughout the year and meet the increasing demand.



RISING PRESSURES ON SUSTAINABILITY

- Growing initiatives to develop an independent farming technique that has a lower impact on climate have led to an overall increase in demand.
- Up to 95% less water is required compared to alternative farming methods.⁽³⁾
- Environmentally friendly opportunity for supermarket locations leading to reduced transportation costs.



SCARCITY OF ARABLE LAND

- The scarcity of arable land combined with the increasing demand for high-quality crops and optimum agricultural productivity is projected to drive the system's demand over the forecast period.⁽¹⁾
- Crops can be grown in climates that would not ordinarily support the cultivation of a specific type of crop.



ADVANCES IN TECHNOLOGY

- The reduction in the price of the light-emitting diodes (LEDs) and the technological advancement in LEDs has helped towards the growth in the vertical farming sector
- LEDs are now considered affordable and efficient enough to be used in vertical farming and reduce the overall farming cost for the growers compared to more traditional electrical lighting alternatives.⁽⁴⁾

(1) Emergent Research, October 2020
(2) The Balance Small Business, December 2020

(3) Agri Farming, August 2019
(4) Markets and Markets, July 2020

04. Vertical Farming Worldwide

During 2019 Asia Pacific accounted for the largest proportion of the vertical farming market (39.2%)(1). The scarcity of land particularly in heavily populated countries has led to this rapid growth, combined with the overall growing population which has resulted in increased demand for food.

Within the forecast period 2020 to 2027, Europe is predicted to be the fastest-growing region. The following factors are all expected to increase the adoption of vertical farming within the region and drive further growth(1):

- Initiatives set to reduce the adverse effects of pesticides and lower the consumption of water
- Increasing government initiatives to establish vertical farms in order to meet growing food demand and overcome the extreme climatic conditions
- Increasing utilisation of advanced technologies such as nanotechnology and artificial intelligence

France in particular is seeing an increased level of investment into indoor and outdoor vertical farming, with several venture capital investors investing within this sector. Jungle, a French vertical farming company, received €42m in equity and debt financing from Founders Future in March 2021(2). The funding will be used to build a new vertical farm, which is set to be fully operational by the end of 2021.

Vertical farming is also growing significantly within the United States, at a CAGR of more than 24% (2018 to 2014)(3), which is evidenced by the high levels of investment seen in recent years. Some examples of recent deals in this sector can be found overleaf.

(1) Emergent Research, October 2020

(2) Sifted, March 2021

(3) The Balance Small Business, December 2020

04. The Market

In 2019, the global vertical farming market was worth €3,3bn and is forecasted to reach €13,5bn by 2027 (CAGR of 20.1%)(1). In terms of growing structures, shipping container-based vertical farms accounted for the largest share of the market (63.5%) in 2019(1). There are many benefits to this type of structure including its ability be transferred to another location, lower water consumption, reduction in running costs along with other environmental benefits. The emergence of more technologically advanced systems and automation will contribute towards the continued growth of vertical farming.

The vertical farming market is highly fragmented and can be divided into sub-sectors within, such as the growers/farmers, technology manufacturers and lighting and LED providers.

Some examples of companies operating in the vertical farming market along with their funding received to date can be found in the tables below.

Growers

Company	Location	Description	Year Founded	Funding ⁽²⁾
Aerofarms	USA	Operator of indoor farming and developer of aeroponic tech.	2004	€183m
BrightFarms Inc	USA	Producer of green salads using hydroponic systems	2011	€184m
Agricool Soc. par Actions Simplifiée	France	Producer of fruits & vegetables in indoor shipping container settings	2015	€37m
Sky Greens Pte Ltd.	Singapore	Operator of a hydraulic-driven vertical farm	2012	€17m
Revol Greens	USA	Operator of an indoor vertical farm	2016	€191m
Plenty	USA	Operator of an indoor vertical farm	2014	€480m
Bowery	USA	Operator of a modern farming company	2014	€190m
Perfectly Fresh	UK	Operator of indoor vertical farms	2016	Undisclosed

(1) Emergent Research, October 2020

(2) Pitchbook Data, Inc, January 2021

Lighting

Company	Location	Description	Year Founded	Market cap
Signify N.V.	Netherlands	Provider of lighting solutions, specifically LEDs used in vertical farming	1891	€5,3bn
OSRAM Licht AG	Germany	Manufacturer of lighting products including LEDs	1919	€5.2bn
Everlight Electronics	Taiwan	Manufacturer of lighting products including LEDs	1983	€583m
Heliospectra AB	Sweden	Developer of lighting systems for controlled environments using LEDs	2006	€19m

