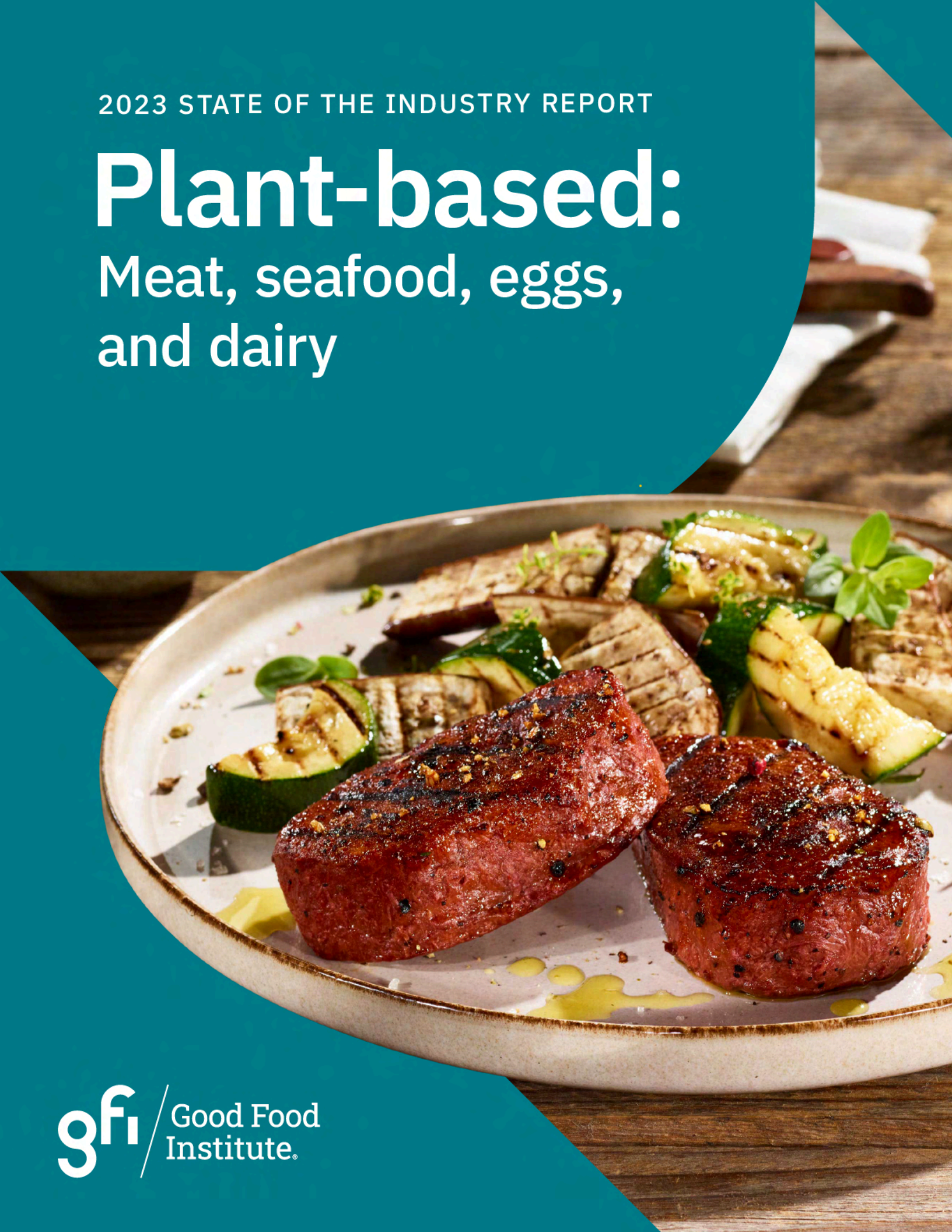
2023 STATE OF THE INDUSTRY REPORT

Plant-based:

Meat, seafood, eggs, and dairy



Good Food Institute

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Editor's note

Over the past decade, the global plant-based food market has grown substantially. This has been largely driven by companies launching products that appeal to mainstream consumers by mimicking the taste, texture, and functionality of conventional animal products. In 2023, new distribution around the world led to pockets of regional sales growth, particularly in markets where plant-based categories are still emerging. Yet a number of challenges persisted in more mature markets, including the United States, where retail dollar and unit sales for plant-based foods declined from 2022.

In the United States, plant-based price increases coincided with elevated inflation and tightened consumer budgets, and purchase dynamics indicated weakening consumer engagement in many plant-based categories. Plant-based meat sales declined more sharply than plant-based food sales overall, and surveys of lapsed consumers showed that plant-based meat products are largely not meeting consumer expectations, particularly in regard to taste, texture, and price. Funding constraints, scaling complexities, and a rise in misinformation and disinformation all posed additional obstacles to growth.

Yet U.S. consumers say they'd be more willing to eat plant-based meat if it tasted better, became more affordable, and overall provided a clear value. There also remain strong consumer tailwinds supporting a shift toward increasing consumption of plant-based foods. None of the challenges facing plant-based foods are insurmountable, but they do require significant increases in government and private sector support, with an eye toward meeting consumer needs. Companies can innovate to improve the eating experience of their products and optimize production to deliver better affordability. The industry can collaborate to better communicate the benefits of plant-based meat and the unique value of their products to consumers.

The past year saw progress made up and down the supply chain. New products with improved health propositions hit the shelves. Large companies released plant-based alternatives to popular branded products, leveraging those brands' equities. Research continued to optimize plant protein cultivation, take advantage of agricultural by-products, and create processes and ingredients that more closely match the sensory attributes of conventional meat, seafood, egg, and dairy products.

Despite tough market conditions, the stark realities of our food system remain: Global meat consumption is projected to rise significantly by 2050, and animal agriculture alone accounts for between 11 and 20 percent of greenhouse gas emissions. Taken together, these projections point to the urgent need for the kinds of solutions provided by alternative proteins.

If the world is to achieve our climate, biodiversity, public health, and food security goals, reimagining the way meat is made will be as essential as the global transition to renewable energy. When compared to conventional meat, alternative proteins dramatically reduce emissions, feed more people with fewer resources, reduce pandemic and antibiotic-resistance risks, and free up lands and waters around the world for restoration and recovery.

GFI's annual State of the Industry Reports equip food system stakeholders with an in-depth understanding of the alternative protein market and its challenges and opportunities. These reports also serve as a global call to action:

Alternative proteins are agricultural innovations that, with proper levels of government and private support, will help ensure planetary and public health, transforming our global food system for the better.

Plant-based meat is a powerful tool for tackling such challenges. At scale, alternative proteins including plant-based meat, seafood, eggs, and dairy could enable a shift toward less resource-intensive ways of producing protein. But first, the industry must overcome challenges like distorted nutrition narratives and premium pricing compared to conventional meat, and must continue to improve taste and sensory attributes so that plant-based products more closely resemble meat. The next generation of consumers is signaling enthusiasm for plant-based meat as a solution to food made with fewer resources and less harm to the environment. With additional funding and support, the industry is poised to satisfy that growing interest.

This report details the innovations and developments that moved the field forward in 2023. But there is still much to be done. As a nonprofit and international network of organizations, GFI is accelerating alternative protein innovation and bringing more people into the field. Policymakers and governments, scientists and students, industry leaders and global citizens can all ensure that the sector of nature-positive proteins continues to progress, offering the world a far more sustainable food future.

With gratitude and deep respect to all those on this journey, we invite you to dig deep into this 2023 State of the Industry Report.

Best,

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SVP of Corporate Engagement

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Government Relations

About GFI's State of the Industry Report series

GFI's State of the Industry Report series serves as our annual alternative protein sector deep-dive. The series compiles business developments, key technologies, policy updates, and scientific breakthroughs from around the world that are advancing the entire field. This year's reports include:

Cultivated meat and seafood

Fermentation: Meat, seafood, eggs, and dairy

Plant-based meat, seafood, eggs, and dairy

Global policy: Public support, regulation, and labeling

The *Plant-based meat, seafood, eggs, and dairy* report synthesizes 2023 updates across the global industry focused on plant-based alternatives to conventional animal products. For a primer on the latest science and technological developments of plant-based alternative proteins, please visit GFI's science of plant-based meat deep dive page.

Symbols to look for

Throughout the 2023 State of the Industry Report series, look for symbols highlighting how developments in the past year advanced the alternative protein sector in the areas of health and nutrition, sustainability, and path-to-market progress. Dig deeper and Opportunity icons are calls to action for researchers, investors, and others seeking to learn more and advance the field.

Health

Sustainability

Opportunity

Path-to-market

Dig deeper

Please note that The Good Food Institute is not a licensed investment or financial advisor, and nothing in this report is intended or should be construed as investment advice.

About the Good Food Institute

As a nonprofit think tank and international network of organizations powered by philanthropy, GFI works alongside scientists, businesses, and policymakers to make alternative proteins as delicious, affordable, and accessible as conventional meat. In Asia Pacific, Brazil, Europe, India, Israel, and the United States, our teams are mobilizing the international community to use markets and technology to replace harmful practices with ones that are better for the climate and biodiversity, food security, and global health.

We focus on three programmatic priorities:

1. *Cultivating a strong scientific ecosystem*

GFI's science and technology teams map out the most neglected areas that will allow alternative proteins to compete on taste and price. We produce open-access analyses and resources, educate and connect the next generation of scientists and entrepreneurs, and fund research that benefits alternative protein development across the sector.

2. *Influencing policy and securing government investment*

GFI's policy teams ensure that alternative proteins are a part of the policy discussion around climate change mitigation and global health. In every region where we have a presence, we advocate for government investment in alternative proteins and educate regulators on novel proteins such as cultivated meat.

3. *Supporting industry to advance alternative proteins*

GFI's corporate teams are replicating past market transformations and partnering with companies and investors across the globe to drive investment, accelerate innovation, and scale the supply chain—all faster than market forces alone would allow.

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Newsletters | GFI's suite of expertly curated newsletters puts timely news, insights, and opportunities right in your inbox. Check out gfi.org/newsletters to find the ones most suitable for your interests.

Monthly seminar series | Each month, we host online seminars with leading experts from around the world: The *Business of Alt Protein* series is geared toward a commercially focused audience on topics related to starting and scaling a good food business. The *Science of Alt Protein* series addresses a technical audience and focuses on cutting-edge research developments that enable alternative protein innovation.

This State of the Industry Report series, as well as all of GFI's open-access insights and data, are made possible by gifts and grants from our global community of donors. If you are interested in learning more about giving to GFI, please visit here or contact philanthropy@gfi.org.

Executive summary

Executive summary

The plant-based meat, seafood, egg, and dairy sectors experienced both headwinds and tailwinds in 2023. While some regions, especially those with emerging plant-based markets, saw growth in product distribution, U.S. sales of plant-based foods declined as inflation continued and many consumers signaled that products weren't yet meeting their expectations on taste, texture, and affordability.

Governments such as Canada, Denmark, and Germany increasingly committed significant public funding to plant-based research, while private investment into the sector fell—albeit at a slower rate than global venture funding across all sectors. Plant-based meat products, on average, continued to be sold at significant price premiums compared to conventional meat, and sensory gaps to conventional meat remained. All the while, consumers—especially in the United States and Europe—contended with high interest rates and elevated inflation, limiting consumers' willingness to spend on higher-priced protein products.

Amid these conditions, the industry continued to mature. New scientific and technical groundwork was laid. Companies conducted analyses that proved out sustainability benefits of plant-based products. Governments and investors financed researchers and companies. And manufacturers introduced new products, developed strategic partnerships, and built new production facilities. However, although pockets of progress across categories and geographies are clear, plant-based meat is facing significant challenges. The sector needs more progress on price parity, taste parity, manufacturing capacity, and consumer understanding, especially in nutrition, if it is to deliver on its promise of serving as a commonplace center-of-plate protein for mainstream consumers.

Plant-based meat, seafood, eggs, and dairy, part of our 2023 State of the Industry Report series, takes a field-wide, global view of the progress made over the past year.

Commercial landscape

New products and categories

Hundreds of new plant-based meat, seafood, egg, and dairy products hit retail shelves in the U.S. market in 2023, including plant-based steak, sushi, boiled eggs, Wagyu-style beef, ribs, and more.

Retail and foodservice trends

- Large companies continued to engage in the sector, including the release of plant-based versions of popular branded products like **Tyson** plant-based nuggets, **Nestlé** plant-based mince meat and plant-based **Häagen-Dazs** products, and **Kraft Heinz** plant-based cheese slices and a plant-based version of Kraft Mac & Cheese product.
- Plant-based meat continued to launch on menus at major chains globally including **Burger King** in Scandinavia, **Subway** in Europe, **Taco Bell** in the United Kingdom, and **Starbucks** in Malaysia.
- **Impossible Foods** launched a lower-fat version of their signature plant-based beef, Impossible Beef Lite, with 75 percent less saturated fat.

New partnerships

Companies continued to collaborate to develop new products, scale production, and leverage mainstream distribution channels. Notable strategic partnerships in 2023 included **Modern Plant-Based Foods** and **Carbone Restaurant Group** developing plant-based pizzas; **JUST Egg** and **Cheryl's Cookies** developing plant-based cookies; and **MorningStar Farms** and **Pringles** developing a new line of plant-based chicken fingers.

Manufacturing capacity

Continuing to expand manufacturing capacity and further develop supply chain infrastructure will be critical to the success of plant-based proteins. New facilities opened in 2023, including **SunOpta**'s 285,000-square-foot facility in Texas, which will manufacture plant-based milk and creamer. Many more facilities broke ground, such as one for German plant-based food company **Planteneers** in Illinois, or were announced, such as agricultural company **Bunge** committing $550 million to build a new facility in Indiana.

Sales

Total U.S. retail plant-based food dollar sales were $8.1 billion in 2023, a slight decline from $8.2 billion in 2022. Plant-based meat and seafood sales declined, which indicates that opportunities exist to better meet consumer needs on key product characteristics like taste and price.

- Eighty-one percent of households that purchased plant-based foods in 2023 purchased more than once throughout the year.
- Plant-based milk held nearly 15 percent market share of total milk dollar sales in 2023.
- Across the majority of plant-based categories, repeat purchase rates held relatively steady year over year.

Investments

According to GFI's analysis of data from the Net Zero Insights platform, plant-based meat, seafood, egg, and dairy companies raised $907.7 million in 2023 (representing 11 percent of all-time investment), bringing total private investments in the sector to $8.5 billion. The number of unique investors in plant-based companies grew by 10 percent to more than 1,293 unique investors.

Science and technology

New sources of plant-based ingredients, new ways to cultivate these plants, and novel processes to optimize taste, texture, and nutrition were key technological themes driving research for plant-based foods in 2023. Advances were made in ingredient development, from new animal-free fats and emulsifiers to novel aquatic, leguminous, and upcycled protein sources. Improved scalability of traditional texturization methods like extrusion was achieved, and promising newer bottom-up methods like fiber spinning and a patent-pending "process-controlled microstructure design" expanded available technologies for scalable plant-protein texturization. In 2023, Beyond Meat released their second ISO-reviewed Life Cycle Assessment (LCA) which showed the Beyond Burger 3.0 patty generates 90 percent fewer greenhouse gas emissions, uses 97 percent less water and land, and requires 37 percent less non-renewable energy than an average conventional beef patty.

Government and regulation

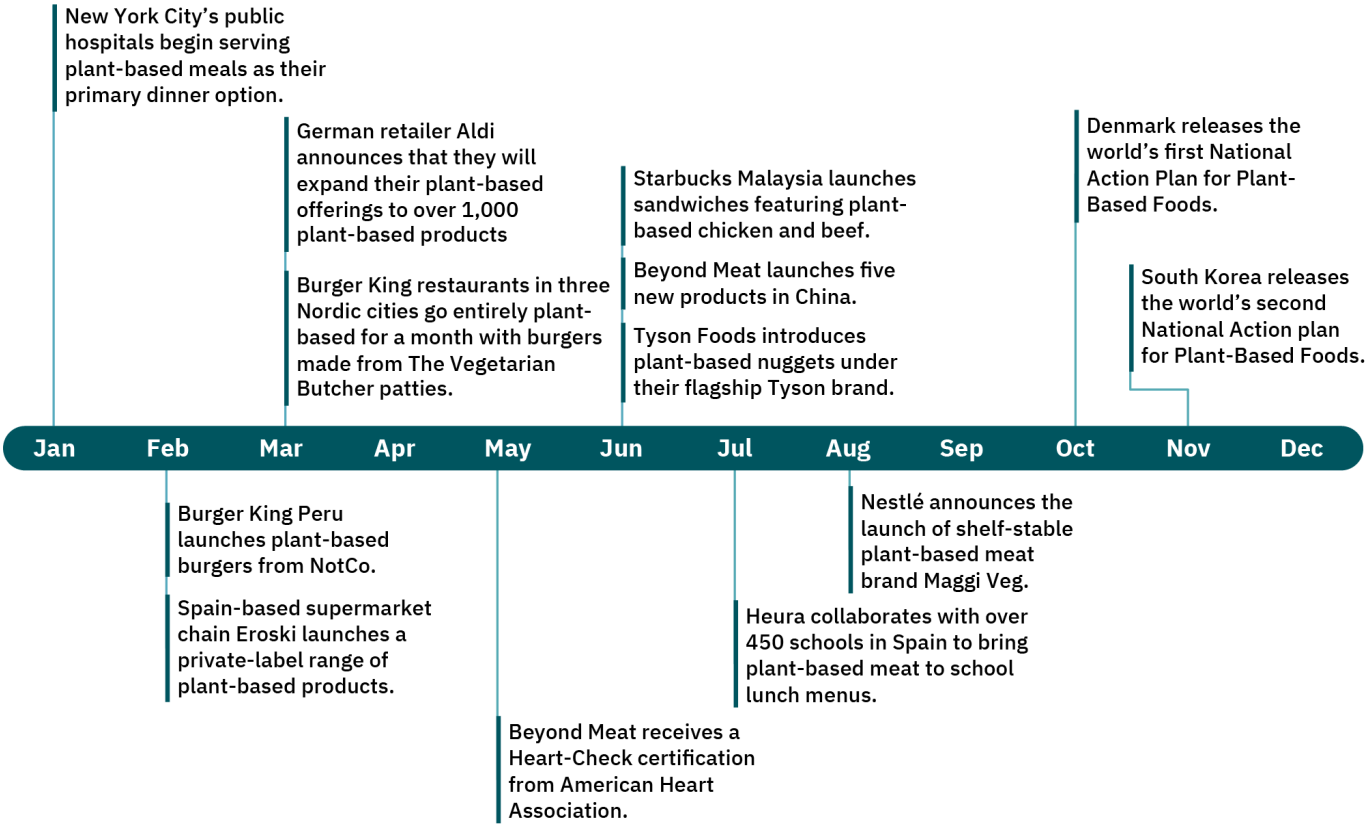
Milestones in 2023 government support of plant-based alternative proteins spanned the globe. In the Americas, Canada continued its investment leadership with CAD 150 million ($110 million) in public funding that will support plant-based protein market growth, while in Europe, the United Kingdom and Germany both announced large commitments to alternative protein R&D and commercialization. Government support of alternative protein startups and product development was announced in Brazil, Japan, Singapore, South Korea, and more.

Table 1: Invested capital in plant-based meat, seafood, eggs, and dairy

Category	2023	2006–2023	Highlights
Total invested capital	$908MM	$8.5B	2023 invested capital represented 11% of all-time investment.
Invested capital deal count	125	1,211	2023's largest investment was the $300 million convertible note raised by Oatly.
Unique investors	187	1,293	The number of all-time unique investors grew by 10% in 2023.
Liquidity event capital	$389MM	$25.7B	Above Food, a plant-based ingredient and end products company, announced plans to merge with Bite Acquisition Corp., a publicly traded special purpose acquisition company (or SPAC). Above Food was valued at $319 million in the announced deal.

Source: GFI analysis of data obtained from Net Zero Insights platform

Figure 1: Timeline of key plant-based updates in 2023



Commercial landscape

Commercial landscape

Overview

The global plant-based meat, seafood, egg, and dairy industry continued to grow and evolve in 2023.

