Good Food Institute

EXECUTIVE SUMMARY | 2021 STATE OF THE INDUSTRY REPORT

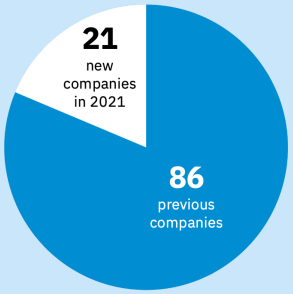
Cultivated meat and seafood

2021 was a year of robust activity and progress in the cultivated meat industry. Governments invested new public funding, the United States launched a center for excellence in cellular agriculture at Tufts University, and more countries made strides in the race to approve cultivated meat products.

The supply chain strengthened as several new pilot-scale production facilities opened, and the largest meat company in the world signaled its confidence in the industry with a $100 million investment and an announcement that it would go to market with cultivated meat by 2024. The world's first-ever life-cycle assessment and techno-economic analysis for cultivated meat that involved industry and government data and participation were published, creating the most inclusive picture ever of what a global transition to cultivated meat might look like. These studies also spurred healthy conversation about the future of cultivated meat, illustrating the need for further research and development in the sector.

Commercial landscape

Companies dedicated to producing cultivated meat



107 total companies (2021)
↑ 24% YOY increase

Facility launches. Several landmark facilities opened in 2021, including Future Meat's pilot plant, Wildtype's pilot plant with annual production capacity of 200,000 pounds, UPSIDE Foods' facility with current production capacity of 50,000 pounds and future capacity of 400,000 pounds, and Shiok Meats' mini plant for cultivated seafood R&D.

Geographic expansion. 2021 saw the first launches of cultivated meat companies in Mexico and Brazil and a cultivated seafood company in Africa.

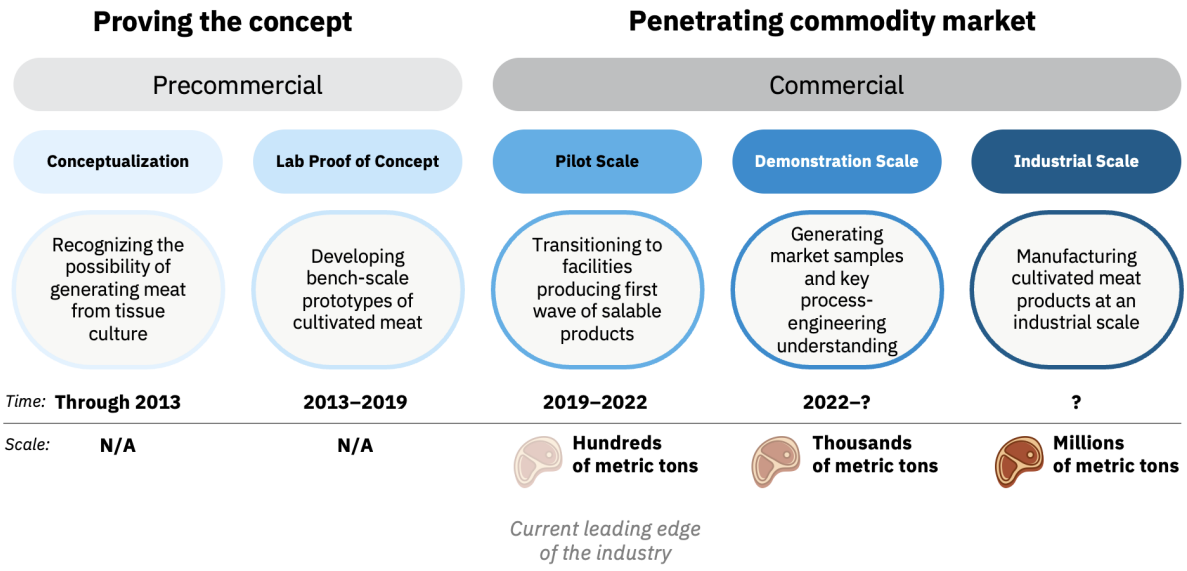
Activity from the world's largest meat company. JBS, the largest protein company and the second-largest food company globally, announced a $100 million investment that includes the following:

1) An agreement to acquire Spanish company BioTech Foods and invest in the construction of a new production facility in Spain.