Other systems/technologies

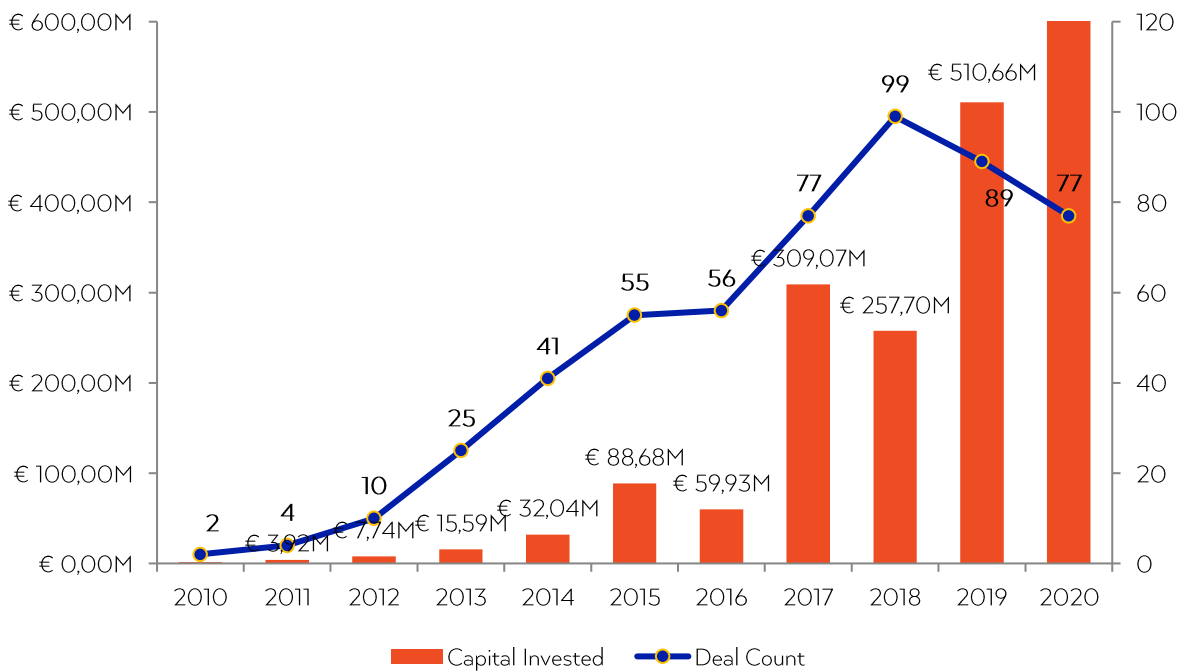
Company	Location	Description	Year Founded	Funding received to date(1)
Freight Farms Inc	USA	Manufacturer of shipping container vertical farming technology	2010	€24m
Infarm	Germany	Developer of IoT technology and data science-based indoor vertical farming system. Infarm is active in 10 countries and 30 cities worldwide	2013	€270m
Illumitex Inc	USA	Developer of a computer-vision artificial-intelligence platform intended for horticulture	2005	€54m
Artemis	USA	Developer of a web-based SaaS platform used within indoor agriculture operations	2015	€12m

(1) Pitchbook Data, Inc, January 2021

05. M&A Activity

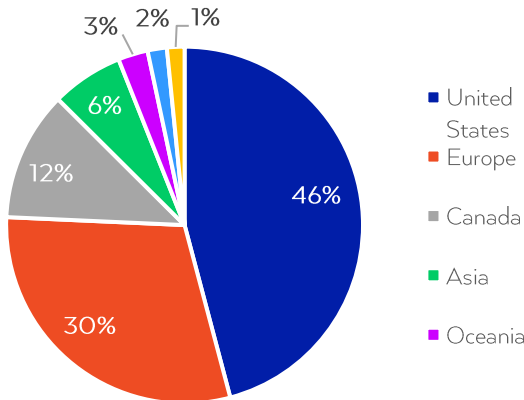
Capital invested in vertical farming, indoor farming and urban farming

- Over €1.8bn has been invested globally since 2015, of which €677m (36%) was invested in 2020 alone.
- On average, there has been 80 deals per year over the last 5 years.
- Around 71% of deals in 2020 were later stage venture capital funding, and a further 8% early-stage venture capital demonstrating that the vast majority of investment is in relatively early-stage businesses with strong growth potential.

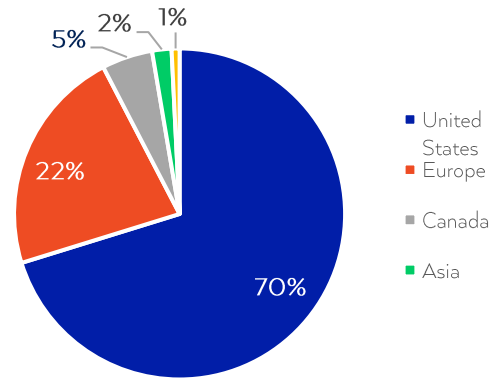


(1) Emergent Research, October 2020
(2) Pitchbook Data, Inc, January 2021

Deal Count by Global Region⁽¹⁾



Capital Invested by Global Region⁽¹⁾



Select recent transactions

- Oct-20: Plenty Unlimited Inc, a US operator of indoor vertical farming, raised \$140m (€126m) of Series D funding led by SoftBank Investment Advisors. The funds raised are to support the development of a new farm in California.
- Sep-20: LGT Lightstone Aspada invested €170m in Infarm Indoor Urban Farming GmbH, a German developer of IoT technology and data science-based indoor vertical farming systems.
- Mar-20: PlantLab Groep B.V., a Dutch operator of custom-built indoor farms, received €20m of development capital from De Hoge Dennen Capital to be used to open indoor production sites in countries including the Netherlands, US and the Bahamas.
- Oct-19: Bowery Farming Inc, a US based modern indoor farming company, raised \$50m (€46m) in venture funding led by Temasek Holdings.