Euromonitor's estimate for the total global retail sales of plant-based meat, seafood, milk, yogurt, ice cream, and cheese was $29 billion in 2023 (Euromonitor does not report on plant-based eggs). Despite a 34-percent increase over 2019 sales ($21.6 billion), the global market for alternative proteins remains small compared to conventional animal products. Advancements in product innovation, affordability, accessibility, and more are needed to grow this industry. New activity in 2023 included the announcement and/or completion of new facilities, the launch of new products, and the formation of strategic partnerships. Some key trends that emerged include:

- Large food and meat companies continued to engage in the sector including **Tyson**, **Nestle**, and **Kraft Heinz**.
- Products continued to be added to menus at major chains such as **Burger King**, **Subway**, **Taco Bell**, and **Starbucks**.
- Companies expanded distribution into new markets and new channels such as noncommercial foodservice environments like airlines, hospitals, and schools.
- New formats, product types, formulations, and line extensions launched in the global market including plant-based steak, sushi, and boiled eggs.
- Companies and organizations formed new partnerships to advance current and future products and grow the sector as a whole.

These events from 2023 all contributed to an ever-evolving global market for plant-based alternatives. Continued activity such as the examples described in this section will be key to delivering products that meet consumer needs across regions and allow these products to compete with conventional foods.

> ***Check out our monthly Alternative Protein Opportunity newsletter for updates***
>
> Across the globe, plant-based products launch or expand distribution every week. GFI's monthly Alternative Protein Opportunity newsletter tags and categorizes notable plant-based distribution updates, new product launches, partnerships, facility openings, and more, helping you keep up with the fast-moving plant-based landscape.
>
> Sign up here.

Facilities

Continuing to build manufacturing capacity and further develop supply chain infrastructure for plant-based proteins will be critical to the success of the industry in the short and long term. GFI's latest analysis underscores the opportunities that exist to optimize the manufacturing landscape for plant-based meat. Retrofitting existing facilities, developing strategic contract manufacturing partnerships, and building new facilities will be important in the growth of the industry across the globe.

In 2023, a variety of companies and organizations announced, broke ground on, and opened facilities throughout the world.

Opened in 2023

- Food and beverage producer **SunOpta** opened a $125 million, 285,000 square-foot plant-based beverage production facility in Texas, which created 175 jobs and will allow the company to double their plant-based beverage business by 2025 over 2020 levels.

- Plant protein manufacturer **Ojah**, which specializes in high-moisture extrusion technology, expanded their Netherlands facility from 6,500 square meters to 10,000 square meters, more than doubling their current production capacity.
- Plant-based baby formula brand **Else Nutrition** added a second U.S. powder production facility and began manufacturing at a new plant in Europe as the company aims to triple their production capacity.
- United Arab Emirates-based food producer **The IFFCO Group** opened their first 100-percent plant-based meat factory in the Middle East. The Dubai facility is producing The IFFCO Group's **THRYVE** brand of products made from fava beans.
- Plant-based oils and food producer **AAK** officially opened their Innovation Center of Excellence in Zaandijk, the Netherlands, which aims to improve the taste and functionality of plant-based products.
- Sweden-based **Lantmännen Biorefineries** opened a $77 million wheat protein extraction facility in Norrköping, Sweden to broaden their production capacity.
- Spain-based **Mommus Foods** opened a new factory that has the capacity to produce 100,000 units per month of plant-based cheese.
- France-based ingredients company **Roquette** opened a new €4.5-million innovation center that provides technical and R&D support, equipment, labs, and scale-up testing for the plant-based ingredients market.
- Chicago-based food and commodities company **ADM** opened an 800-square-meter plant-based innovation center in the United Kingdom that includes a kitchen, chef's presentation theater, and flavor development lab.
- **ADM** also purchased Canadian pulse processor **Prairie Pulse**, adding another facility to their plant protein operations.

Broke ground in 2023

- The **University of British Columbia** broke ground on a 9,500-square-foot Food & Beverage Innovation Centre intended for both teaching and product development. The facility is expected to be complete by 2024, and one of its research projects will include the development of a plant-based Wagyu-style beef product.
- German plant-based food company **Planteneers** has started construction on a plant-based meat production facility in Illinois that is expected to open in summer 2024.

Announced in 2023

- French plant-based meat producer **Umiami** announced their acquisition of a 14,000-square-meter **Unilever** factory in Duppigheim.
- Large agricultural company **Bunge** committed to invest around $550 million in a new Indiana facility for soy protein concentrate for use in plant-based foods and other products.
- **Climax Foods**, a Berkeley-based alternative dairy company, announced the construction of their first production facilities, timed with the introduction of their first artisanal plant-based cheeses in Los Angeles, New York, and San Francisco.
- **Danone** North America announced a plan to invest $65 million over the next two years to build a new bottle production line in Florida that will help expand production of key U.S. brands, including **Silk** coffee creamers.
- **ADM** and **Marel** are partnering on an alternative protein taste and texture innovation center in the Netherlands, which is expected to open in the second half of 2024.
- Plant-based food supplier **Finnebrogue** invested £2.8 million to upgrade their plant-based meat facility in Northern Ireland. The upgrade will reduce carbon dioxide emissions and increase capacity.

- New Zealand beverage manufacturer **Free Flow Manufacturing** announced plans to open the country's first dedicated plant-based milk facility in 2023.
- Canadian plant-based company **No Meat Factory** announced plans to open their first U.S. facility in Stanwood, Washington, producing a line of plant-based meat products.

A few trends emerge from the facility news above. Many companies, including **AAK**, **Roquette**, and **ADM** opened innovation-focused facilities. Other companies expanded current facilities or entered new markets for the first time. **Continuing to prioritize research and development to create tasty and affordable products while growing production to improve accessibility are crucial actions needed to address industry barriers and challenges.**

Company landscape

Tables 2 and 3 provide alphabetized lists of the top plant-based meat and milk brands by Euromonitor's global retail dollar sales estimates in 2023.

Table 2: Brands with the most total plant-based meat & seafood retail dollar sales globally (alphabetized)

Brand	Parent company	Headquarters	Year founded
Beyond Meat	Beyond Meat Inc.	United States	2009
Field Roast	Maple Leaf Foods	Canada	1991
Gardein	Conagra	United States	1919
Garden Gourmet/Hälsans Kök	Nestlé SA	Switzerland	1866
Impossible	Impossible Foods Inc.	United States	2011
Lightlife	Maple Leaf Foods	Canada	1991
Morningstar	Kellanova	United States	1906
Quorn	Monde Nissin Corp.	United Kingdom	1985
Rügenwalder Mühle	Rügenwalder Wurstfabrik Carl Muller GmbH & Co KG	Germany	1834
Yves Veggie Cuisine	The Hain Celestial Group Inc.	United States	1993

Source: Euromonitor International Limited [2023] © All rights reserved. Data displayed is from Staple Foods 2023, retail value RSP, Meat & Seafood substitutes top global brands, listed in alphabetical order.

Table 3: Brands with the most total plant-based milk retail dollar sales globally (alphabetized)

Brand	Parent company	Headquarters	Year founded
Almond Breeze	Blue Diamond Growers	United States	1910
Alpro	Danone Group	France	1919
Coconut Palm	Coconut Palm Group Co Ltd.	China	1956
Dou Ben Dou	Fujian Dali Food Co Ltd.	China	1989
Kikkoman	Kikkoman Corp.	Japan	1917
Lolo	Wanxiang Sannong Co Ltd.	China	1969
Oatly	Oatly	Sweden	1994
Silk	Danone Group	France	1919
Vitasoy	Vitasoy International Holdings Ltd.	China	1940
Yangyuan	Hebei Yangyuan Zhihui Beverage Co Ltd.	China	1997

Source: Euromonitor International Limited [2023] © All rights reserved. Data displayed is from Dairy Products and Alternatives 2023, retail value RSP, Plant-based milk, top global brands, listed in alphabetical order.

More information on these and other companies is available in GFI's company database.

Involvement by diversified companies

Many of the global leaders in consumer packaged goods (CPG) and meat production have some level of involvement in the alternative protein industry. Whether through investment, acquisitions, partnerships, or production, this engagement can and has played an impactful role in supporting the growth of the sector.

Table 4: Conventional companies with involvement in plant-based meat, seafood, eggs, and dairy

	PepsiCo	Nestlé	Kraft Heinz	AB InBev	General Mills	Danone	Coca-Cola	Maple Leaf	Tyson	JBS	Cargill	Smithfield	Hormel Foods
	CPG companies							Meat companies					
Investment	✓	✓			✓	✓			✓		✓		
Acquisition		✓	✓			✓		✓		✓			
Partnership	✓		✓								✓		
R&D and manufacturing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Source: GFI analysis of publicly reported industry news and events

Table 5: Conventional companies with involvement in alternative proteins

Cultivated meat · Fermentation · Plant-based

	PepsiCo	Nestlé	Kraft Heinz	AB InBev	General Mills	Danone	Coca-Cola	Maple Leaf	Tyson	JBS	Cargill	Smithfield	Hormel Foods
	CPG companies							Meat companies					
Investment	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		
Acquisition		✓	✓			✓		✓		✓			
Partnership	✓	✓	✓	✓	✓			✓		✓	✓		✓
R&D and manufacturing	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Source: GFI analysis of publicly reported industry news and events

Partnerships

Partnerships in the plant-based sector play a major role in the growth and success of the industry. **Companies and organizations can share knowledge and expertise to develop new products, optimize inputs, conduct research, scale production, and share distribution channels to make these products more accessible across markets.** While not comprehensive, the list below highlights some notable partnerships from 2023.

Table 6: Partnerships table

Product development partnerships

Many of the partnerships happening in the plant-based industry are centered around product development as companies collaborate to leverage each other's product knowledge, infrastructure, and brand equity.

Companies/organizations	Details
Modern Plant-Based Foods & Carbone Restaurant Group	Developing plant-based pizzas
CP Kelco & Chr. Hansen	Developing shelf-stable plant-based yogurt
SimpliiGood & Haifa Group	Developing spirulina products
Nepra Foods & a U.S. bread company	Developing gluten-free bread with plant-based eggs
Schouten Europe & Grassa	Developing alternative protein products from grass protein
More Foods & Tivol	Developing plant-based meat products from pumpkin seeds
Vly & KWS	Developing plant-based foods from pea protein
Plant Based Seafood Co. & ICL Group Ltd.	Developing technologies for plant-based seafood
JUST Egg & Cheryl's Cookies	Developing plant-based cookies with plant-based eggs
MorningStar Farms & Pringles	Developing a new line of plant-based chicken fingers
Plant Based Foods & Violife	Developing plant-based ready-to-eat meals
Alpha Foods & The EVERY Company	Developing a range of plant-based foods
Foody's & Cocuus	Developing 3D printed plant-based bacon
DayDayCook & Nestle	Developing a range of plant-based meal products
Hunger Brands, Heura Foods, & Väcka	Developing a plant-based meat brand
Alpha Foods & Eat JUST	Expanding Alpha Foods' plant-based breakfast items
Green Rebel & AirAsia	Providing plant-based meat on inflight menus
Wunderkern & Bauer	Developing alternative dairy products

Ingredient-focused partnerships

One key to developing and improving products is optimizing ingredients. In 2023, a variety of partnerships focused on plant-based ingredients.

Companies/organizations	Details
Ready Burger & Givaudan	Working to improve fat used in burgers
Nepra Foods & Scoular	Develop and market specialized plant-based ingredients
Megmilk Snow Brand Co. & Agrocorp International	Making plant-based ingredients for alternative meat and dairy products
Amfora & McClintock LLC	Improving protein content and yields of soy varieties
Roquette & Daiz	Producing texturized, pea-based protein ingredient
Cargill & Cubiq Foods	Incorporating plant-based fats into ingredient offerings

R&D partnerships

Organizations are coming together to tackle major research needs and uncover opportunities across the plant-based sector.

Companies/organizations	Details
Hunch Ventures & Earth First Food Ventures	Build Net-Zero Food Innovation project
Group of public and private Netherlands entities	Identify food safety and quality risks in plant-based products
Protein Industries Canada & Wageningen University	Support alternative protein research and development
Food Systems Innovations & Noa Weiss	Launching an AI tool to optimize plant-based proteins

Scaling and distribution partnerships

Growing scale and increasing the distribution of products is a significant barrier in alternative proteins. Partnerships in this area can allow companies to access existing infrastructure to reach more markets and consumers.

Companies/organizations	Details
Fresh Del Monte & Vertage	Scale production of plant-based cheese products
DUG & Haofood	Expanding plant-based milk brand to China
Vgarden & MCT Dairies	Expanding plant-based products to the United States
PURIS & Palmer Holland	Expanding PURIS' distribution of pea ingredients

Product launches

New plant-based products are hitting grocery shelves every year, and distribution on current products is expanding. While not a comprehensive list of every launch in 2023, below are some notable launches that demonstrate the ever-changing plant-based landscape.

Retail

Large food and meat companies continue to get involved in the plant-based sector. A variety of companies announced plant-based product launches in retail in 2023.

- **Tyson Foods**, a leading U.S. meat company, introduced plant-based nuggets under their flagship brand. The decision marked the first time plant-based products are available under the Tyson brand rather than the Tyson-owned **Raised and Rooted** brand. The nuggets are available in both retail and foodservice in the United States.
- **Nestlé**, the world's largest food and beverage company, announced the launch of shelf-stable plant-based meat brand **Maggi Veg** in Chile. The Maggi Veg line includes plant-based minced meat made from soy. The company also debuted their first plant-based line of **Häagen-Dazs** products set to appear first in Canada.
- **Kraft Heinz** launched Kraft Heinz Not Company plant-based cheese slices in retail stores across the United States and their NotMayo product in U.S. Target locations. The partnership with NotCo also produced a plant-based version of the classic Kraft Mac & Cheese product. They also debuted three new flavors of their plant-based Philadelphia Cream Cheese line across the United States after a successful trial.

Retailers are also getting involved. Whether it be through developing their own private label line of plant-based products or making commitments to expand store sets, retailers are demonstrating their commitment to plant-based foods.

- **Albertsons**, the U.S. grocery chain, is expanding their private-label **Open Nature** brand with 12 new plant-based products, including shredded cheese, yogurt, and ice cream.
- Spain-based supermarket chain **Eroski** revealed a private-label range of plant-based products, including milks, burgers, and chicken nuggets, and more products were added in 2023.
- German budget retailer **Aldi** announced that they will expand their plant-based offerings to over 1,000 plant-based products by the end of 2024, including a variety of plant-based meat and dairy products.

Plant-based categories, particularly plant-based meat, continued to evolve in 2023 with innovation in the form of new product types, formats, formulations, and line extensions hitting retail shelves.

- Canadian plant-based seafood brand **Konscious Foods** announced that their plant-based frozen sushi range will now be available in **Whole Foods Market** locations across North America.
- South Korea's **UNLIMEAT** announced the launch of plant-based tuna made from soy. UNLIMEAT's existing plant-based pulled pork product line is distributed at **Albertsons** stores across the United States.
- Plant-based brand **Daring** announced they are releasing their first line of frozen entrees, which will be available in several varieties and will feature Daring's signature plant-based chicken, along with new teriyaki pieces and buffalo wings products.

- **Impossible Foods** launched a lower-fat version of their signature plant-based beef. Impossible Beef Lite has 75 percent less saturated fat and 45 percent less total fat than 90/10 conventional beef.
- **Beyond Meat** introduced Beyond Burger Chicken-Style, Beyond Schnitzel, and Beyond Tenders at supermarkets across the Netherlands. The company also expanded distribution on their Beyond Steak, the first plant-based steak to be certified by the American Heart Association, and Popcorn Chicken products in the United States.
- Whole-cut plant-based meat producer **Juicy Marbles** launched their plant-based filet steak at the Austrian supermarkets **BILLA PLUS** and **BILLA PFLANZILLA**. They also reached a long-term distribution agreement with British retailer **Waitrose** for Juicy Marbles' plant-based filet mignon and announced the development of the first plant-based rib with edible bones.
- Plant-based company **Crafty Counter** is launching their egg-free hard-boiled WunderEggs made with cashews, almonds, and coconuts into **Whole Foods Market** stores in the United States.
- Israel-based **Redefine Meat** is now offering their plant-based products at **Shufersal**, the largest supermarket chain in Israel.
- Spanish food tech companies **Foody's** and **Cocuus** launched 3D-printed plant-based bacon in **Carrefour** supermarkets across Spain.

Foodservice

In 2023, the foodservice sector rebounded from historic traffic declines in 2020 due to the COVID-19 pandemic. People are returning to their favorite restaurants and in turn, plant-based companies are continuing to lean into this unique channel. **Foodservice environments can be pivotal in delivering a unique, oftentimes first, experience with plant-based alternative products, setting the stage for future encounters.**

Convenience plays a major factor in consumer behavior, and no operators do it better than quick service and fast-casual restaurants. Below are examples of how chains are incorporating plant-based alternatives into their menus.

- **Starbucks** Malaysia launched sandwiches containing plant-based chicken and beef in partnership with **Green Rebel Foods**.
- Jackfruit-based meat producer **Jack & Annie's** is partnering with fast-casual chain **Smashburger** to offer a jackfruit burger at select Smashburger locations in Colorado, New York, and New Jersey.
- **Subway** locations across Northern Europe will now feature **The Vegetarian Butcher**'s plant-based beef slices as part of the new Plant-Based Steak Sub.
- **Burger King** restaurants in three Nordic cities—Oslo, Stockholm, and Copenhagen—went entirely plant-based for a month with burgers made from The Vegetarian Butcher patties.
- Chile-based **NotCo** launched new NotCheese products at **JUMBO**, one of the largest retailers in Chile, and partnered with **Burger King Peru** to provide plant-based cheese products for their plant-based Whopper.
- Californian plant-based seafood company **Impact Food** entered a strategic distribution agreement with fast-casual chain **Pokeworks**.
- Fast-casual chain **TGI Fridays UK** announced that Brazilian company **Future Farm** will supply TGI Fridays plant-based burger patties for their plant-based menu offerings.
- **Taco Bell UK** launched a plant-based seasoned beef product at 132 locations.
- **NotCo**'s plant-based milk and cheese products are now available at Starbucks locations across Mexico and Argentina.

- Fast food chain **Shake Shack** launched new plant-based custard and shake products at all of their 260+ locations across the United States. The ice cream treats are made with the plant-based company **NotCo**'s **NotMilk** product. Shake Shack also introduced a plant-based burger to their national menu.

- **Caribou Coffee** and **Eat Just** announced that Caribou's JUST Egg Roasted Tomato & Pesto Flatbread is now a permanent menu option at 400 locations in the United States after outperforming the chain's existing vegetarian breakfast option by 45 percent.

- **Oatly** partnered with **Insomnia Cookies** to make available Oatly's original and chocolate-flavored oat milk at more than 250 Insomnia Cookies locations in North America.

Full-service restaurants offer plant-based companies the perfect place to deliver their product in an elevated setting. In 2023, young brands debuted at a variety of specialty restaurants.

- **Redefine Meat**, the Israel-based maker of 3D-printed plant-based meat products, said their products are now on menus at nearly a dozen restaurants across Italy.

- Israeli startup **Chunk Foods** launched their whole cut plant-based steak at **Talk of the Town Restaurant Group**'s **Charley's Steak House** in Orlando, Florida. This launch represents the first time a steakhouse chain has featured a plant-based steak option.

- Israel's **Yo Egg**, which produces runny-yolk eggs from chickpeas and soy, debuted at six Los Angeles restaurants: **Real Food Daily**, **Junkyard Dog**, **Flore**, **Swingers Diner**, **Coyote Grill**, and **Loma Linda's Vegan District Asian Eatery**.

- Plant-based egg company **Zero Egg** will launch their Zero Egg Breakfast Sandwich at all **The Friendly Toast** restaurant locations in the United States.