2) Establishing Brazil's first cultivated protein R&D center.

Figure 1: 2021 cultivated meat around the globe

Figure 2: Leading edge of cultivated meat production



Companies at the leading edge of the industry are now manufacturing cultivated meat at pilot scale, a crucial early step to assess the viability of industrial-scale production.

Investments

Investment in cultivated meat companies topped $1.36 billion in 2021, more than doubling the previous cumulative investment in the industry. 2021 also saw more than a hundred new investors enter the space.

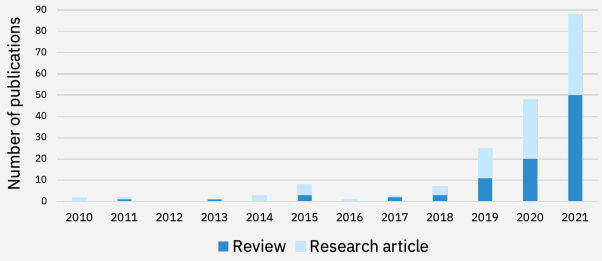
Category	2021	2020	All-time (since 2016)	2021 highlights
Total invested capital	$1.38B	$410M	$1.93B	2021 invested capital grew 336% from 2020.
Invested capital deal count	64	51	188	2021's largest investment was $347M (Future Meat Tech.).
Unique investors	258	157	453	The number of new unique investors grew by 62% in 2021.
Growth stage deals (Series B and above)	7	1	8	These included Eat Just, Future Meat, and Finless Foods.
Liquidity events	$18.6M	$0	$18.6M	MeaTech acquired cultivated fat producer Peace of Meat.

Science and technology

In 2021, the science and technology landscape for cultivated meat accelerated:

Techno-economics. In late 2020 and early 2021, three techno-economic analyses of hypothetical commercial-scale cultivated meat production were published: **Humbird, 2020,** and **2021**; **Vergeer, 2021** (funded by GFI and using industry-provided data); and **Risner, 2021**.

Open-access R&D. **Companies** and **academic laboratories** continue to push the boundaries of cultivated meat research. In 2021, GFI awarded **research grants** for 22 innovative projects related to cultivated meat.



Scientific papers. Research into cultivated meat is heating up. GFI's science and technology team has been tracking scientific publications focused on cultivated meat, and each year the numbers continue to rise.

Government and regulation

As of the end of 2021, Singapore remains the only nation to approve the sale of a cultivated meat product. But other countries are making strides in the race to approve and invest in these products:

Momentum in Israel. In preparation for his first meeting with U.S. president Joe Biden, Israeli prime minister Naftali Bennett was briefed by GFI Israel on the importance of alternative proteins to climate change mitigation. GFI Israel's managing director also served on the country's official delegation to COP26.

Public funding. The Israel Innovation Authority announced a ₪220 million ($69 million USD) investment in four new innovative consortia, including a cultivated meat consortium composed of companies and research institutions.

In October 2021, the EU government funding program REACT-EU, launched in response to the Covid-19 pandemic, awarded cultivated meat company Mosa Meat and partner Nutreco a €2 million grant for research into lowering the cost of cell culture media.

The USDA announced an award of $10 million for the creation of a **center of excellence** in cellular agriculture at Tufts University, and the U.S. National Institutes of Health granted **$1.5 million** to Defined Bioscience to develop a cell culture medium supplement.