Aeroponics - Source: Modern Farmer



Source: Greenhouse Product News, April 2019

(1) Pitchbook Data, Inc, January 2021

06. Case Studies



Perfectly Fresh

Founded in 2016, Perfectly Fresh is a vertical farming operator based in the UK.

Perfectly Fresh brings together commercial growers, APS Group; technical experts, P3P Partners; and financial specialists, Triple Point to deliver consistent, safe, and delicious produce in an efficient and environmentally friendly way.

The Company's operation is a pioneering example of the finest British engineering being harnessed to meet the growing needs of an ever-expanding global population. Perfectly Fresh has built a Research and Development facility in Selby, Yorkshire comprising of two germination rooms and four test growing areas. This custom-built UK facility results in premium quality crops available all year round.

At the forefront of this new agricultural advance, Perfectly Fresh is contributing to the rapidly growing awareness of the environmental impact of agriculture, and the need for high quality, low impact produce.



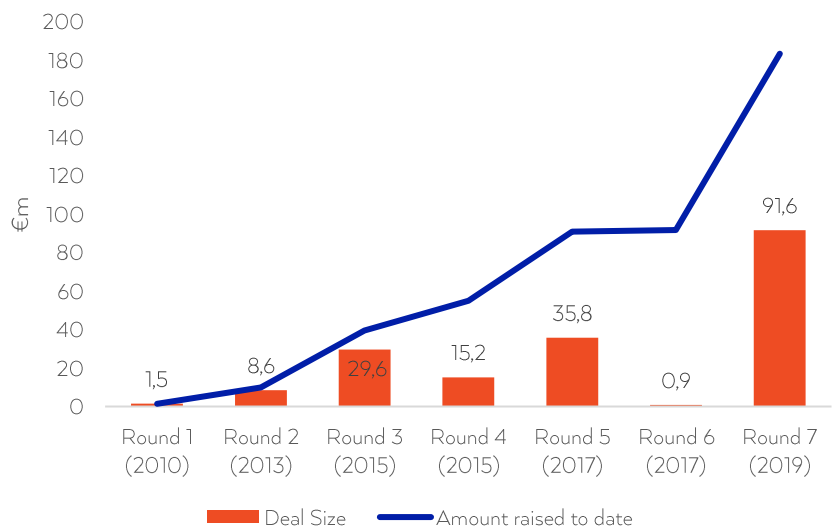
06. Case Studies



AeroFarms develops and operates indoor farming facilities that use aeroponic technology. According to PitchBook, AeroFarms claims to achieve productivity that is 75x higher than a standard outdoor farm field and 10x higher than a typical hydroponic greenhouse. It also claims to use 95% less water, 40% fewer nutrients and no pesticides or herbicides. The company operates one of the largest indoor vertical farms in the world in Newark, NJ.

AeroFarms has undertaken a series of fundraising in recent years, raising over €173m since 2010. In March 2021, AeroFarms announced its intention to go public at a valuation of \$1.2bn through a reverse merger with special purpose acquisition company (SPAC), Spring Valley(2). The funds will be used expand its operations and further invest in R&D.

Deal History



Source: Pitchbook Data, Inc

(1) Pitchbook Data, Inc

(2) Financial Times, March 2021

Latest Transactions

ARGENTINA 03/2021 Sucesores de Alfredo Williner S.A. Dairy Various Banks Debt Advisory	AUSTRALIA 06/2020 JE Tipper Wholesale Distribution Fruit & Veg Beemart fruit veg Sell-side	NETHERLANDS 06/2020 Hems B.V. Slaughterhouse Tomassen Vlees B.V. Sell-side
ECUADOR 05/2020 Corporación Favorita Catering Services Hanaska Catering Buy-side	NETHERLANDS 04/2020 Investors Specialized in the development, production and on-farm application of water-soluble complementary feed RS Holding B.V. Equity Raise	UNITED KINGDOM 01/2020 A Pearson Holdings Limited Tomato Grower Shawbrook Bank Debt Advisory
ARGENTINA 08/2019 Verónica S.A.I.C.I.A.F. e I. Dairy Various Banks Capital Raise	ARGENTINA 08/2019 Local Private Investors Asian Restaurant Asian Bistro Argentina S.R.L. Sell-side	NETHERLANDS 07/2019 The Group of Butchers Producer of handcrafted sausages Schouten Vleeswaren Sell-side

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