Sometimes overlooked but ever-present are noncommercial foodservice locations such as schools, businesses, airports, hospitals, entertainment, and more. Below are a few examples of plant-based alternatives showing up in ubiquitous, everyday locations that reach significant numbers of consumers.

- After a successful pilot program, **New York City's public hospitals** began serving plant-based meals as the primary dinner option for inpatients at all of their 11 public hospitals.

- Movie theater chain **AMC Theaters** will now feature a plant-based grilled chicken sandwich, patty melt, and gourmet tenders made with **Dr. Praeger's** plant-based products.

- German airline **Eurowings Discover** is integrating **Beyond Meat's** meatballs into their in-flight menu, becoming the first German airline to incorporate plant-based meats on flights.

- Germany's national train service, **Deutsche Bahn**, continued their plant-forward approach with a plant-based currywurst.

- **Heura**, a plant-based meat producer based in Spain, has collaborated with over 450 schools in the region to bring their plant-based meat to school lunch menus.

- U.S. plant-based chicken company **Rebellyous Foods** secured a distribution agreement with **Vizient**, a purchasing organization for healthcare and educational institutions in the United States.

E-commerce

E-commerce is another channel where products and brands can get their foot in the door by selling products directly to consumers. This platform is important in a company's distribution strategy, allowing them to reach consumers quickly and across regions while limiting upfront time and costs needed to get products on shelves and menus. E-commerce developments in 2023 include:

- Following a successful trial in the eastern and midwestern United States, the **Plant Based Seafood Company**'s Mind Blown Crab Cakes are now available nationwide through online retailer **Hungryroot**.
- Singaporean plant-based seafood company **Growthwell** launched the **HAPPIEE!** brand in the United Kingdom via **Ocado**'s and **Tesco**'s e-commerce websites.
- **Beyond Meat** launched five new products in China, including new varieties of burgers and dumplings. The products are available at **METRO**, **Ole**, and **Sam's Club** in addition to e-commerce platforms **Tmall** and **Pinduoduo**.
- South Korean plant-based cheese brand **Armored Fresh** is launching a U.S.-wide e-commerce platform for their plant-based sliced, cubed, and spreadable cheeses.
- **Oatly** and **Amazon** announced a distribution agreement that will make Oatly products available on Amazon's marketplaces in Germany, France, Italy, Spain, the Netherlands, and Belgium.
- **Romil Ratra**, a hotelier and restaurateur based in India, partnered with **Graviss Good Foods** to found Plantaway, a brand offering plant-based meat, milk, cheese, dips, and dressings. The brand will launch via its online store and other e-commerce platforms such as **Amazon**, **Vegan Dukan**, and **Big Basket**.
- India's **Wakao Foods** launched a new Continental Burger Patty made from jackfruit, pea protein, and spices, which is now available on Wakao's website and select e-commerce platforms.

Activity in blended meat

Blended meat is another area with involvement from major conventional meat companies, recent product launches, and new start-ups. Blended meat is defined here as products that combine plant protein or mycoprotein (and sometimes vegetables) with conventional meat components to form an end product. Hybrid meat refers to alternative protein products made from multiple production platforms such as cultivated fat and plant-based proteins. More research and industry alignment are needed around the nomenclature used to describe these emerging product formulations.

Hormel produces their Applegate Well Carved line of burgers and meatballs combining whole vegetables with conventional meat. **Perdue**, in partnership with the **Better Meat Co**., owns the brand Perdue's Chicken Plus, a line of kid-focused chicken products mixing in a quarter cup of chickpeas and cauliflower per serving. One recently announced start-up, **Momentum Foods**, launched products under the brand name Paul's Table that feature 90 percent plant-based ingredients and 10 percent animal-based ingredients such as collagen and fat. Other examples of blended meat companies include **Rebel Meat**, **Grateful Market**, **Phil's Finest**, **Mush Foods**, and **Nanka**.

Despite recent activity in blended meat, this category remains relatively small and discrete. **These companies and brands, as with any emerging category, will not only have to create products that successfully meet consumers' needs but will also have to craft and hone clear messaging that drives home the benefits of these foods to consumers.**

Consumer insights

Consumer insights

This section focuses on U.S. consumer perceptions, behaviors, and needs for plant-based meat Comparisons to global consumers and specific regions are noted, and additional consumer insights for other regions can be found in reports by GFI's affiliates and partners in Brazil, Europe, Israel, Asia-Pacific, and China.

Overview

In the United States, 36 percent of consumers reported eating plant-based meat in 2023, with 25 percent eating it monthly or more frequently, according to research conducted by Morning Consult on behalf of GFI in December 2023. This research also showed that 95 percent of plant-based meat eaters also reported eating conventional meat, which parallels panel data showing that 95 percent of households that bought plant-based meat also bought conventional meat (based on GFI and Plant Based Foods Association (PBFA) analysis of data commissioned from SPINS). This underscores that omnivore shoppers are a significant market for plant-based proteins, and suggests the food's broad appeal. While plant-based meat sales were down in 2023, 25 percent of Americans reported continuing to eat plant-based meat products at least once per month and former consumers who have not eaten plant-based meat in the past year say they are likely to repurchase products as taste and texture improve and costs decline.

> ***Research conducted by Morning Consult on behalf of GFI***
>
> Polling firm Morning Consult conducted multiple surveys of the U.S. population on behalf of GFI throughout 2023 to understand their evolving perceptions of and behaviors toward alternative proteins. Results from our December research are summarized throughout this section.

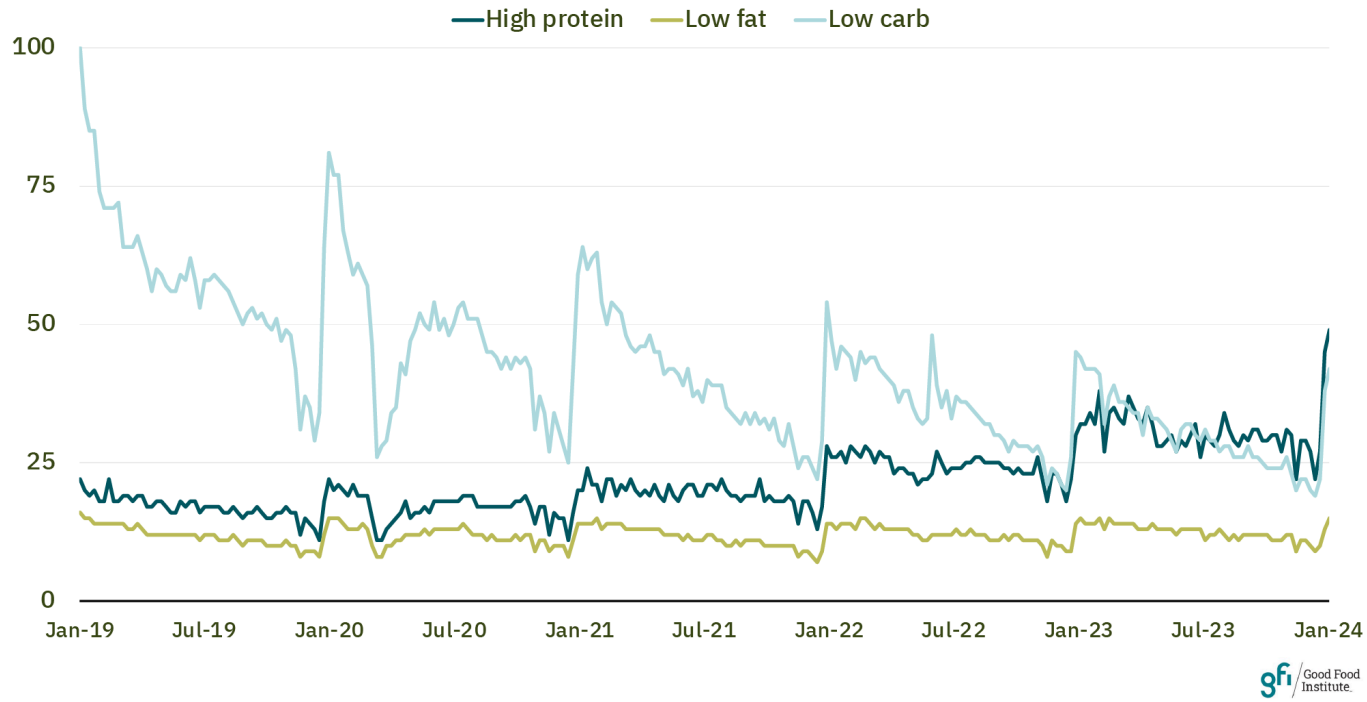
Conventional meat consumption, reduction, and substitution

Meat consumption and the role of protein:

Conventional meat sales in the United States have risen every year for the past decade, according to USDA estimates.

In recent years, protein has become an increasingly important driver of food choice, likely contributing to increases in meat consumption. In 2023, "high protein" overtook "low-fat" and "low-carb" in Google search trends for the first time (see figure 2).

Figure 2: Google searches for protein overtake other nutrition topics, 2019-2023



Source: Google Trends: Nutrition Topics in U.S., 2019-2023; numbers are indexed to maximum value of any included search during period

According to research conducted by Morning Consult on behalf of GFI, 66 percent of U.S. consumers claim it is important to them to eat a high-protein diet. For most, this is due to the association between protein and health: a 2022 Euromonitor poll of global consumers found that more than 57 percent of consumers sought to increase their protein intake because it is "better for [them]" or "makes [them] feel healthier."

Many plant-based meat brands communicate protein content on the front and back of their packaging. Including this metric connects with consumers who are seeking to increase protein intake. Continuing to develop products that contain protein content similar to conventional meat, and communicating the presence of that protein content on packaging, will be important for plant-based meat companies as the industry grows.

Meat reduction:

Despite Americans' high meat consumption and desire for protein, a significant number express interest in reducing meat consumption, primarily due to health concerns. A total of 59 percent of U.S. adults claim to consider "negative health effects" when choosing whether to consume conventional meat.

But rates of vegetarianism and veganism in the United States are low. Morning Consult's polling on behalf of GFI found three percent following vegetarian and three percent following vegan diets; a 2023 Gallup poll and a 2022 McKinsey poll found comparable rates.

While few Americans are eliminating meat entirely, a significant minority report reducing meat consumption.

In a 2023 survey by AP-NORC, 43 percent of consumers reported eating less meat than they used to. Morning Consult's polling on behalf of GFI found 11 percent of consumers report reducing their consumption of all major non-seafood meat types (beef, pork, and poultry) in the past year, with 18 percent reporting eating less beef and 18 percent less pork.

Health and social factors:

Consumers reducing meat consumption consistently cite health as a reason, with 57 percent claiming this contributes "a lot" or "some" to their meat reduction (GFI/Morning Consult, Dec. 2023). An AP-NORC survey similarly found that 50 percent of consumers claim health as their top reason for reducing meat consumption when asked to choose between health, money, the environment, and taste.

The experience of the COVID-19 pandemic seemed to influence much of consumers' health concerns about meat. A total of 55 percent of Americans say they consider the use of antibiotics in meat when choosing whether to eat meat, and 55 percent say they consider the risk of foodborne illness (GFI/Morning Consult, Dec. 2023). While these are higher than the number of consumers who report actually reducing their meat consumption, they point to public health concerns as a tension many consumers face. Many consumers also say they worry about the individual health effects of meat consumption. A 2021 study found eight to 28 percent of those surveyed were aware of increased risks of various conditions including heart disease, cancer, and diabetes from red meat consumption, with heart disease awareness highest at 28 percent.

Plant-based meat is uniquely positioned as an alternative to conventional meat that can offer consumers the protein they want while allowing them to reduce their meat consumption, which many consumers say they aspire to do for a variety of reasons: personal health benefits like lower cholesterol and lower risk for heart disease; public health benefits like not contributing to antibiotic resistance: and environmental benefits like less water and land use and fewer greenhouse gas emissions. These aspirational benefits, if messaged effectively and balanced with core consumer drivers of taste, texture, and price parity with conventional meat, are opportunities to tap into consumer drivers that can grow the category.

Om Noms are plant-based protein strips
Photo credit: YUMASOY FOODS LTD.

Consumer awareness and use

While U.S. plant-based meat retail sales decreased in 2023, usage patterns suggest that plant-based meat enjoys a strong core of loyal consumers, has room to grow with a large number of still-unaware consumers, and that even lapsed and holdout consumers remain open to plant-based meat if companies continue to innovate and improve the taste and price of their products (see figure 3).

Awareness, familiarity, and appeal:

A December 2023 poll conducted by Morning Consult on behalf of GFI found that 58 percent of U.S. adults claim awareness of plant-based meat and 47 percent say they are "very" or "somewhat" familiar. While 41 percent claimed to have seen, read, or heard "a lot" or "some" about plant-based meat in the past year, only 10 percent claimed to have heard "a lot," suggesting many remain unaware of recent coverage of the category, giving companies room to shape perceptions (see figure 3). The more consumers hear about plant-based meat, the more likely they are to express an interest in purchasing it (see figure 4).

Trial:

Only 43 percent of U.S. adults report having ever tried a plant-based meat product (GFI/Morning Consult, Dec. 2023). This leaves almost 6 in 10 Americans completely untapped for the plant-based meat market. Ensuring these potential consumers consider trying it, and that their taste, affordability, and other product needs are met, will help set up the category for deeper consumer engagement past an initial trial.

Purchase and eating frequency:

While most Americans have not yet tried plant-based meat, most who have continue to enjoy it regularly:

- 13 percent of Americans eat plant-based meat once a week or more frequently.
- 12 percent eat it less than weekly but at least once a month.
- 11 percent report eating it a few times or at least once per year.

This points to a loyal core of consumers who are likely to continue using the category in the future, despite overall sales declines in 2023 (GFI/Morning Consult, Dec. 2023).

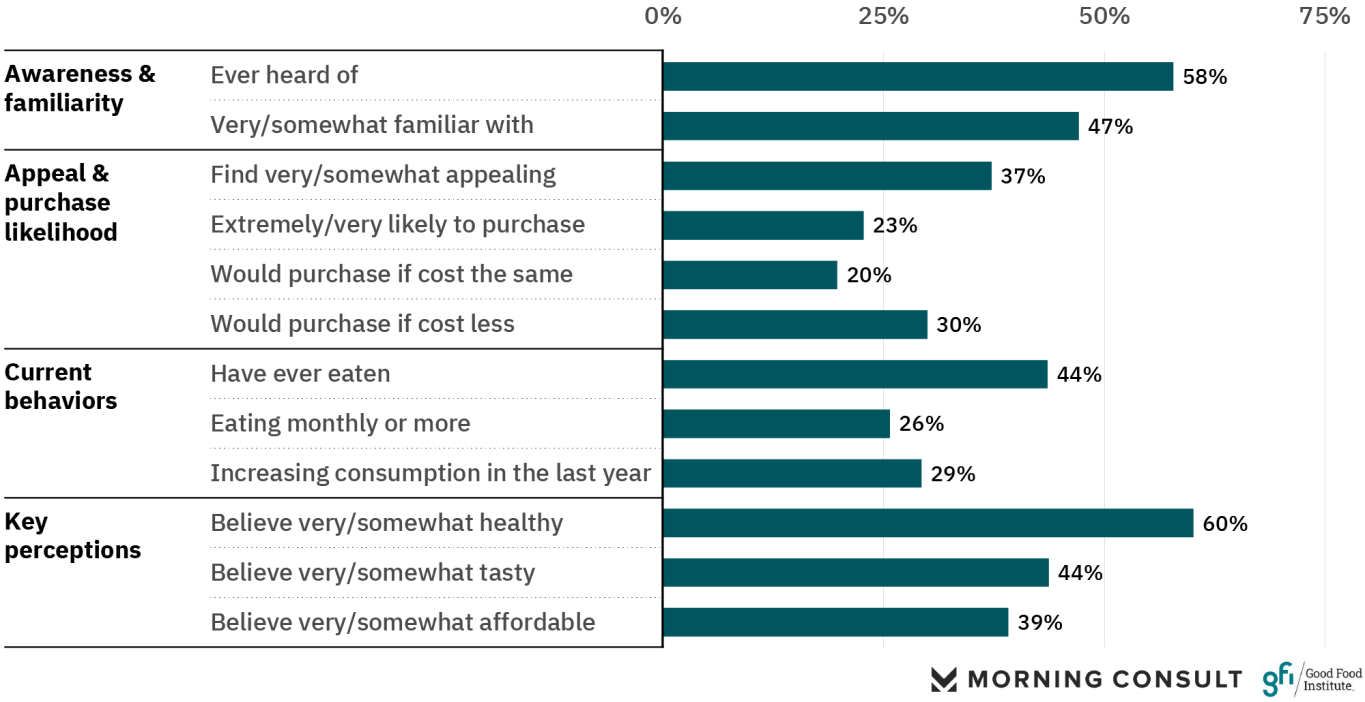
Consumers' increasing and decreasing consumption of plant-based meat:

A total of 51 percent of Americans have not yet tried plant-based meat (GFI/Morning Consult, Dec. 2023). Of those who haven't tried it, about half don't expect to purchase plant-based meat in the future, while the other half do. **Meanwhile, lapsed users who have not purchased it in the past year remain very open to repurchasing if products more closely match the taste and texture of meat.**

Many consumers reported increasing their consumption of plant-based meat in 2023. Morning Consult found that 29 percent of consumers reported eating "significantly" or "somewhat" more plant-based meat, 42 percent ate a "comparable" amount, and only 21 percent ate "somewhat" or "much" less. Mintel saw even higher numbers of consumers intending to purchase plant-based meat products in the coming year, at 32 percent.

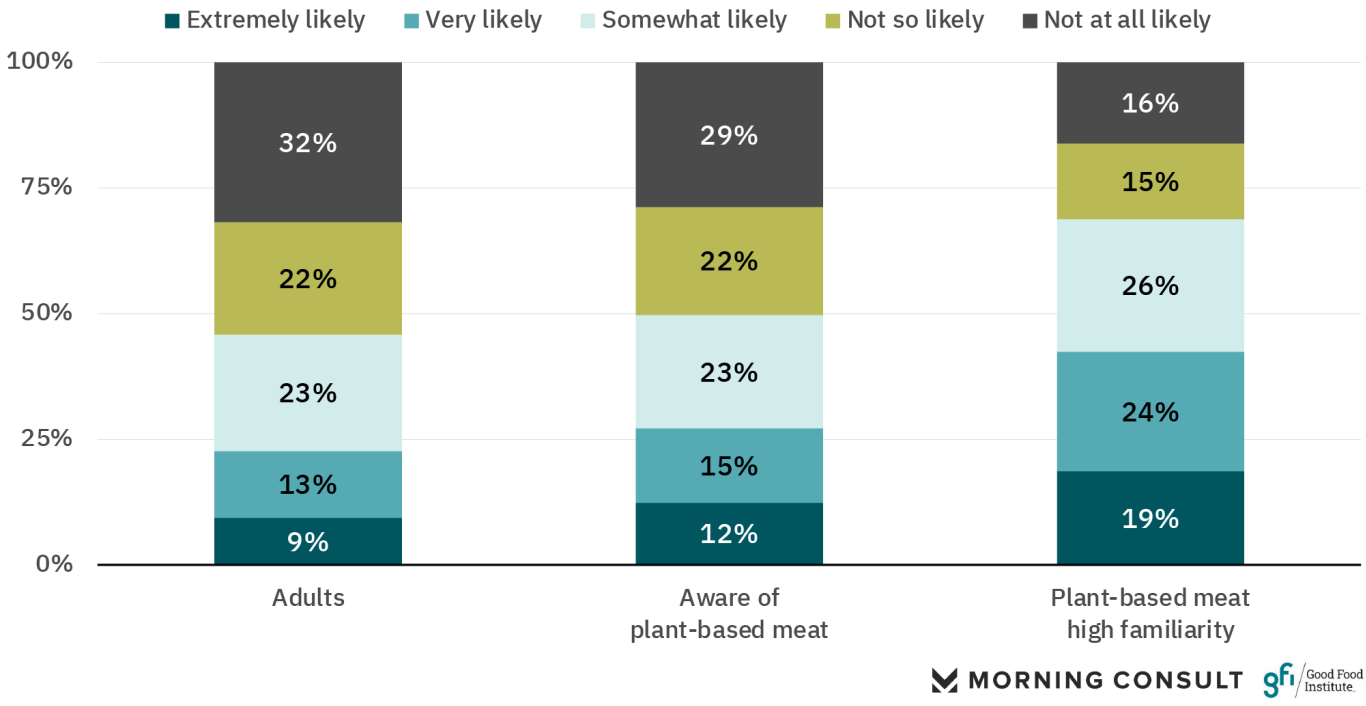
Overall, these usage rates align with household penetration rates seen in retail data and suggest a core of loyal users and further room for plant-based meat to grow.