Opportunities

Capturing even a fraction of the global meat market—estimated in 2020 at **328 million tons** and worth more than $1 trillion—is a colossal opportunity. Doing so will require a remarkable deployment of scientific innovation, infrastructure development, investment, and—crucially—a robust ecosystem to support the industry's growth. Fortunately, 2021 was a year of growth and commercialization for the field of cultivated meat. The industry made considerable progress in scaling the technology, desiloing the industry via commercial partnerships, and carving out a key regulatory precedent. But there is a lot more work to do, and GFI's teams of scientists, lobbyists, lawyers, and corporate engagement specialists all over the world are focused on projects that will lift up the entire cultivated meat sector globally, allowing us to sustainably meet the world's growing demand for protein.

Download the full report online.

About GFI

The Good Food Institute is a nonprofit think tank working to make the global food system better for the planet, people, and animals. Alongside scientists, businesses, and policymakers, GFI's teams focus on making plant-based and cultivated meat delicious, affordable, and accessible. Powered by philanthropy, GFI is an international network of organizations advancing alternative proteins as an essential solution needed to meet the world's climate, global health, food security, and biodiversity goals. To learn more, please visit www.gfi.org.

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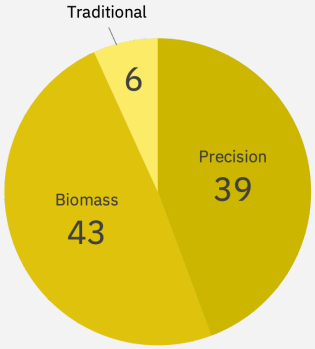
EXECUTIVE SUMMARY | 2021 STATE OF THE INDUSTRY REPORT

Fermentation: Meat, seafood, eggs, and dairy

Fermentation is a powerful enabling technology that is increasingly driving innovations across the alternative protein industry. In 2021, the sector continued to expand with key developments across commercial, product, investment, science and technology, and government and regulation landscapes.

Commercial landscape

Number of companies by type of fermentation



New startups. Fifteen known startups dedicated to the use of fermentation for alternative proteins were founded in 2021, along with new suppliers focused on fermentation-enabled alternative protein ingredients.

Precision fermentation. Activity in precision fermentation increased, with nine of the 15 new companies focused on precision fermentation and six focused on biomass fermentation.

Known companies. Eighty-eight known companies are now dedicated to fermentation-enabled alternative proteins, an increase of 20 percent from the number of known companies in 2020.

Business lines. At least 75 additional companies have a business line in alternative protein fermentation.

Products

In 2021, companies advanced applications of fermentation technology to develop end products and ingredients to enhance plant-based products across categories, including whole-cut meat, seafood, chicken, beef, pork, cheese, eggs, milk, yogurt, and ice cream.

Eggs. The EVERY Company, formerly Clara Foods, **launched their first animal-free egg protein, ClearEgg,** in November 2021 in partnership with Pressed Juicery.

Dairy. Perfect Day's **recombinant whey proteins** became broadly commercially available in a range of products and brands.

Fats and oils. Cultivated Biosciences announced they were developing a functional fat ingredient from oleaginous yeast that can be used as a high-fat component of plant-based dairy formulations. **Mycorena unveiled a new fungi fat ingredient** that releases flavor in a similar way to animal-based fats.

Investments

Investment in fermentation technology skyrocketed in 2021. Fermentation companies focused on the alternative protein sector raised $1.69 billion—almost three times the amount raised in 2020—representing 60 percent of all-time sector funding and accounting for a third of 2021 alternative protein industry funding.

Category	2021	2013–2021	Highlights
Total invested capital	$1.69B	$2.81B	2021 invested capital grew 285% from 2020.
Invested capital deal count	54	161	2021's largest investments were $350 million (Nature's Fynd and Perfect Day).
Unique investors	130 new	434	The number of new unique investors grew by 43% in 2021.
Growth-stage fundraising (Series B and above)	9	9	2021 saw the first growth-stage fundraising in the fermentation industry, including three deals >$200 million.
Liquidity events	$9.3M	$1.50B	Quorn, the mycoprotein pioneer founded decades before most other mycoprotein companies and now owned by parent company Monde Nissin, accounts for the vast majority of fermentation liquidity events.