Figure 3: Plant-based meat consumer metrics



Source: Poll by Morning Consult on behalf of GFI, n=2,228 US adults, December 2023

Figure 4: How likely are you, if at all, to purchase plant-based meat products?



Source: Poll by Morning Consult on behalf of GFI, n=2,228 US adults, December 2023

Consumer motivations

Lapsed consumers of plant-based meat tend to point to taste and price as reasons they stopped purchasing. Looking ahead, products more closely mimicking the sensory experience of conventional meat will be important to acquire new consumers (see figure 5). Meanwhile, most consumers see plant-based meat as healthy and believe it is as healthy as or healthier than conventional meat.

Health as a reason to try plant-based meat:

A 2021 survey by Consumer Reports found that 51 percent of consumers eating plant-based meat claimed it was healthier than conventional animal meat. And a 2023 survey by Mintel saw 55 percent of consumers who reported increasing their plant-based meat consumption cite health as their top reason. Taste and environmental concerns consistently rank as additional drivers of stated purchase intent (see figure 6).

Perceptions and comparisons to conventional meat:

U.S. adults rate plant-based meat positively on most of the key factors driving their decision-making: safe, healthy, good for the environment, and nutritious. However, a slight minority of consumers describe the products as tasty, affordable, and good value, suggesting gaps remain around sensory quality and price. A total of 45 percent of U.S. adults also describe the products as processed, which signals an opportunity to gain a deeper understanding of health-related motivators and barriers (GFI/Morning Consult, Dec. 23).

Consumers are more likely to rate conventional meat as tasty, high-protein, affordable, good value, easy to find, and easy to cook, and they are more likely to rate plant-based meat as healthy, good for the environment, and low in saturated fat and cholesterol. This suggests many consumers already see the unique benefits of these products, but there is also a need for product innovation, cost reduction, and consumer education to maximize plant-based meat's appeal (see figure 7).

Perceptions of plant-based meat as processed: In 2023, processed foods gained media attention. Some coverage mentioned deliberate misinformation and disinformation campaigns focused on plant-based meat, as documented by a 2023 social media analysis by Changing Markets Foundation and Ripple Research. However, most consumers do not appear to be aware of or concerned by these claims: a majority of consumers in 2023 who reported hearing media coverage of plant-based meats said the coverage was primarily positive (47 percent) or neutral (45 percent) (GFI/Morning Consult, Dec. 23).

Consumers report seeking out healthy and high-protein foods. U.S. adults are most likely to rate plant-based meat as "better" (in the case of overall healthiness) or "equal to" (in the case of protein) animal-based meat (see figure 7).

A majority of Americans claim it is "somewhat" or "very" important for them to avoid eating processed foods, and also claim to avoid foods for other reasons, including nutritional components like saturated fat and cholesterol where a majority rate plant-based meat as equal to or better than conventional meat. Plant-based meat companies have explored marketing about or featuring on-pack health benefits, including low cholesterol and low saturated fat content.

While the 2022 McKinsey survey found that 43 percent of consumers want to reduce their intake of processed food, 2023 saw few changes in consumer behaviors around plant-based meats.

Consumer opportunities in Southeast Asia

A study conducted in late 2023 by the Good Growth Co. and released by GFI APAC revealed that most consumers in Southeast Asia intend to continue eating animal meat and nearly a quarter want to increase their consumption. Interestingly, enthusiasm for plant-based meat was highest not among vegetarians or even flexitarians, but among consumers who eat the most conventional meat and are most likely to consume more of it.

The study showed that Southeast Asian consumers broadly view plant-based meat as a healthy and delicious product, but that cost remains a major barrier. If plant-based meat manages to achieve a 20 percent lower price than conventional meat, more than 80 percent of Southeast Asian consumers say they would buy it, including about half of those who would otherwise reject it. Conversely, if plant-based meat is priced 20 percent higher than conventional meat, there are large drop-offs in potential interest among everyone except the most enthusiastic consumers. With the average plant-based meat product price 35 percent higher than its conventional counterpart, there is an enormous opportunity to bring consumers into the category.

Since Southeast Asian consumers primarily view plant-based meat as an opportunity to diversify their protein consumption, interest in trying blended meat products—which mix plant-based meat and conventional meat within a single product—was nearly unanimously positive, even garnering support among consumer segments uninterested in fully plant-based products. The vast majority (93 percent) of surveyed consumers expressed interest in trying blended meat, including more than 75 percent of people who were skeptical of trying fully plant-based meat and 80 percent of those who have eaten plant-based meat but don't intend to again. This research indicates strong market opportunities for novel protein products and innovation that can meet consumer needs on taste and affordability.

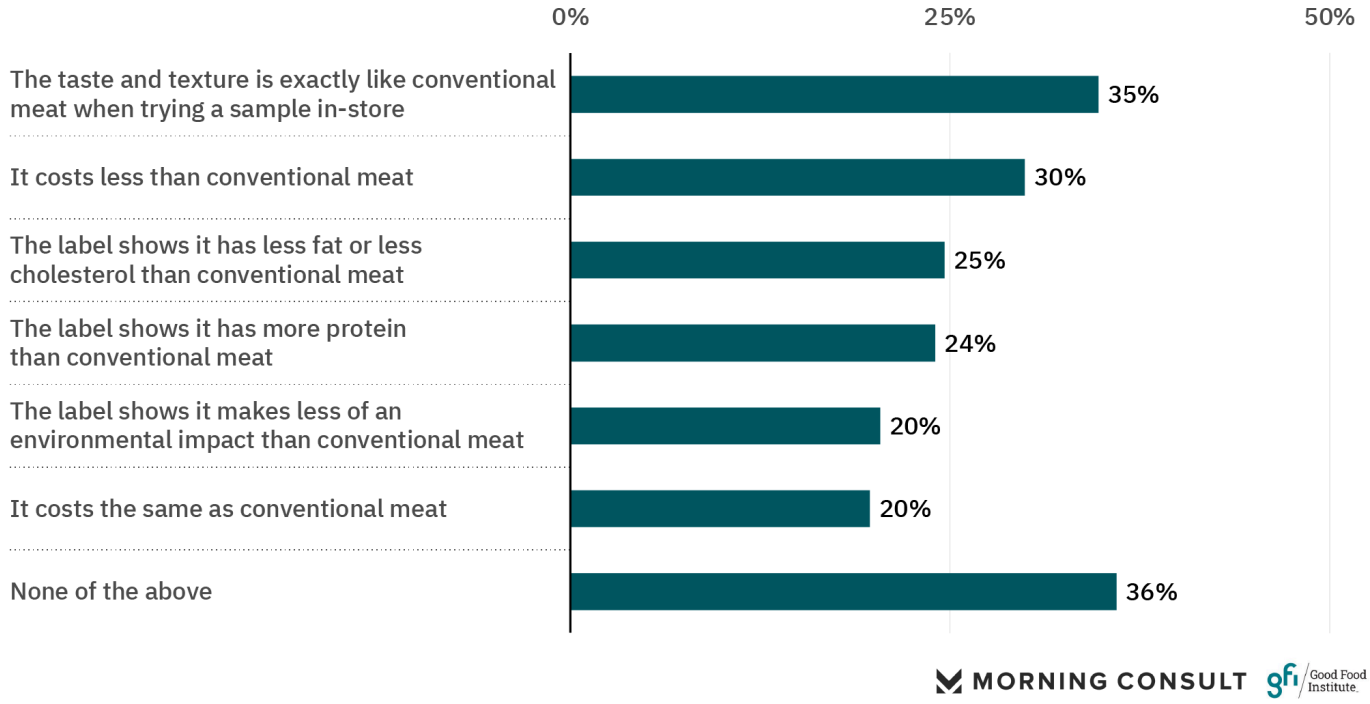
Appealing to lapsed consumers:

Around 50 percent of lapsed consumers claim they would buy a new plant-based meat product if they were offered a sample and found its taste and texture were exactly like conventional meat, and 43 percent would consider purchasing if it cost less than conventional meat (GFI/Morning Consult, Dec. 23).

Improving taste and texture and exposing consumers to new products should be a top priority for plant-based meat companies as they continue to innovate with new products, improve existing ones, and continue working to lower prices.

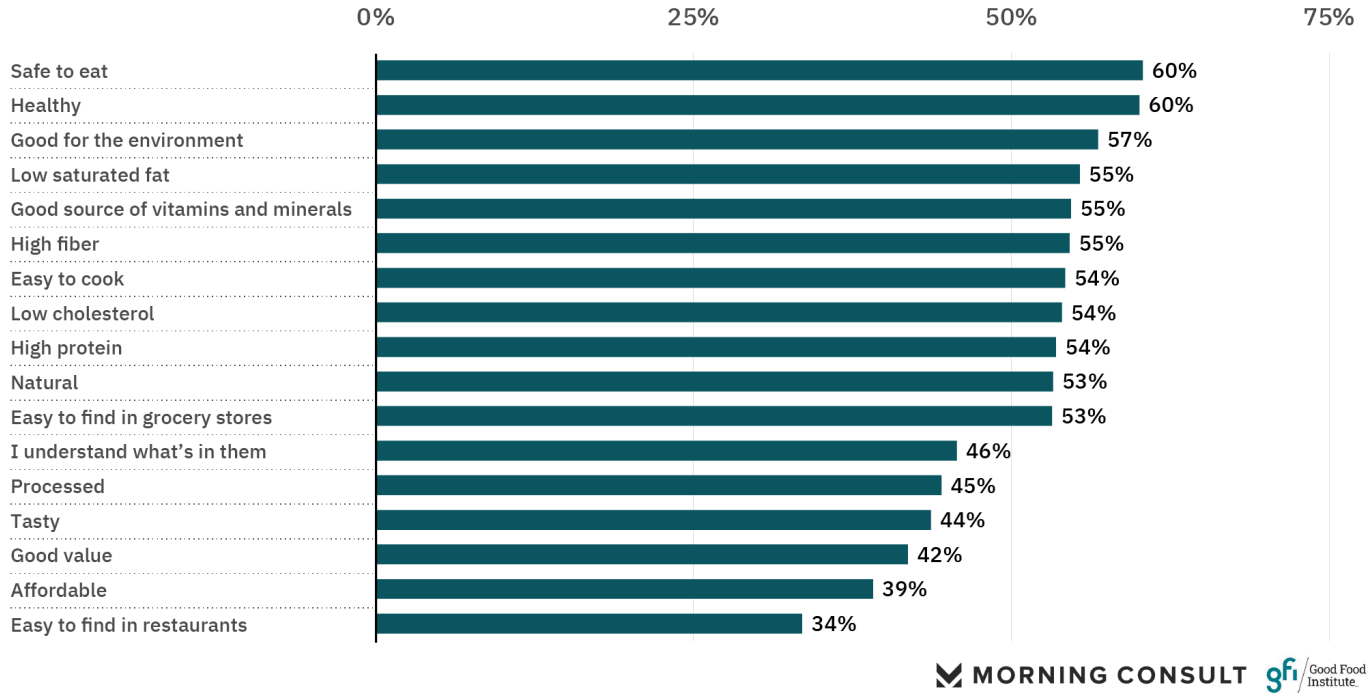
Tender Food's plant-based meat. Photo credit: Tender Food

Figure 5: Which of the following reasons, if any, would convince you to buy a new plant-based meat product?
Select all that apply



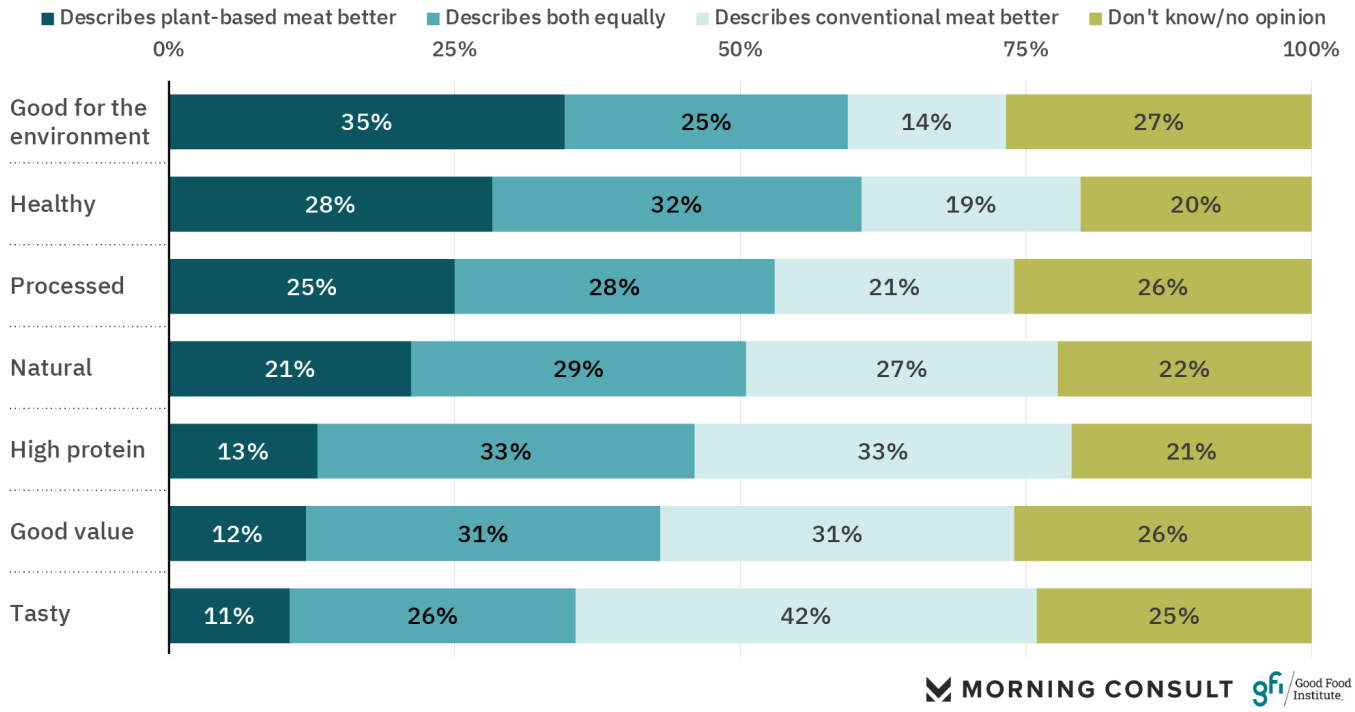
Source: Poll by Morning Consult on behalf of GFI, n=2,228 US adults, December 2023

Figure 6: How well do each of the following attributes describe plant-based meat products?
"Very" or "somewhat" well (top 2 box)



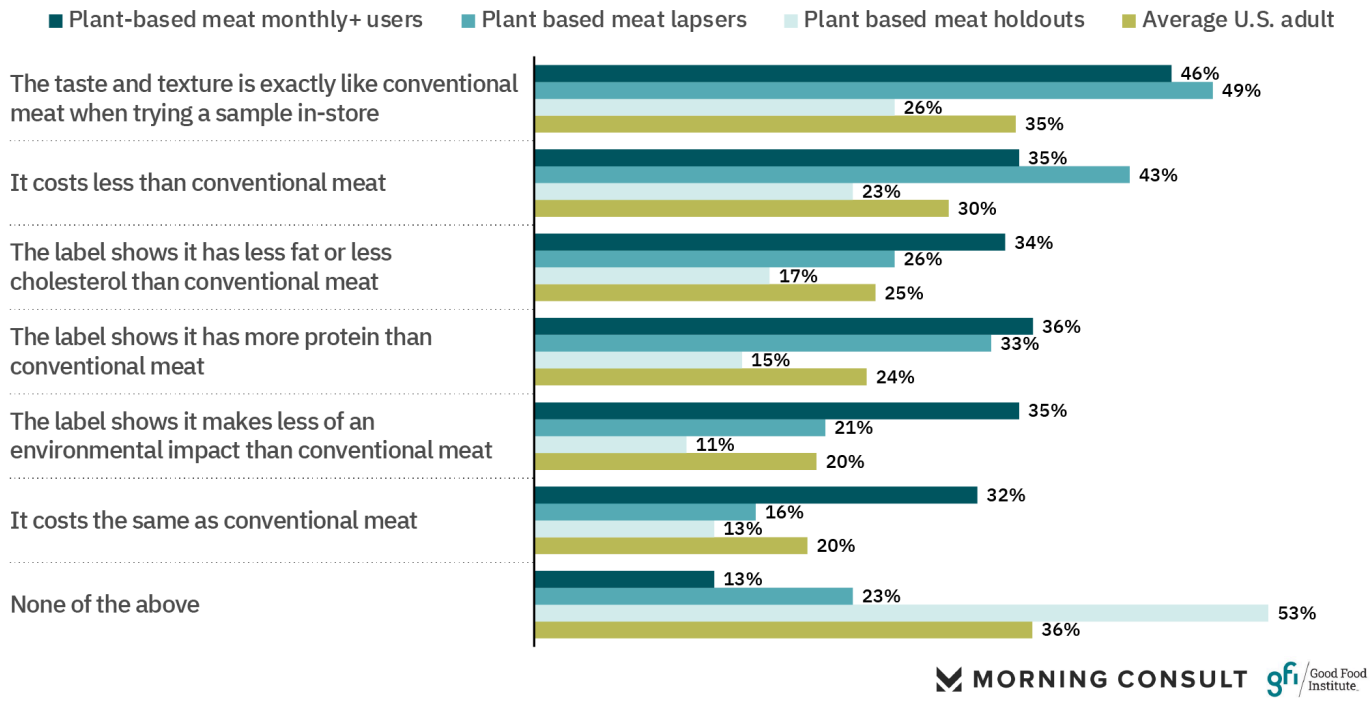
Source: Poll by Morning Consult on behalf of GFI, n=2,228 US adults, December 2023

Figure 7: Do each of the following attributes describe plant-based meat or conventional meat better?



Source: Poll by Morning Consult on behalf of GFI, n=2,228 US adults, December 2023

Figure 8: Which of the following reasons, if any, would convince you to buy a new plant-based meat product?
Select all that apply.



Source: Poll by Morning Consult on behalf of GFI, n=2,228 US adults, December 2023

Sales

Sales

U.S. retail sales overview

Over the past decade, the U.S. plant-based food retail market has grown substantially. When GFI began tracking plant-based food sales in U.S. retail, we sized the 2017 market at $3.9 billion, according to SPINS data. In 2023, the market was worth $8.1 billion. This growth has been driven by products that appeal to mainstream consumers by mimicking the taste, texture, and functionality of conventional animal products.

Companies ranging from startups to large food manufacturers generated growth through significant innovation and investment in their plant-based portfolios. Across categories, consumers have more options than ever when selecting plant-based meat, seafood, egg, and dairy products that can be swapped in for their conventional counterparts, and many plant-based categories increasingly make up notable shares of their overall categories. Against this backdrop of long-term progress, 2023 was characterized by a challenging market environment.