Science and technology

GFI (via its research grant program) funded three projects on fermentation-derived fat solutions using oleaginous yeast, microalgae fermentation, and lipophilic yeast.

A consortium of European companies and universities launched a three-year "**Bio-purification of plant proteins**" project to explore how fermentation can improve plant-based protein ingredients.

BioFoundries and other computational tools emerged, such as Ginkgo Bioworks **Grow with Ginkgo program** and Google DeepMind's protein-structure prediction algorithm **AlphaFold2**.

At least 11 new manufacturing facilities for fermentation were announced in 2021 across Europe, the United States, and Asia. Of these, at least eight are focused on biomass fermentation.

Government and regulation

Regulatory advances. **Motif FoodWorks**, **The EVERY Company**, and **Nature's Fynd** all received a no-questions letter from the U.S. Food and Drug Administration. Their products are generally recognized as safe (GRAS). Products include a heme protein derived from yeast, a soluble egg protein produced by yeast, and a fungi-derived protein.

Investments and funding. Israeli company Imagindairy, which uses precision fermentation to create milk proteins, received funding from the Israel Innovation Authority.

Opportunities

Fermentation firmly established itself as an indispensable third pillar of alternative proteins in 2021. Fermentation is one of the oldest technologies, yet it is being reimagined for use in the alternative protein sector at a rapid rate of innovation. Because of its vast potential in technical and product development innovation, fermentation is well positioned to exceed the sensory, nutritional, environmental, social, market, and functional paradigms of status quo proteins in today's food system. Alongside plant-based proteins and cultivated meat, fermentation can help us sustainably feed a global population of nearly **10 billion** people by 2050.

This past year, fermentation proved that it offers competitive prices and unparalleled functionality and scalability. It is poised to revolutionize the entire alternative protein industry, with spillover applications in plant-based products and cultivated meat. Fermentation can enable a new generation of proteins, fats, and other functional ingredients to create a range of alternative meat, seafood, eggs, dairy products, and more. Investors agreed, and a record amount of funding poured into the fermentation space, leading the way for even greater advances in 2022.

The alternative protein industry has just scratched the surface of the potential for fermentation-based approaches, and both consumers and existing players in the sector are eager for the innovative products and solutions that fermentation can provide.

As we look ahead, we anticipate several trends to emerge in this sector.

- **Fermentation will gain broader recognition for environmental and other benefits.**
- **Computational approaches will accelerate innovation.**
- **Hybrid products will become increasingly common.**
- **A greater variety of sources will be explored for use in alternative proteins.**
- **Fats, oils, and specialty dairy products made via precision fermentation will hit the market.**
- **Products will be brought to market with increasing frequency.**

Download the full report online.

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Plant-based meat, seafood, eggs, and dairy

In 2021, steady momentum continued in the plant-based industry after rapid growth from 2019 to 2020. Brands in the U.S. market launched hundreds of new products, global retail sales of plant-based meat surpassed $5 billion, new technology demonstrated its potential to advance the market, and regulatory wins on food labeling helped ensure a level playing field. Despite food industry disruptions caused by the pandemic, the growth of plant-based proteins signals an increasing global appetite for more sustainable alternatives to conventional animal products.

Products

In 2021, companies advanced applications of plant-based technology to produce new and enhanced products across categories. More than 250 new SKUs were added to shelves in U.S. retail.

Category expansion. Companies are innovating beyond the burgers that led the next-generation plant-based meat category. New products include plant-based bacon, sausages, and deli meats, in addition to an expanding range of chicken and seafood alternatives.

Price parity. Several plant-based meat companies moved closer to **price parity**—though the gap is still significant. For example, **OmniFoods** reduced prices of OmniPork by 22 percent, and **Impossible Foods** once again cut prices at wholesale and retail.