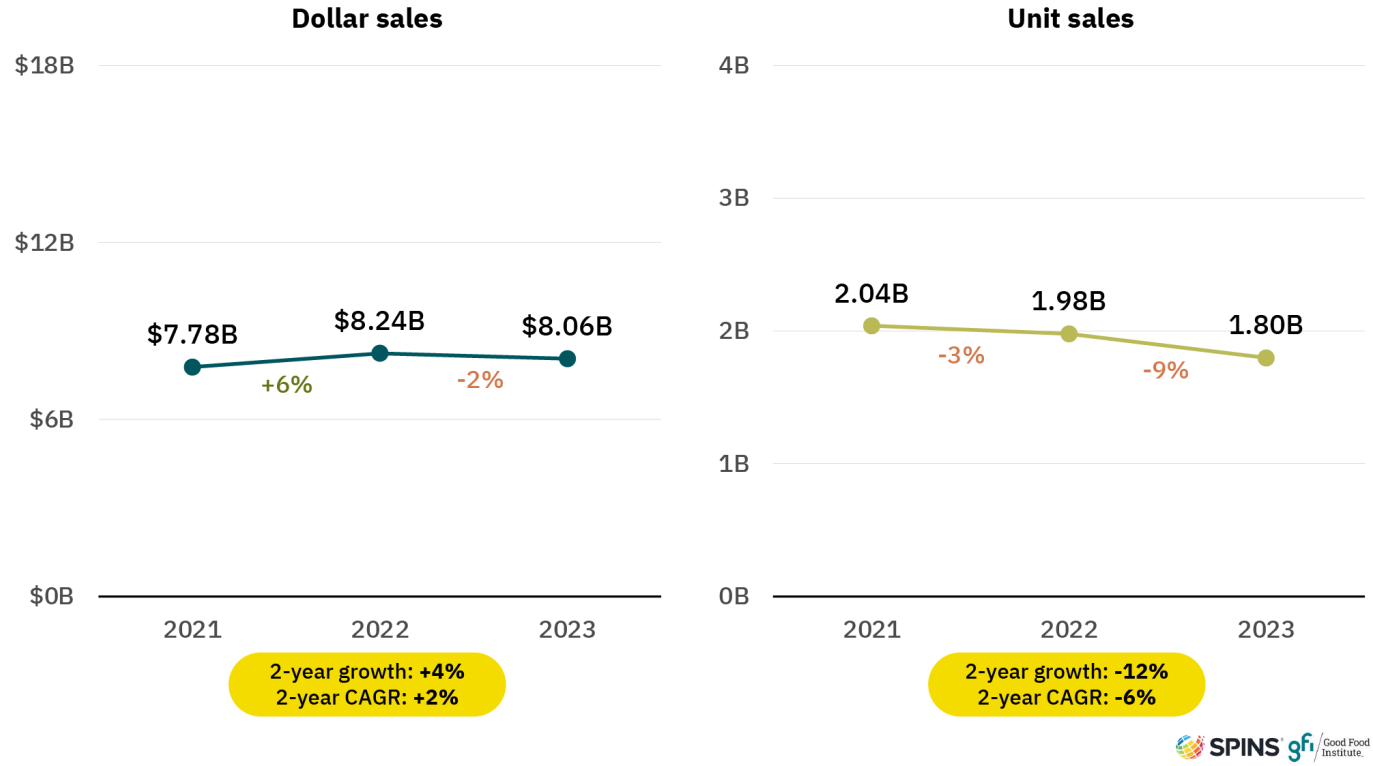
Insights released by GFI and PBFA based on retail sales data commissioned from SPINS show that the 2023 U.S. retail plant-based food market was worth $8.1 billion. Plant-based unit sales were down nine percent from 2022, while dollar sales were down two percent. Plant-based food unit sales fell across most categories tracked in this dataset in 2023, while dollar sales increased for some. Inflation continued to impact retail food sales as prices rose across most categories in 2023.

Key insights

- **Despite most plant-based categories experiencing unit sales declines,** plant-based creamers, protein powders and liquids, and baked goods and other desserts saw both unit and dollar sales increase in 2023.
- **Plant-based milk remains the largest category.** The category reached $2.9 billion in sales in 2023 managing to grow in dollar sales by one percent while units declined eight percent in 2023.
- **Plant-based meat and seafood sales declines continued**. Both dollar and unit sales fell for the second consecutive year indicating that opportunities exist to better meet consumer needs on key product characteristics like taste and affordability.
- **Six in 10 U.S. households purchased plant-based foods in 2023.** The majority of U.S. households purchased in the sector and 81 percent did so more than once throughout the year.

Evergrain's plant-based protein powder made with upcycled barley protein. Photo credit: The Hut Group

Figure 9: Plant-based foods market, U.S. retail (2021–2023)



Sales data note: The data presented in this graph 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.
Source: Total market = SPINS Natural Grocery Channel + SPINS Conventional Multi Outlet Channel + SPINS Convenience Channel (powered by Circana, formerly IRI & NPD) | 52 Weeks Ending 12-3-2023

Box 1: U.S. retail market data collection

Point-of-sale (POS) data

To size the U.S. retail market for plant-based foods, GFI and PBFA commissioned retail sales data from the market research firm SPINS. The firm built the dataset by first pulling in all products with the SPINS "plant-based positioned" product attribute. The dataset was further edited by adding plant-based private-label products. Inherently plant-based foods, such as chickpeas and kale, are not included. **Due to the custom nature of these categories, the retail data presented on this page may not align with standard SPINS categories**. Additionally, SPINS pulled in relevant mainstream subcategories (excluding plant-based positioned products) to create the conventional categories discussed above. Finally, the total edibles category was pulled to bring in all grocery, frozen, and refrigerated edible items across the retail grocery landscape as well as protein powders and bars. SPINS obtained the data over the 52-week, 104-week, 156-week, and 208-week periods ending December 3, 2023, from the SPINS Natural Supermarket Channel, SPINS Conventional Multi-Outlet Channel, and SPINS Convenience Channel (powered by Circana).

SPINS defines these channels as follows:

- **Conventional Multi Outlet (MULO)**: More than 110,000 retail locations spanning the grocery outlet, the drug outlet, and selected retailers across mass merchandisers, including Walmart, club, dollar, and military.
- **Natural Supermarket Channel**: More than 1,900 full-format stores with $2 million+ in annual sales and 40% or more of UPC-coded sales from natural/organic/specialty products.

- **Convenience Channel**: More than 147,000 convenience locations that are less than 5,000 square feet, have extended hours, stock at least 500 SKUs, and provide a mix of grocery items like beverages, snacks and confections, and tobacco.

This is generally considered the broadest available view of retail food sales, although not all retailers are represented. Some companies, such as Whole Foods Market, Trader Joe's, and Costco, do not report their scan data to Circana but are represented via projections. Please note that this methodology has changed compared to that used in previous reporting by GFI. We do not recommend comparing data released in prior years to the data included here.

Consumer panel data

To understand consumer purchasing dynamics and demographics, GFI and PBFA also commissioned consumer panel data from SPINS. The process for pulling the panel data was separate from that for the POS data, which may result in minor category differences. SPINS combines Circana Scan Panel with proprietary Product Intelligence to provide a unique view into shopper incrementality, loyalty, cross-purchase, demographics, and more. SPINS obtained the data over the 52-week, 104-week, 156-week, and 208-week periods ending December 3, 2023, from all U.S. outlets.

Categories

Plant-based food categories exist in various stages of development, and unit sales declined across most categories in 2023. Plant-based milk remains the largest category with nearly 15 percent market share of total milk dollar sales. Emerging categories such as plant-based eggs also experienced declines in 2023 after unit sales grew 25 percent in 2022.

Closing the price gap

In 2023, every plant-based and conventional food category GFI has data on—as well as the total food and beverage retail category—saw average prices per unit grow. Consumers continue to see higher prices at the shelf, making the price gap between plant-based and their conventional counterparts a relevant challenge to plant-based brands hoping to reach a broader swath of consumers.

Plant-based manufacturers can drive appeal and establish their products as everyday options by closing this price gap. In 2023, pound for pound, the average price premium was 77 percent for plant-based meat and seafood. Per dozen, the average price premium for plant-based eggs was 317 percent, and gallon for gallon, the premium for plant-based milk was 104 percent.

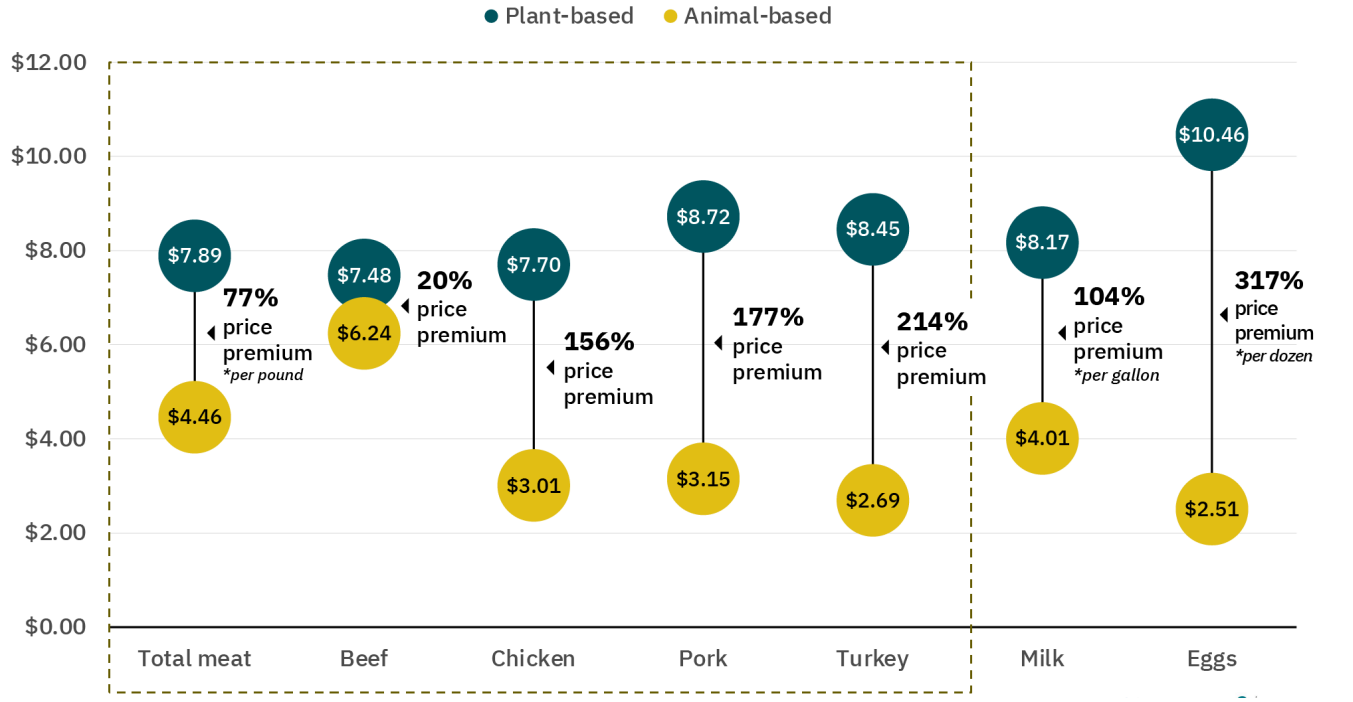
For a comprehensive overview of U.S. retail sales data, including coverage of all plant-based categories and additional detail on the plant-based meat and plant-based milk categories, as well as consumer purchase dynamics, check out GFI's market data page.

Figure 10: Plant-based food category dollar sales, dollar sales growth, unit sales, and unit sales growth 2023

Category	2023 dollar sales	1-year dollar sales growth (2022–2023)	2-year dollar sales growth (2021–2023)	2023 unit sales	1-year unit sales growth (2022–2023)	2-year unit sales growth (2021–2023)
Plant-based milk	$2.9 B	1%	9%	744 MM	-8%	-10%
Plant-based meat and seafood	$1.2 B	-12%	-13%	215 MM	-19%	-26%
Plant-based creamer	$701 MM	10%	35%	141 MM	4%	14%
Plant-based meals	$498 MM	-14%	-15%	96 MM	-22%	-28%
Plant-based protein liquids and powders	$392 MM	8%	21%	26 MM	2%	10%
Plant-based yogurt	$384 MM	-3%	1%	145 MM	-10%	-15%
Plant-based ice cream and frozen novelty	$351 MM	-9%	-14%	65 MM	-13%	-21%
Plant-based butter	$292 MM	-1%	5%	70 MM	-10%	-23%
Plant-based bars	$253 MM	7%	22%	59 MM	-1%	-5%
Plant-based ready-to-drink beverages	$247 MM	-1%	20%	60 MM	-3%	12%
Plant-based cheese	$219 MM	-9%	-10%	43 MM	-12%	-15%
Tofu, tempeh, and seitan	$201 MM	3%	8%	67 MM	-2%	-2%
Plant-based cream cheese, sour cream, and dips	$129 MM	-2%	7%	23 MM	-4%	-1%
Plant-based baked goods and other desserts	$105 MM	8%	23%	17 MM	1%	5%
Plant-based condiments and dressings	$90 MM	1%	7%	15 MM	-5%	-8%
Plant-based eggs	$43 MM	-5%	11%	9 MM	-13%	8%
TOTAL	**$8.1 B**	**-2%**	**4%**	**1.8 B**	**-9%**	**-12%**

Sales data note: The data presented in this graph 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.
Source: Total market = SPINS Natural Grocery Channel + SPINS Conventional Multi Outlet Channel + SPINS Convenience Channel (powered by Circana, formerly IRI & NPD) | 52 Weeks Ending 12-3-2023

Figure 11: Plant-based versus animal-based price per weight comparison, 2023



Source: Plant-based meat prices per pound are based on frozen and refrigerated plant-based meat subcategories from SPINS year ending 12/3/23. Animal-based meat prices per pound are based on data for fresh meat subcategories from the Circana year ending Dec 2023. Plant-based milk prices per gallon and plant-based egg prices per dozen are based on the custom plant-based categories created by GFI & PBFA from SPINS data year ending 12/3/23. Animal-based milk and egg prices from US BLS statistics – December 2023 value.

U.S. consumer dynamics and research

Familiarity, awareness, and trial of plant-based foods have grown dramatically over the last decade. In recent years, however, the number of households purchasing has leveled off or declined for some plant-based categories.

There is still progress to be made on important characteristics like taste, price, nutrition, and convenience for plant-based meat, seafood, eggs, and dairy to compete with the larger conventional market. Strides forward on these characteristics will be paramount to reaching more consumers and driving loyalty in the long run.

Consumer demographics for overall plant-based foods

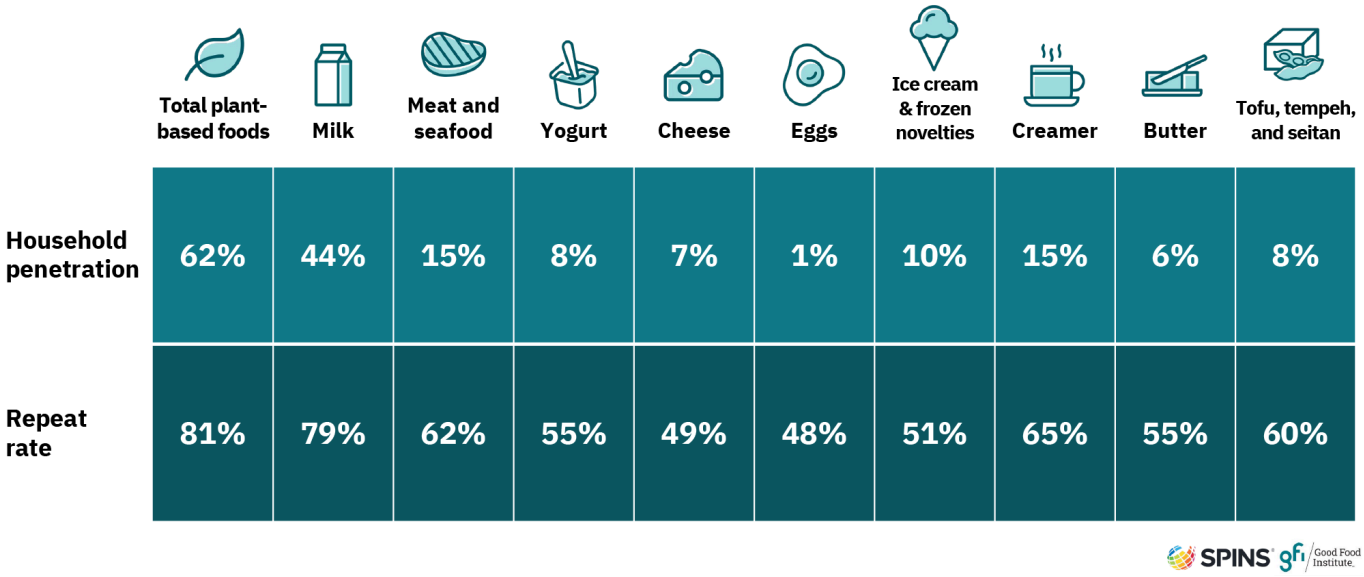
Plant-based food category purchases resonate with select consumer demographics. Relative to the average household, purchasers of plant-based foods tend to be younger, be from higher-income households, and have graduate degrees. Asian American consumers are also more likely to buy plant-based foods.

In addition to sales data, other key metrics including household penetration and repeat purchase rate demonstrate growth opportunities for plant-based categories.

- **Six in 10 households purchased plant-based foods in 2023.** The majority of U.S. households purchased plant-based products, similar to 2022.
- **Plant-based milk had the largest share of households purchasing among plant-based categories.** Nearly half of U.S. households purchased plant-based milk at least one time in 2023. Additionally, nearly 80 percent of those households were repeat purchasers.
- **Plant-based meat and seafood were purchased by 15 percent of households.** Among those households, 62 percent purchased multiple times in the category.
- **Plant-based creamers reached as many households as plant-based meat and seafood did.** In the United States, 15 percent of households purchased plant-based creamers in 2023, up from 11 percent in 2020.
- **Many plant-based categories saw household penetration rates fall somewhat or slightly in 2023.** All plant-based categories tracked in the dataset saw household penetration rates decline or stay flat versus 2022 levels. Notably, plant-based meat and seafood fell from 19 percent in 2022 to 15 percent in 2023, indicating a need to reengage consumers.
- **Most repeat buying rates held steady in 2023.** Across the majority of plant-based categories, repeat rates held relatively steady year over year.
- **Households that purchased in one plant-based category were much more likely to be purchasers of other plant-based categories.** For example, 25 percent of households purchasing plant-based milk also purchased plant-based meat and seafood, compared to 15 percent of total households. And 67 percent of households purchasing plant-based meat and seafood also purchased plant-based milk, compared to 44 percent of total households.
- **Households that purchased both plant-based and conventional meat are high-value consumers.** Households buying both plant-based and conventional meat spent 20 percent more by dollars (and 17 percent more by units) on total food purchases than the average household and 21 percent more by dollars (and 18 percent more by units) than households only buying conventional meat in 2023. Price points and household sizes likely play a role in this increased spending. Nonetheless, consumers purchasing plant-based meat and seafood are valuable shoppers.

Source: Unless otherwise cited, all U.S. retail sales and U.S. consumer dynamics data reported above were derived from GFI's analysis of SPINS data.

Figure 12: Purchase dynamics of plant-based foods 2023



Household data note: SPINS uses a separate process from the sales data to pull household panel data which may result in minor category differences.
Source: National Consumer Panel (powered by Circana), All Outlets, 52 weeks ending 12-3-23

Global retail sales overview

The plant-based categories discussed previously in this chapter are not just established in the United States but all over the globe. Global retail sales data estimates from Euromonitor International provide a look at how major plant-based segments fare around the world. Euromonitor's estimate for the total global retail sales of plant-based meat, seafood, milk, yogurt, ice cream, and cheese was $29 billion in 2023 (Euromonitor does not report on plant-based eggs).

Plant-based meat

Global retail dollar sales of plant-based meat and seafood were estimated to reach $6.4 billion in 2023. The majority of those sales are concentrated in Europe and North America.

Plant-based meat sales remain small compared to conventional meat sales. For context, Euromonitor estimates total conventional meat retail and foodservice volume sales in tons to have reached 410 million in 2023 compared to plant-based meat achieving just 656,000 tons globally.