Sales

U.S. retail plant-based food sales metrics, 2021

	Dollar sales	1-yr. dollar growth	3-yr. dollar growth	Dollar share	3-yr. share growth	Unit sales
Total plant-based foods	$7.4B	6%	54%	4%	79%	1.9B
Plant-based meat	$1.4B	0%	74%	1.4%	19%* *2-yr. share growth	281M
Plant-based milk	$2.6B	4%	33%	16%	20%	788M

Total U.S. retail plant-based food dollar sales grew three times faster than total food sales in 2021 to $7.4 billion.

- **Almost every category grew**, even on top of a strong 2020 that experienced above-average activity owing to impacts of the pandemic.
- **Plant-based meat** sales remained steady in 2021 at $1.4 billion.
- **Plant-based milk** sales grew 4 percent to $2.6 billion.
- **Plant-based eggs**, the smallest but fastest-growing category, saw sales grow 42 percent to $39 million.

Sources: SPINS Natural Enhanced Channel, SPINS Conventional Multi Outlet Channel (powered by IRI) | 52 Weeks Ending 12-26-2021. Panel data from NCP, All Outlets, 52 weeks ending 12-26-21. Note: The data presented in this table is based on custom GFI and PBFA plant-based categories that were created by refining standard SPINS categories. Due to the custom nature of these categories, the presented data will not align with standard SPINS categories.

Investments

Plant-based meat, egg, and dairy companies raised $1.9 billion in 2021, bringing total investments in such companies to $6.4 billion.

Category	2021	1980–2021	Highlights
Total invested capital	$1.93B	$6.36B	2021 invested capital represents 30% of all-time investment.
Invested capital deal count	140	621	2021's largest investment was $500 million raised by Impossible Foods.
Unique investors	312 (new)	1,093	The number of new unique investors grew by 40% in 2021.
Liquidity event capital	$1.93B	$25B	Oatly's IPO in 2021 raised $1.43 billion.
Liquidity event count	19	91	
Other financing capital	$31M	$158M	The vast majority of other financing events are private investments in public equity (PIPEs).
Other financing count	2	9	

Science and technology

2021 saw several developments in the realm of plant-based ingredients, including commercialization of new biodiverse ingredient sources and improved scalability of plant protein processing techniques. On the plant-based meat manufacturing side, advances were pioneered in alternatives to high-moisture extrusion technology, including **shear-cell technology**—which creates fibrous texture by applying shear force to plant-proteins between two cylindrical rotating plates—and **3D printing**, which can enable the fabrication of highly sophisticated products that mimic whole-muscle meat cuts.

Government and regulation

Government support. Governments including Denmark, Germany, the European Union, Norway, the United Kingdom, and the United States funded plant-based protein research.

Label censorship. In 2021, a federal court ruled that governments could not violate plant-based food companies' First Amendment right to free speech by citing government definition of food-related terms. Additionally, several state legislators introduced label censorship bills that would restrict the use of terms such as "meat," "beef," or "chicken" on plant-based products. Fortunately, no new label censorship laws were enacted.

Opportunities

Successfully capturing the massive opportunity that alternative proteins present will require greater R&D investments from both the private and the public sectors. Global demand for meat is rising—by 2050, **meat consumption is estimated to increase by 70 to 100 percent** over 2005 levels. For governments, NGOs, scientists, companies, and consumers who want to achieve net-zero emissions and keep climate change below 1.5 degrees (or even 2.0), the call to action is clear—elevate investments in plant-based proteins. Plant-based meat production leads to between **30 and 90 percent less emissions** (in CO2-eq) than conventional meat, demonstrating alternative proteins can be a key tool for climate mitigation.

To maximize the category's potential, plant-based meat must compete with conventional meat products on the table stakes of consumer choice—taste, price, and accessibility. Few consumers today believe that plant-based meat tastes as good as or better than conventional meat. Of consumers who plan to buy plant-based meat less often, 64 percent say it's because they prefer the taste of conventional meat, according to UBS Evidence Lab. Meanwhile, price parity with conventional meat remains a significant opportunity, as plant-based meat, on average, is twice as expensive per pound (according to GFI's analysis of *The Power of Meat 2022*).