Plant-based milk

Global retail dollar sales of plant-based milk were estimated to reach $18.7 billion in 2023. APAC led the way with more than double the estimated sales of the next closest region, North America.

Plant-based yogurt

Led by Europe, global retail dollar sales estimates of plant-based yogurt hit $1.6 billion in 2023.

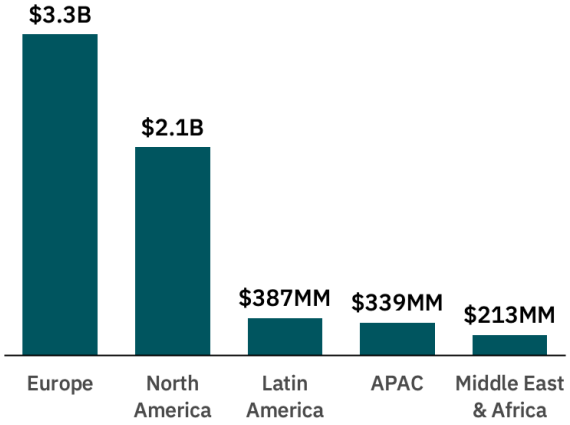
Plant-based ice cream

Global retail dollar sales estimates of plant-based ice cream were $1.4 billion in 2023. Estimated sales were concentrated primarily in North America and Europe.

Plant-based cheese

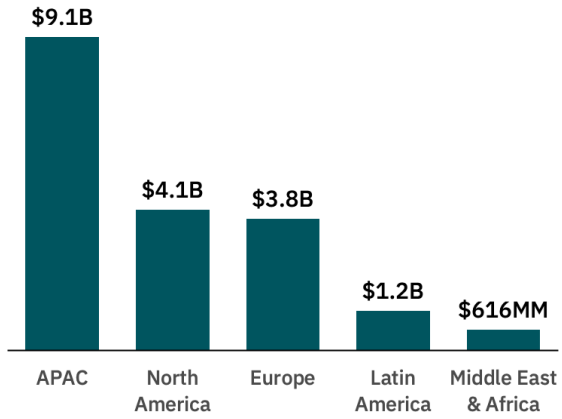
Estimated global retail dollar sales of plant-based cheese reached $896 million in 2023, led by North America and Europe.

Figure 13: Global 2023 plant-based meat and seafood retail dollar sales estimates



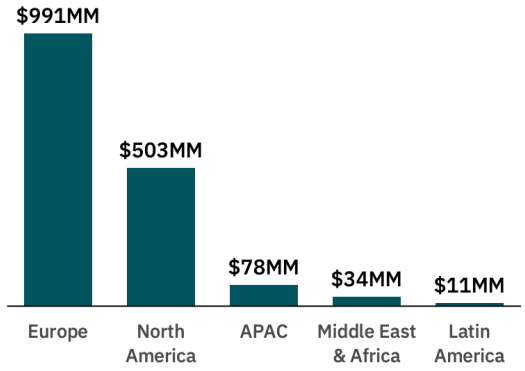
Source: Euromonitor International Limited, Staple Foods 2023, Meat & seafood substitutes, retail value RSP incl. sales tax, US$.

Figure 14: Global 2023 plant-based milk retail dollar sales estimates



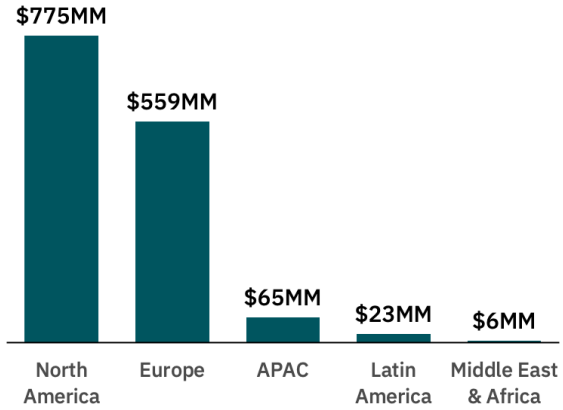
Source: Euromonitor International Limited, Dairy Products and Alternatives 2023, Plant-based milk, retail value RSP incl. sales tax, US$.

Figure 15: Global 2023 plant-based yogurt retail dollar sales estimates



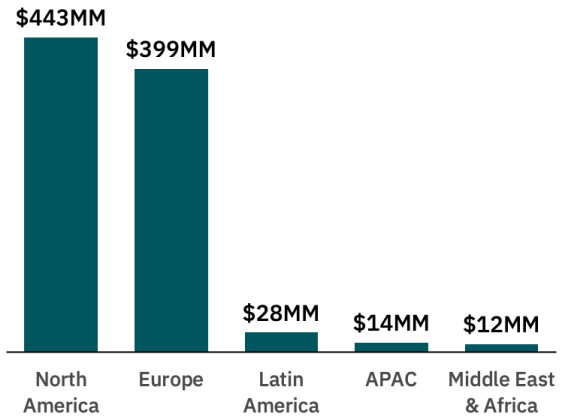
Source: Euromonitor International Limited, Dairy Products and Alternatives 2023, Plant-based yogurt, retail value RSP incl. sales tax, US$.

Figure 16: Global 2023 plant-based ice cream retail dollar sales estimates



Source: Euromonitor International Limited, Snacks 2023, Plant-based ice cream, retail value RSP incl. sales tax, US$.

Figure 17: Global 2023 plant-based cheese retail dollar sales estimates



Source: Euromonitor International Limited, Dairy Products and Alternatives 2023, Plant-based cheese, retail value RSP incl. sales tax, US$.

Box 2: Global retail market data collection

Euromonitor is one of a few providers of standardized retail sales data across global regions. The company assembles data through a combination of desk research, store checks, trade surveys, and company analysis.

Desk research relies on data and insights from a variety of sources:

- Euromonitor
- Governmental and official sources
- National and international trade press
- National and international trade associations
- Industry study groups and other semi-official sources
- Company financials and annual reports
- Broker reports
- Online databases
- Financial, business, and mainstream press

In-store checks and web scraping of e-commerce retailer sites are used to gather data on these key factors:

- **Place:** products tracked in all relevant channels—selective and mass, store and non-store.
- **Product:** innovations in products, product attributes, pack sizes, and formats.
- **Price:** brand price variations across channels and comparison with private-label pricing.
- **Promotion:** marketing and merchandising trends, offers, discounts, and tie-ins.

Trade surveys supply additional or missing data:

- Fill gaps in available published data per company.
- Generate a consensus view of the size, structure, and strategic direction of a category.
- Access year-in-progress data where published sources are out of date.
- Evaluate expert views on current trends and market developments.

Company analysis:

At a global level, Euromonitor's research combines a mix of industry interaction and use of secondary sources such as annual accounts, broker reports, financial press, and databases. From a data perspective, the aim is to build "top-down" estimates of major players' total global and regional sales. At a country level, in line with local reporting requirements, Euromonitor accesses annual accounts, nation-specific company databases, and local company websites. These are all invaluable sources in building a view of each domestic player's size and position within very specific categories of the industry.

Combined, these methods enable Euromonitor to assemble a rigorous dataset that provides a global perspective on sales for various plant-based categories.

Data validation:

All data is subjected to an exhaustive review process, at country, regional, and global levels.

The interpretation and review of sources and data inputs form a central part of the collaboration between industry teams and country researchers. Numbers are delivered to regional and global offices with an audit trail of sources and calculations to allow for a thorough evaluation of data sense and integrity. Upon completion of the country review phase, data is reviewed on a comparative basis at regional and then global levels. Comparative checks are carried out on per capita consumption and spending levels, growth rates, patterns of category and subcategory breakdowns, and distribution of sales by channel. Top-down estimates are reviewed against bottom-up regional and global market and company sales totals. Where marked differences are seen between proximate country markets or ones at similar developmental levels, supplementary research is conducted in the relevant countries to confirm and/or amend those findings. This process ensures international comparability across the database, that consistent category and subcategory definitions have been used, and that all data has been correctly tested. Euromonitor makes sure that possible discrepancies between different published sources have been reconciled and that their interpretation of opinion and expectation from each country's trade sources has been applied to form a coherent international pattern.

Note: Data is based on Euromonitor's "meat and seafood substitutes" category, which includes chilled, frozen, and shelf-stable products. Note that data may differ from previous reports. In previous reports, this Euromonitor category also included tofu (now a standalone subcategory), and previous reports refined graphs to display only estimated plant-based meat sales.

U.S. foodservice sales overview

A little over a decade ago, food expenditures coming from away-from-home purchases surpassed food-at-home purchases in the United States. This trend continued as consumers shifted their food spend to foodservice environments, until 2020 when the COVID-19 pandemic hit and individuals turned primarily to retail environments for food purchases. Fast forward to 2022 and away-from-home food purchases recovered to pre-pandemic levels of 2019 but the landscape had, nonetheless, changed dramatically.

Circana's data on total food operator purchases from broadline distributors showed that in 2023, both dollar and pound sales increased 4 percent from 2022, a third consecutive year of growth since declines in 2020.

When compared to pre-pandemic levels of 2019, dollar sales have grown 28 percent while pound sales are just one percent above previous highs. This gap between dollar and pound sales growth represents the impact of price increases in the sector over the last four years.

According to the U.S. Bureau of Labor Statistics, in December 2022, food-away-from-home prices were eight percent higher than the same month in 2021. In December of 2023, prices were five percent higher than 2022 levels.

Price increases across food sectors have affected consumer behavior in the foodservice channel. In the first month of 2023, 73 percent of U.S. adults reported noticing that dining at restaurants cost more than it had in the past, according to Morning Consult.

Foodservice sales, overall, have worked their way back from 2020 losses but face new challenges. **The trend of consumers increasingly turning toward out-of-home eating occasions over the long term appears strong, making this channel one to prioritize.**

U.S. plant-based protein foodservice sales

In 2023, the plant-based proteins category in foodservice saw modest dollar and pound sales declines, from broadline distributors to operators.

These declines follow two years of strong growth after the major decline in 2020. Conventional meat on the other hand saw dollar sales fall three percent while pound sales increased by four percent, a sign of price decreases in the latest year. Conversely, dollar sales outpacing pound sales is a sign of increased prices.

Despite conventional meat prices falling in 2023 versus 2022, over the last five years (2019–2023), average prices per pound for conventional meat have risen 18 percent while prices for plant-based proteins are up just 10 percent.

- In sales by weight, the top product types within the plant-based proteins category are tofu (31 percent), beef (29 percent), grain/nut/veggie items (17 percent), chicken (11 percent), and pork (nine percent).
- Since 2019, analogs—products meant to replicate the taste, texture, and experience of conventional meat—have outpaced more vegetable-forward plant-based proteins. In 2023, analogs made up 50 percent of the total category pound sales, up from 39 percent in 2019.
- Three emerging analog product types include pork patties, chicken nuggets, and chicken tenders. All three grew both dollar and pound sales in the double digits in 2023 and now make up 10 percent of category pound sales, up from six percent in 2019.
- Despite conventional meat dollar sales rising 21 percent from 2019 to 2023, pound sales grew just three percent from 2019 highs, representing price increases of 18 percent. Price growth has impacted on categories across the foodservice channel over the last five years, particularly conventional meat. This has resulted in dollar sales often well surpassing previous highs of 2019 while pound sales remain relatively flat.

U.S. plant-based milk and cheese foodservice sales

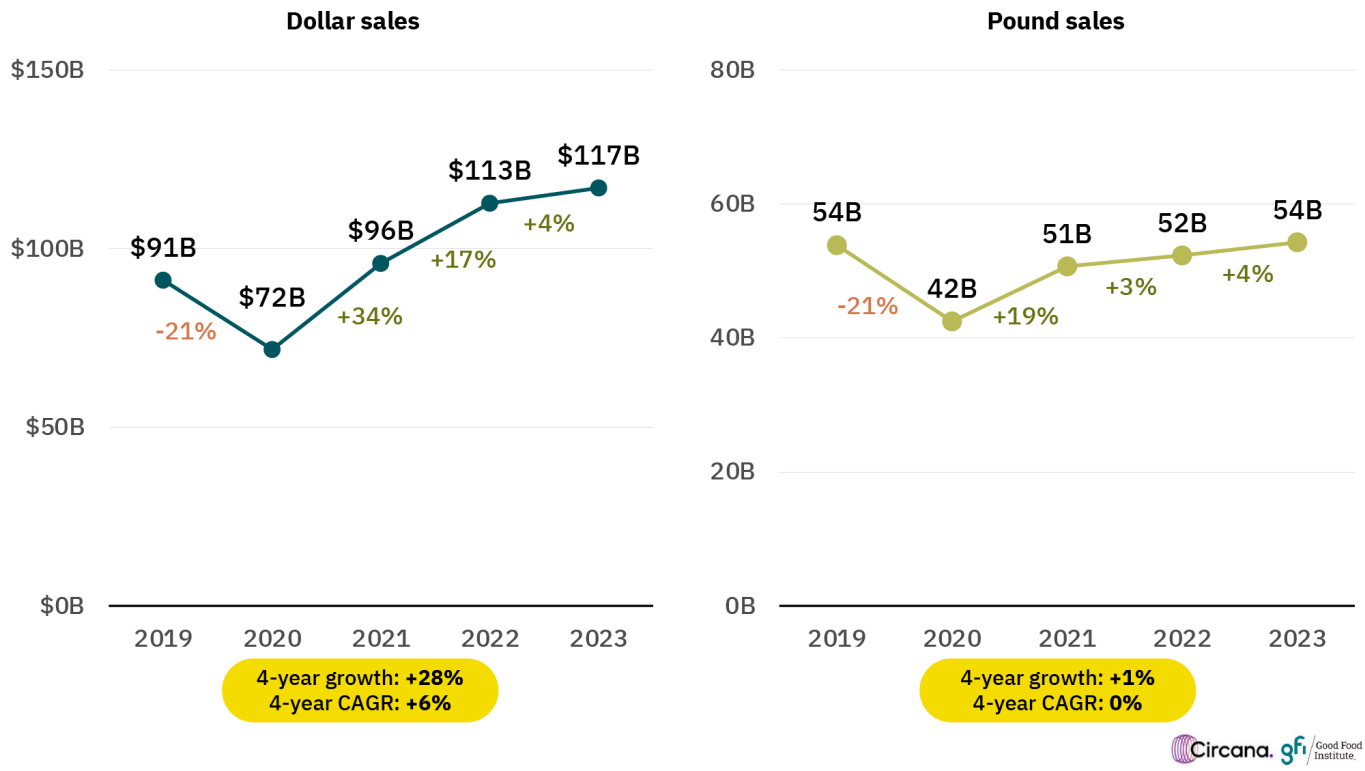
In 2023, GFI commissioned data on plant-based milk and plant-based cheese in the foodservice channel.

Plant-based milk has seen impressive growth in foodservice since 2019 with dollar sales up 81 percent and pound sales up 55 percent. Meanwhile, conventional milk dollar sales grew 34 percent and pound sales grew eight percent over the same timeframe. Notably, plant-based milk made up a 12 percent share of the total milk market in broadline distributor sales in 2023.

Plant-based cheese experienced similar trends to plant-based proteins in 2023 with dollars down three percent and pounds down six percent. Since 2019, dollar sales have grown 26 percent while pound sales have declined nine percent, a sign of significant price increases. Meanwhile, conventional cheese saw dollars grow 18 percent and pounds three percent since 2019.

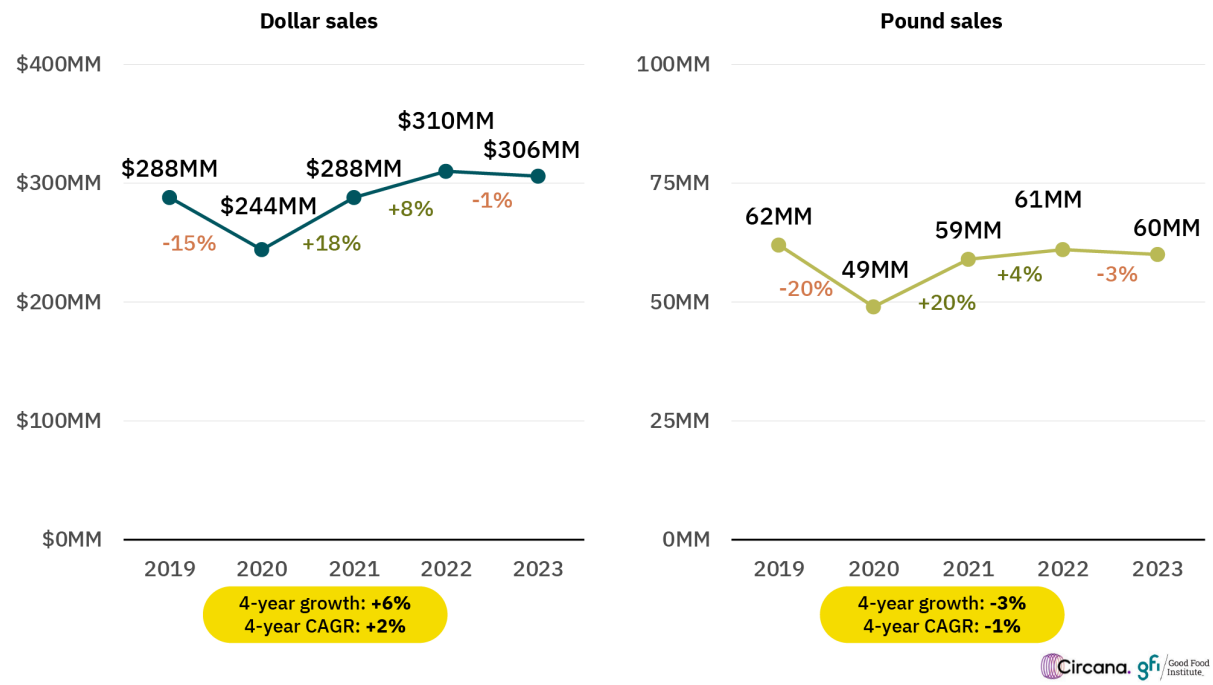
Data reveals that U.S. consumers are shifting more of their food expenditures to foodservice environments. This, in turn, makes the channel a high priority for companies to engage with early and often. Additionally, the industry offers the opportunity to deliver curated experiences around a product or brand that can play an important role in bringing consumers in and driving loyalty.

Figure 18: Total food market, U.S. broadline distributor foodservice sales, 2019–2023



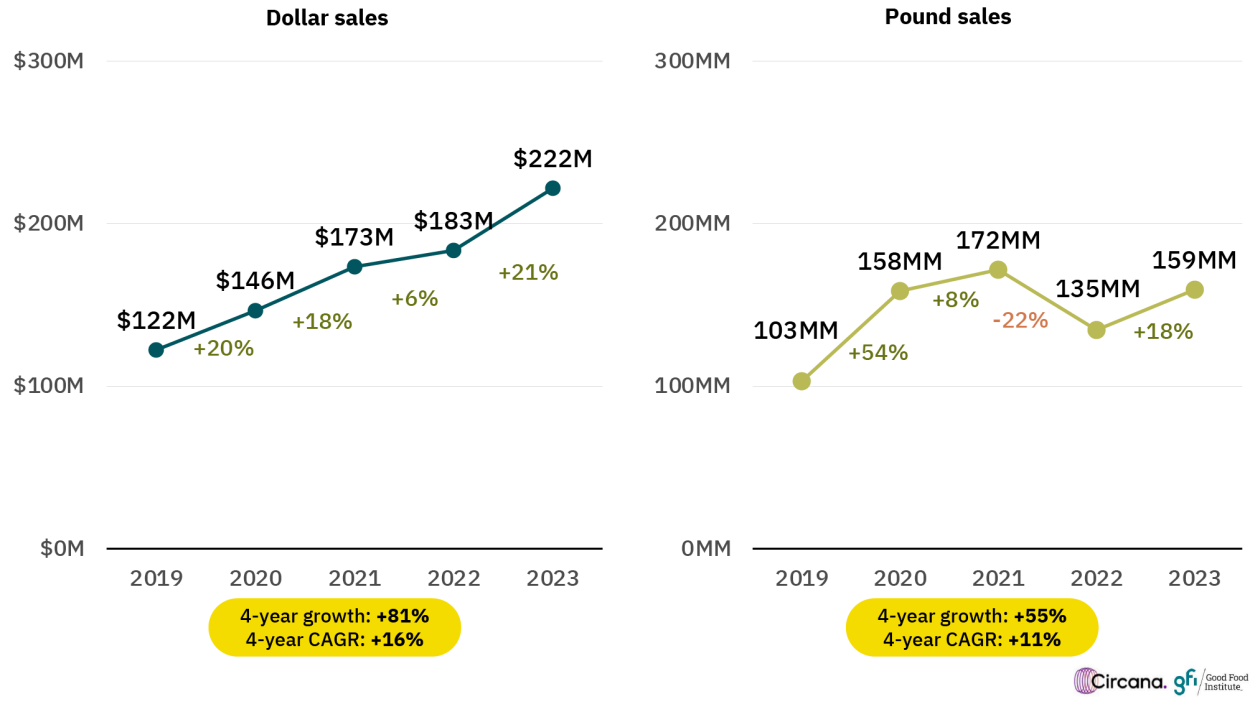
Source: Circana/SupplyTrack, Product Class: Total food. Dollar and pound sales are 12 months ending December 2023 vs 4 prior years

Figure 19: Plant-based proteins market, U.S. broadline distributor foodservice sales, 2019–2023



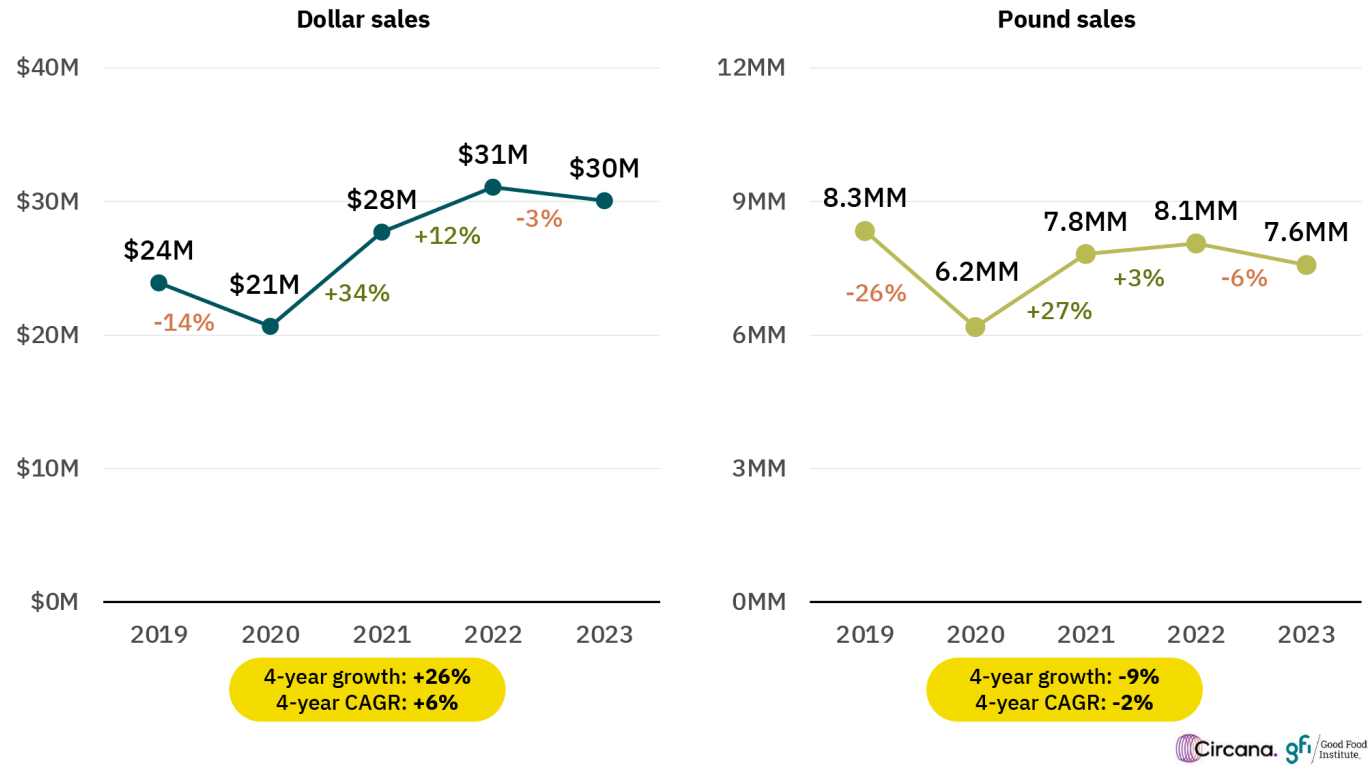
Source: Circana/SupplyTrack, Product Class: Plant-based proteins (analogous meat alternatives, grain/nut/veggie alternatives, tofu/tempeh). Dollar and pound sales are 12 months ending December 2023 vs 4 prior years.

Figure 20: Plant-based milk market, U.S. broadline distributor foodservice sales, 2019–2023



Source: Circana/SupplyTrack, Product Class: Milk alternatives. Dollar and pound sales are 12 months ending December 2023 vs 4 prior years.

Figure 21: Plant-based cheese, U.S. broadline distributor foodservice sales, 2019–2023



Source: Circana/SupplyTrack, Product Class: Cheese alternatives.
Dollar and pound sales are 12 months ending December 2023 vs 4 prior years.

Box 3: U.S. foodservice data collection

Distributor to operator sales data

GFI, in partnership with PBFA, commissioned foodservice sales data from Circana, formerly IRI & NPD, focusing on various plant-based and conventional categories. Circana collects point-of-sale data from selected broadline distributors for their SupplyTrack Tracking Service. This data reflects itemized sales from broadline distributors shipped to foodservice operators. The SupplyTrack service currently tracks 17 participating broadline distributors, data from 280+ categories, and collects 700,000+ operator purchases monthly. SupplyTrack covers ~41 percent of the total foodservice landscape (86 percent of all broadline distribution). Broadline distributor sales generally skew toward small-/medium-sized chains and noncommercial operators and away from large chains, however the data reaches both commercial and noncommercial operators across sizes and the following segment types:

- **Commercial:** QSR, FSR, Convenience Stores, Food Stores, and Other Retail.
- **Noncommercial:** Education, Government, Health Care, Business & Industry, Lodging/Casino, Recreation, and other noncommercial environments.

The SupplyTrack data obtained from Circana covers sales across the U.S. market for the five years 2019, 2020, 2021, 2022, and 2023, all 12 months ending in December.

Read GFI's latest deep dive on foodservice sales and consumer insights in the United States.

Investments

Investments

Overview

Companies primarily involved in plant-based meat, seafood, eggs, or dairy have raised $8.5 billion since 2006, with over half of investments coming in the last three years alone.

While 2023 fundraising totals marked a decline from 2022 levels for plant-based food companies, other primarily venture-backed sectors like fintech also experienced funding declines of around 50 percent year-over-year (YOY), reflecting the challenges of fundraising in a subdued private capital environment.

Various industries contended with a tepid private funding landscape in 2023, driven by rising interest rates, elevated inflation, and a mixed economic outlook.

As a result, global venture funding across all sectors fell 42 percent YOY in 2023 to its lowest levels since 2017. Climate tech equity investments decreased by as much as 40 percent YOY, despite the sector receiving significant government support through the Inflation Reduction Act and other policies that helped to de-risk and fuel investment. Investments in food tech startups declined by 61 percent YOY.

Plant-based companies raised $907.7 million in 2023, representing a 28 percent decrease from the $1.3 billion raised in 2022—a lower rate of decline than overall global venture funding.

Not all regions saw decreases in plant-based investments. Plant-based funding in Europe rose for the second consecutive year to $584 million in 2023, a 74 percent increase from 2022, marking the highest annual total for the region to date. For the first time, European investments comprised more than half of all invested capital in the plant-based industry for the year.

The wider alternative protein industry (inclusive of plant-based, cultivated, and fermentation-enabled proteins) also saw private funding fall in 2023. While alternative protein companies raised $15.7 billion from 2014 to 2023—over half of which was raised in 2020 and 2021—investments dipped from $2.9 billion in 2022 to $1.6 billion in 2023. That said, these totals (and those for plant-based companies) are likely underestimated. Some companies raised funds that were not publicly reported under simple agreements for future equity (SAFE) or bridge rounds to increase financial runway. While certain deals, in general, are not publicly disclosed, we suspect an increased frequency of under-reporting this year based on the larger number of SAFE and bridge rounds and our conversations with market participants. Some of these investments may eventually be reported as investments in 2024.

Even in the face of fundraising challenges, the plant-based industry continued to advance in 2023, with companies around the world hitting key product development, distribution, and scaling milestones. All the while, companies continued to innovate their processes and products.

The challenging private funding environment for plant-based and alternative protein companies may continue in the year ahead, especially as interest rates in the United States, Europe, and elsewhere are likely to remain elevated in 2024. At the same time, alternative proteins and plant-based meat continue to be critical tools in shifting toward more efficient and sustainable methods of meat production. This also makes plant-based meat, seafood, egg, and dairy production an important ESG opportunity, providing potential upside for investors and the industry.

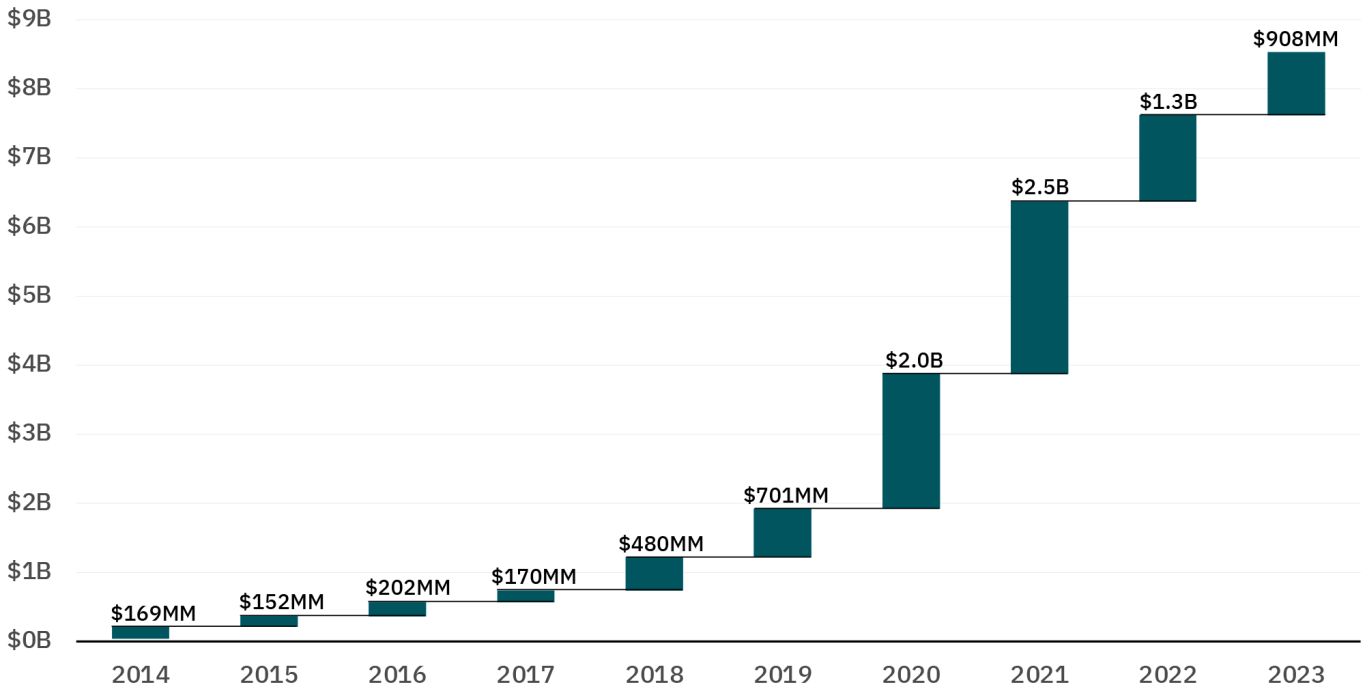
With this backdrop, we expect alternative protein and plant-based investments to evolve in the coming years. A major transition took place in 2023 as the overall venture funding environment moderated after years of heightened activity, and the industry is likely to settle on an adjusted, more realistic path in 2024. In light of the tighter private funding environment that is expected to persist into 2024, we expect the alternative protein companies best positioned to attract equity investment will be those that can demonstrate clear pathways to revenue and profitability.

At the same time, long-term debt, grants, and government incentives are essential for companies to lower their production costs and achieve price parity as they scale production. To enable alternative protein companies to access such funding, they will need creative solutions in areas such as product off-take and leveraging government and philanthropic funding.

Fortunately, there are replicable solutions already being implemented (e.g., school districts procuring alternative proteins for lunch menus) as well as those that have been successfully used in other industries (e.g., government loan guarantees and blended philanthropic financing for renewable energy). Through multi-stakeholder collaboration, these solutions can facilitate the flow of capital into alternative proteins.

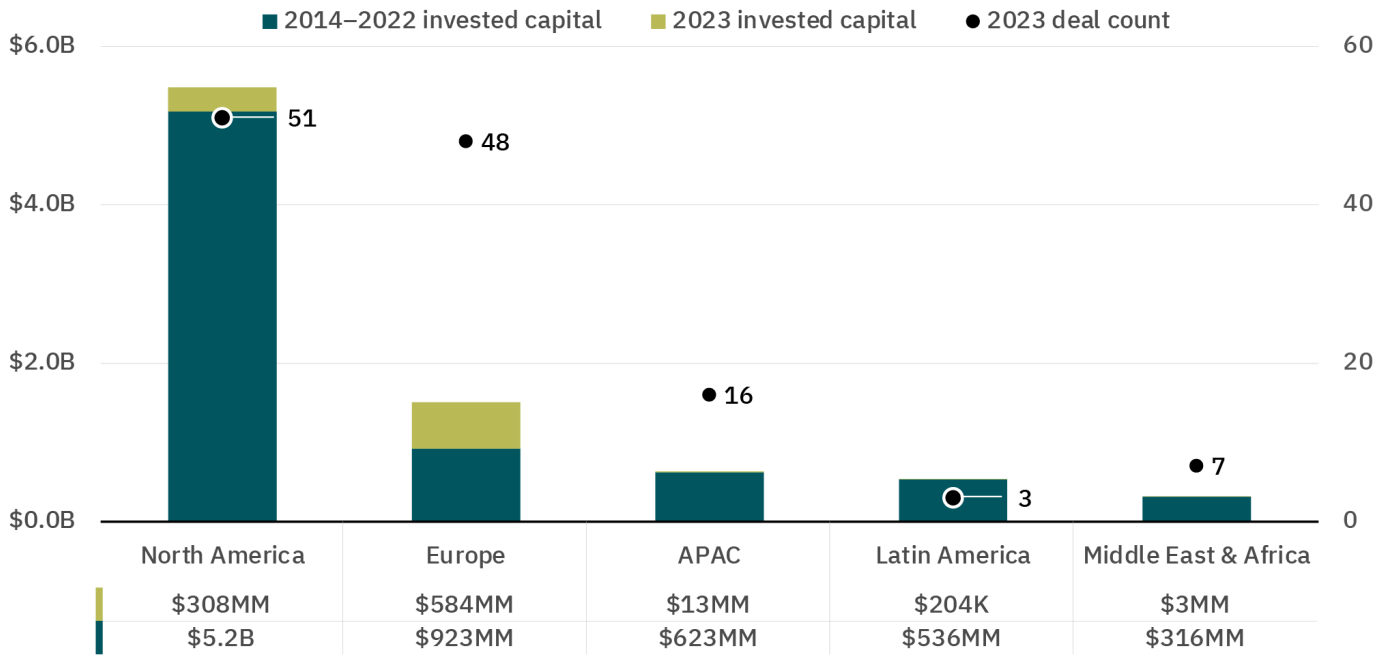
Regardless of external market forces, if governments and companies are serious about improving food security, reducing emissions, and achieving their climate goals, more alternative protein funding is needed to help companies scale, improve their products, and reduce their costs.

Figure 22: Cumulative and annual investment in plant-based companies (2014-2023)



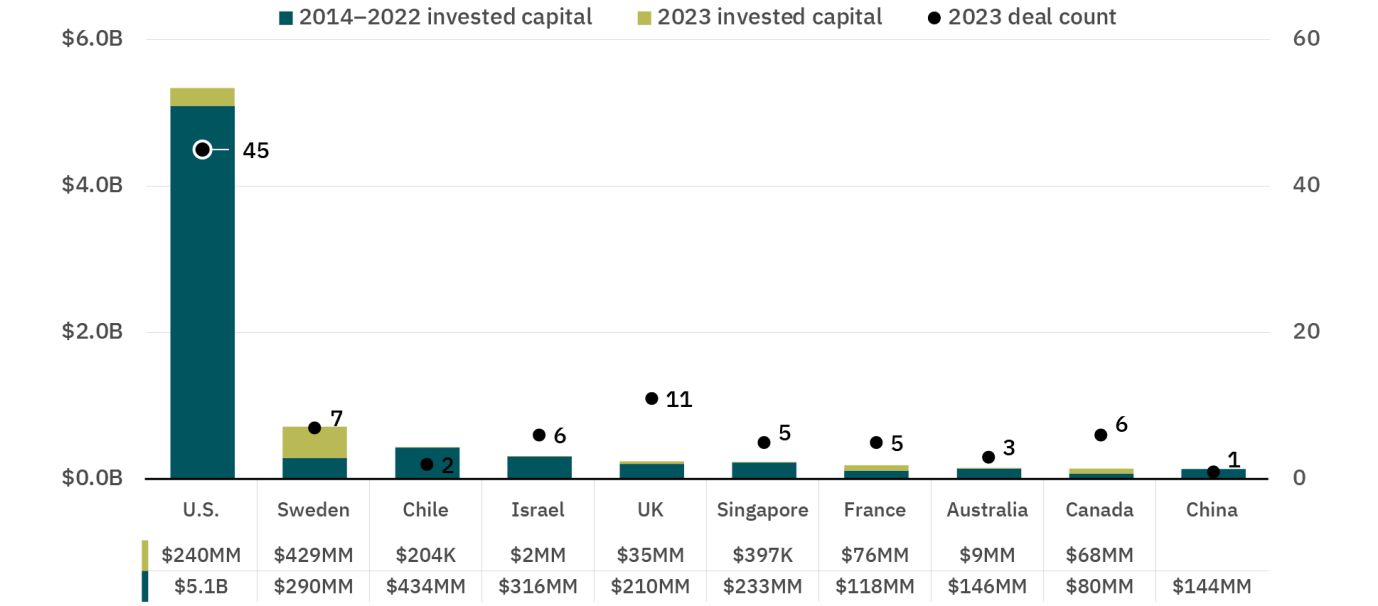
Source: GFI analysis of data from Net Zero Insights.
Note: Data has not been reviewed by Net Zero Insights analysts. The total deal count includes deals with undisclosed amounts.

Figure 23: Investments in plant-based companies by region (2014–2023)



Source: GFI analysis of data from Net Zero Insights.
Note: Data has not been reviewed by Net Zero Insights analysts. The total deal count includes deals with undisclosed amounts.

Figure 24: Investments in plant-based meat and seafood: Top 10 countries (2014–2023)



Source: GFI analysis of data from Net Zero Insights.
Note: Data has not been reviewed by Net Zero Insights analysts. The total deal count includes deals with undisclosed amounts.