Investments in plant-based meat can ensure we realize the potential alternative proteins provide to help sustainably and efficiently feed billions of people, protect public health and lessen the risk of future pandemics, and mitigate the global climate impact of meat production—all while giving consumers more options for tasty, affordable proteins.

Download the full report online.

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EXECUTIVE SUMMARY | 2021 INDUSTRY UPDATE

Alternative seafood

The development and widespread commercialization of alternative seafood is an immensely promising approach to alleviating pressure on both wild fisheries and aquaculture systems while helping to meet global demand for an important source of food. Along with growing consumer interest in plant-based foods, factors like the high incidence of seafood allergies and the high price points of many seafood products—especially products that are consumed raw and thus pose special consumer risks—generate a sizable number of highly motivated early adopters and market entry points for alternative seafood products.

Alternative seafood producers are leveraging technologies across plant-based, fermentation, and cultivated platforms. 2021 was a year of tremendous growth for the alternative seafood industry. The nascent industry gained momentum with an influx of new companies, products, and investments—and U.S. retail sales showed rapid and sustained growth.

Investments

Alternative seafood companies raised $175 million in 2021, nearly double the amount raised in 2020. The $175 million was raised across 15 deals with disclosed deal sizes, bringing total investments to $313 million from 2013 to 2021.

Category	2021	2020	2013–2021	Highlights
Total invested capital	$175M	$91M	$313M	Invested capital grew 92% from 2020 to 2021.
Invested capital deal count	24	20	69	The largest investment of 2021 was $60M (BlueNalu).
Unique investors	108	91	215	The number of new unique investors in alternative seafood grew by 57% in 2021.
Series A rounds	1	3	6	New Wave Foods closed an $18M Series A round in 2021.
Series B rounds	2	1	3	Finless Foods and Gathered Foods closed Series B rounds in 2021.

Commercial landscape

2021 welcomed 18 new alternative seafood companies and saw the first launches of alternative seafood companies in Austria, Latvia, Thailand, Estonia, and South Africa.

Alternative seafood also saw new activity from the conventional seafood industry in 2021, including new investments or launches from Thai Union, Karavela, Long John Silver's, and Nestlé.

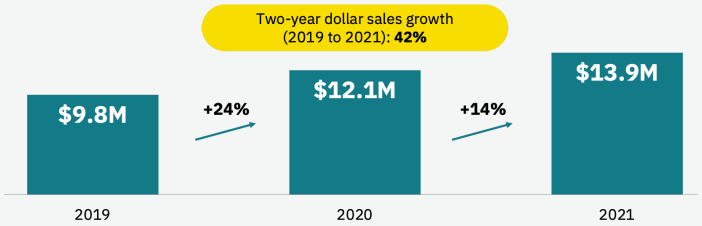
Total alternative seafood companies and companies launched in 2021

Company type	Total	New in 2021
Plant-based	90	11
Cultivated	20	9
Fermentation	10	1
Total	**120**	**21**

Retail sales

Plant-based seafood U.S. retail sales increased from $12.1 million in 2020 to $13.9 million in 2021. While this growth is encouraging, plant-based seafood remains a small fraction of the overall plant-based meat and seafood category and a white-space opportunity in the market.

Total U.S. retail plant-based seafood sales increased by 14 percent in the past year and by 42 percent in the past two years—including growth in both plant-based shellfish and plant-based finfish.



There was a **25 percent increase** in the number of plant-based seafood products sold in retail in the United States in 2021.

Opportunities

With a small but growing industry comes significant opportunities for new product development and innovation, including increasing **species variety**, achieving **texture parity**, positioning products for the **refrigerated seafood section** in grocery stores, and developing and scaling **animal-free omega-3 ingredients**.

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