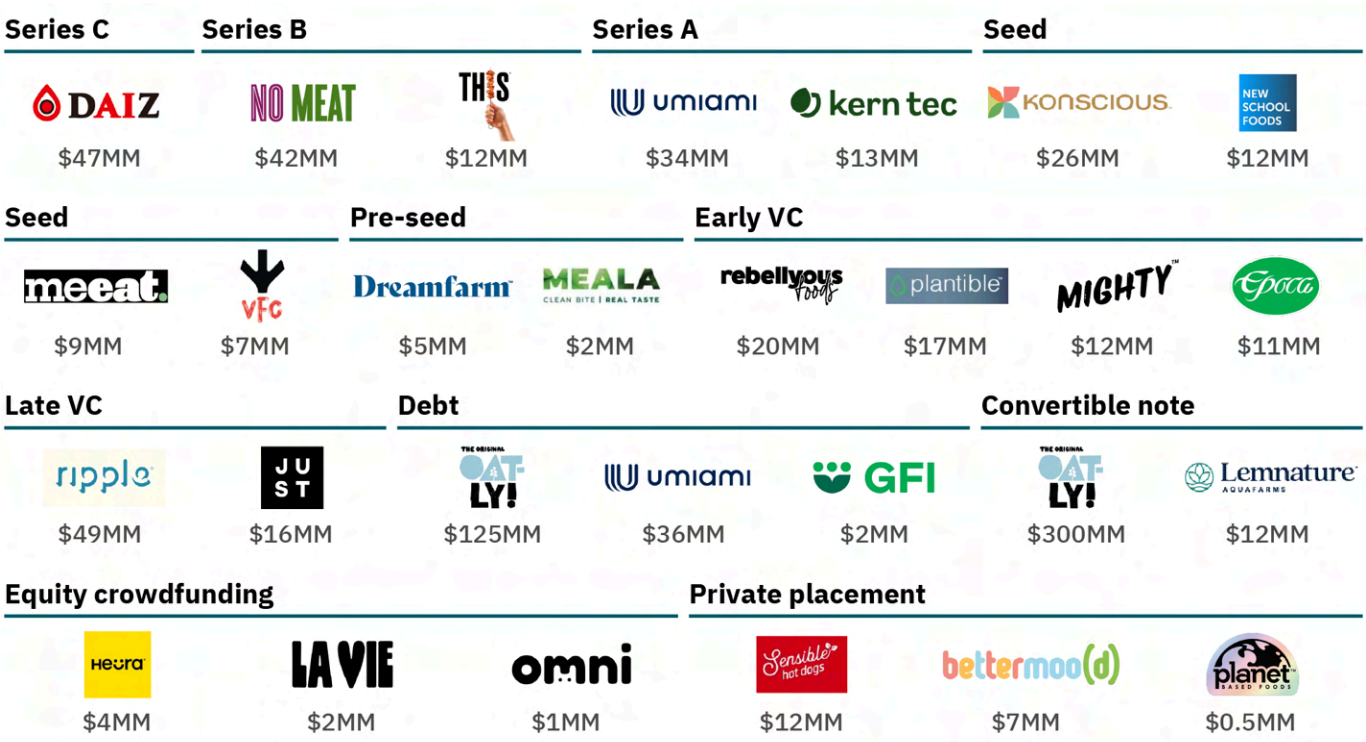
Table 7: Deal type summary statistics

Deal type	Median (2023)	Median (2022)	Median (all years)	Maximum (all years)	Deal count (all years)
Accelerator/incubator	$0.02MM	$0.17MM	$0.09MM	$0.67MM	278
Angel			$0.71MM	$0.71MM	1
Bridge		$20.00MM	$20.00MM	$20.00MM	4
Convertible note	$1.07MM	$1.84MM	$2.45MM	$300.00MM	24
Corporate			$5.60MM	$5.60MM	1
Debt	$35.93MM	$0.60MM	$0.56MM	$125.00MM	46
Debt crowdfunding		$5.86MM	$5.86MM	$5.86MM	1
Early VC	$1.82MM	$1.52MM	$2.84MM	$43.00MM	300
Equity crowdfunding	$0.56MM	$0.40MM	$0.53MM	$7.98MM	41
Growth equity		$5.35MM	$10.00MM	$200.00MM	10
Late VC	$32.50MM	$19.31MM	$16.00MM	$231.00MM	19
Pre-seed	$0.85MM	$0.56MM	$0.58MM	$5.41MM	52
Private placement	$7.39MM	$3.36MM	$7.39MM	$40.23MM	10
Product crowdfunding		$0.08MM	$0.02MM	$0.60MM	17
Seed	$1.59MM	$3.54MM	$1.59MM	$335.00MM	261
Series A	$8.16MM	$10.12MM	$7.90MM	$100.00MM	82
Series B	$27.07MM	$40.00MM	$23.00MM	$135.00MM	32
Series C	$47.49MM	$16.56MM	$47.49MM	$90.00MM	14
Series D		$70.00MM	$72.50MM	$235.50MM	9
Series E			$60.00MM	$300.00MM	3
Series F			$265.05MM	$500.00MM	2
Series G			$127.98MM	$200.00MM	2
Series H			$275.14MM	$500.00MM	2

Source: GFI analysis of data from Net Zero Insights.

Note: Data has not been reviewed by Net Zero Insights analysts. These figures represent summary statistics of invested capital rounds with disclosed deal amounts. Deal count includes rounds with undisclosed amounts. Due to their limited number and size, this table excludes general crowdfunding, equity, and private equity rounds. It also excludes uncategorized rounds. The total deal count includes deals with undisclosed amounts.

Figure 25: 2023 key funding rounds



Source: GFI analysis of data from Net Zero Insights.
Note: Data has not been reviewed by Net Zero Insights analysts. "2023 key funding rounds" includes investments in the 75th percentile or higher by dollar amount for each funding round category that includes more than three deals. For funding round categories that include three deals or fewer, all deals are included.

For a list of investors who have expressed interest in funding plant-based food, companies can request access to GFI's investor directory.

Methodology

GFI conducted a global analysis of plant-based meat, seafood, egg, and dairy investments using data from Net Zero Insights. Our analysis uses a list we custom-built in Net Zero Insights' platform of companies that focus primarily on plant-based products or on providing services to those who produce them.

Types of companies included and excluded

- Our analysis excludes companies involved in plant-based products that are not their core businesses as well as companies using plant-based ingredients other than to create or enable alternative meat, seafood, egg, and dairy products. Some companies included in our list may also offer products or services that apply to another protein category.
- For example, the $200 million that **Eat Just** raised in March 2021 for use across their product lines and the $267 million raised for their **GOOD Meat** division in the funding round completed in September 2021 are categorized under cultivated meat. All other Eat Just funds raised are categorized under plant-based.
- **Cocuus**, who produces both cultivated and plant-based meat, was included in the plant-based meat dataset. Companies focused primarily on plant molecular farming are excluded (they are included under fermentation).

The Net Zero Insights platform contained 1,009 plant-based companies, 504 of which have disclosed deals. Of these, 363 have deals with publicly disclosed amounts. Net Zero Insights primarily tracks deals from publicly disclosed sources unless companies claim their profiles on the platform and provide their own investment information. Because our aggregate calculations include only companies with deals and deal sizes available to Net Zero Insights, they are conservative estimates.

Types of funding included

For this report, invested capital/investment comprises accelerator and incubator funding, angel funding, bridge funding, convertible debt, corporate venture, equity and product crowdfunding, general debt completed deals, debt crowdfunding, seed funding, early-stage venture capital, late-stage venture capital, private equity growth/expansion, capitalization, joint venture, and private placements. Liquidity events comprise completed mergers, acquisitions, reverse mergers, buyouts, leveraged buyouts, spinoffs, and IPOs, while other financing comprises completed subsequent public share offerings and private investment in public equity. We do not include capital raised through a SPAC IPO until the entity has merged with or acquired a target company.

Data provider

Please note that the figures published in this report may differ from prior figures published by GFI as we are now using Net Zero Insights as our investment data provider and are continually working to improve our dataset. To verify your company's data on the Net Zero Insights platform, claim your company's profile here and help us ensure we have access to the fullest, most up-to-date information.

Liquidity events

Liquidity events represent the sale of an equity owner's interest in a company typically through a merger, acquisition, buyout, or IPO. Liquidity events are common components of industry development, as mergers and acquisitions (M&A) allow companies with stronger financial footing to acquire firms with valuable technologies, manufacturing processes, and talent. That said, liquidity event activity is also highly dependent on the broader economic context.

Sixteen liquidity events, also known as exits, took place in 2023.

- The most notable event was **Morinaga Nutritional Foods**' acquisition of plant-based meat company **Tofurky** for an estimated $50 million. This acquisition enabled Tofurky's brand, **Moocho**, to strengthen their integrated supply chain and for Tofurky to enter their next stage of growth.
- Additionally, **Above Food**, a plant-based ingredient and end-products company announced plans to merge with **Bite Acquisition Corp.**, a publicly traded special purpose acquisition company (or SPAC). Above Food was valued at $319 million in the announced deal. Once complete, the combined entity will trade on the NYSE under the ticker symbol ABVE.

In a year when global M&A activity fell to its lowest level in over a decade, the relatively slow pace of notable plant-based liquidity events was representative of the larger funding and M&A environment. The same conditions that led to fundraising difficulties—like economic concerns and a tight financing environment—also contributed to limited M&A activity.

While we expect plant-based liquidity event activity to accelerate in the coming years, as seen in the trajectories of other transformative innovations like electric vehicles, the rate at which it does so will also hinge on conditions like interest rates, economic sentiment, and views of the sector.

Other financing

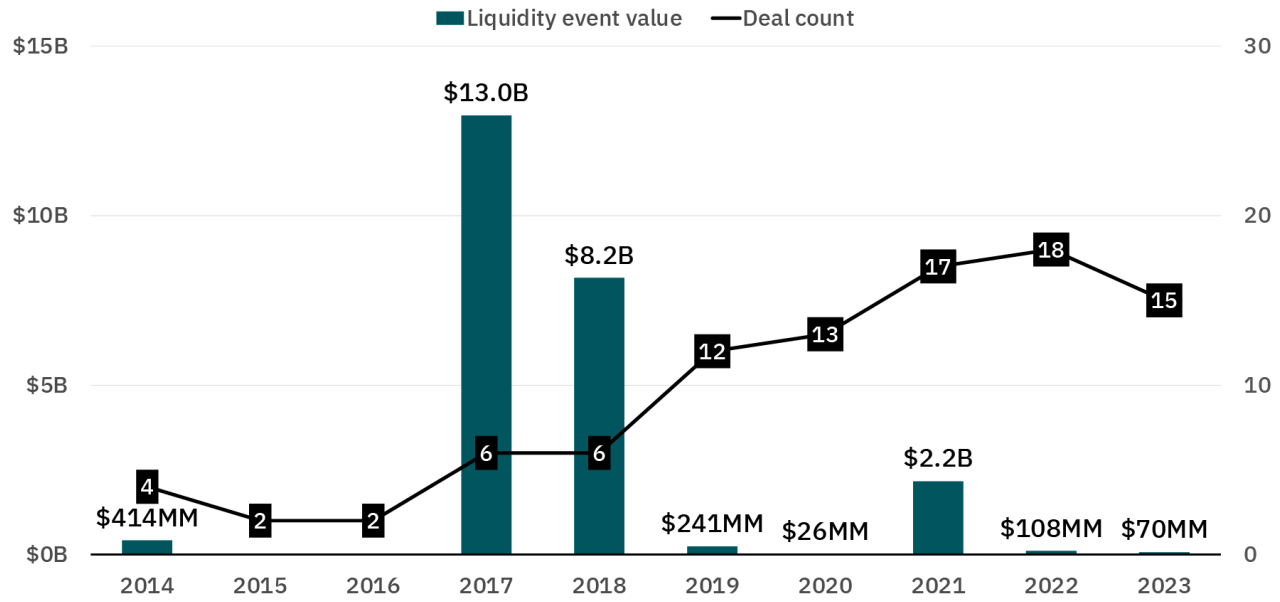
Some public companies pursue financing paths such as subsequent public share offerings and private investment in public equity (PIPE) deals.

Four such deals took place in 2023. The two most notable were by plant-based companies **Bettermoo(d)** and **Sensible Hot Dogs**, who raised $7.4 million and $12 million in post-IPO equity financing, respectively. As more plant-based companies begin trading publicly, we expect to see a higher number of other financing rounds.

Note: Unless otherwise cited, all of the information presented in this Investments section is from GFI's analysis of data from the Net Zero Insights platform. Please note that aggregated data has not been reviewed by Net Zero analysts.

Disclaimer: The Good Food Institute is not a licensed investment or financial advisor, and nothing in the State of the Industry Report series is intended or should be construed as investment advice.

Figure 26: Plant-based companies' global liquidity events (2014–2023)



Source: GFI analysis of data from Net Zero Insights.
Note: Data has not been reviewed by Net Zero Insights analysts.

Science and technology

Science and technology

Overview

Establishing taste and price parity for plant-based foods compared to their conventional animal-based counterparts remained top priorities for researchers and manufacturers in 2023.

Among the many ways the industry advanced toward those goals included: impressive gains in new farming techniques that optimize plant protein cultivation, innovative uses of agricultural by-products, and research to create processes and ingredients that more closely mimic the sensory attributes of conventional meat, seafood, egg, and dairy products.

Additional challenges that continue to affect the plant-based protein industry include manufacturing capacity and scale. Workforce development, supply chain bottlenecks, and limited production capacity have affected the industry's ability to scale. The industry relies heavily on science and technology to help solve these and other hurdles to bring plant-based proteins to the table. In 2023 companies focused on:

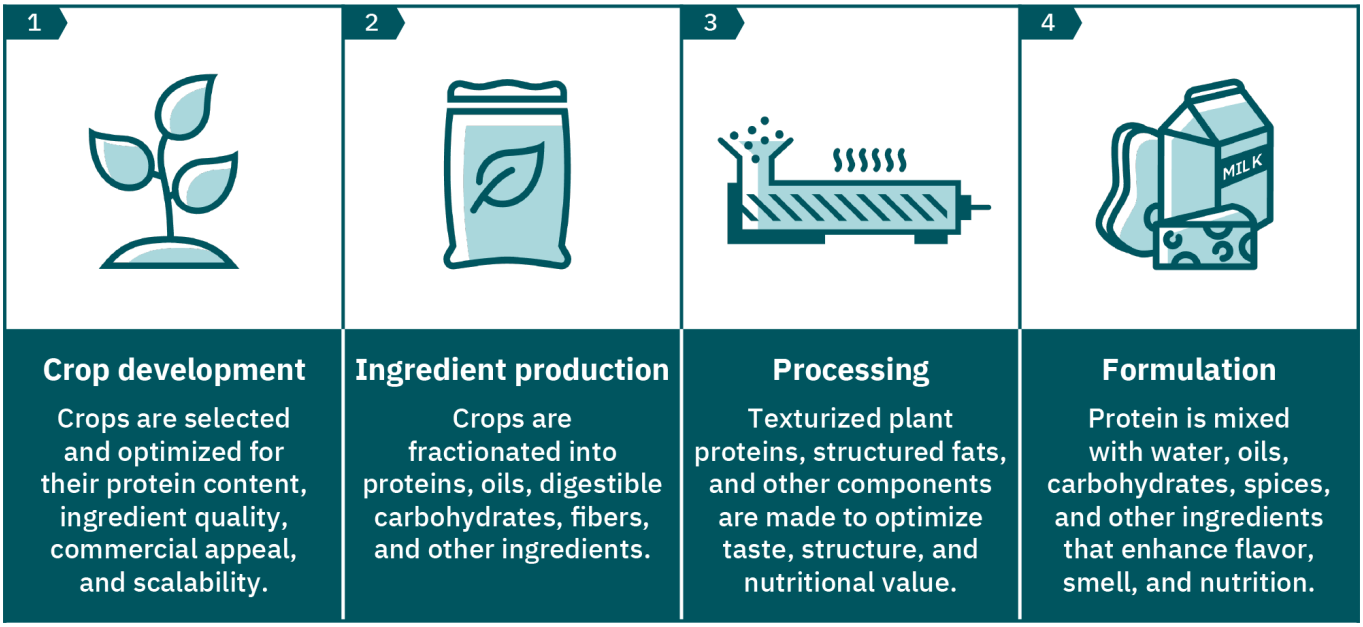
- Adapting diverse crop cultivation strategies to specific regional conditions and needs by exploring indoor, vertical, and aquatic farming techniques.
- Leveraging upcycled ingredients from commercially available sidestreams, such as protein-rich byproducts from potato, cabbage, or broccoli processing.
- Enhancing plant protein formulations with innovative fats and binders.
- Texturizing proteins at scale and with novel technologies, such as cold structuring and spinning.
- Establishing alternative protein innovation centers specifically aimed at providing training opportunities, reducing supply chain frictions, and pinpointing consumer preferences for plant-based foods.

Efforts across the value chain will help incrementally lower costs and improve the taste of plant-based products. However, for the sector to achieve the next level of competitiveness, more open-access collaborations between companies, governments, academics, and other stakeholders are critical. In 2024, GFI will explore the economic viability of plant-based meat by using anonymized industry data to build an open-access techno-economic analysis for the industry. We are currently recruiting partners to contribute and comment on this study.

For more detailed information about the technologies described below, refer to GFI's science of plant-based meat explainer, including deep dives into crop development, ingredient optimization, and end-product formulation and manufacturing.

Research across the technology value chain

Figure 27: Plant-based meat production



Crop development: Enhancing plant diversity, quality, and protein content for optimal downstream production

Crop development traditionally focuses on identifying and breeding crops with beneficial traits, namely high crop yield, pest resistance, and drought resistance. **Along with these more conventional efforts, discovering and breeding crops with high nutrient density and good ingredient qualities will bolster the development of plant-based foods, making them more nutritious and tasty while minimizing downstream processing costs.**

Identifying and leveraging favorable crop traits and associated genes

In 2023, scientists across academia, industry, and governments identified crop genes associated with favorable traits for high-quality protein ingredients.

Researchers at the UK's **John Innes Centre** described the underlying genetic sequence responsible for high-iron peas, while **University of Copenhagen** researchers discovered a gene mutation that prevents the production of bitter compounds in white lupins. Understanding crop traits, like micronutrient density and flavor compound concentrations, and the genes that contribute to them, will be crucial to continue impactful commercial breeding programs that improve protein quantity and quality. One such effort from The European Cooperation in Science and Technology (COST) is the DIVERSICROP Action, which aims to identify genotypes and regional environmental constraints that limit the production of underutilized crops including peas and chickpeas and develop strategies to increase their adoption by farmers.

Beyond identifying genes, a number of excellent breeding efforts were announced this year:

- The Legume Generation project in Europe, with a value of €8.6 million, promotes legume breeding efforts for Europe's protein supply. They are connecting leading European plant research institutions with plant breeders working with soybeans, lupins, peas, lentils, common beans, and clover.

- **Amfora** partnered with AI company **McClintock** to expedite the readiness of their high-yielding, high-protein soybean varieties, specifically bred for plant-based protein production.
- **Plantae Bioscience** created yellow peas with reduced levels of bitter saponin compounds using CRIPSR gene editing techniques.

*Soy breeding company **Benson Hill** also earned ProTerra's Sustainability Certification, a global standard that evaluates products for sustainable agriculture and labor practices, for their non-GMO soy portfolio.*

Cultivating novel crops at commercial scale

The Food and Land Use Coalition identified diversifying protein sources to include alternative proteins as one of "ten critical transitions that would enable food and land use system to provide food security and healthy diets for a global population of over nine billion by 2050, while also tackling our core climate, biodiversity, health, and poverty challenges." Within the sustainable protein category, there are even more opportunities to vary our plant protein sources. Expanding the portfolio of ingredients used in plant-based foods can expedite product heterogeneity and contribute to sustainable agricultural productivity, with on-farm crop diversification positively affecting biodiversity and ecosystem services and food system resilience. **However, the commercial success of these novel ingredients often depends on crop source supply chain availability and economics. As a result, it is vital to advance the cultivation of these novel sources.**

In 2023, crop cultivators optimized the growth of many novel plant protein sources. Researchers at the **University of York**, with funding from **Innovate UK**, began cultivating vertically farmed high-protein amaranth crops with an aim to grow plant protein and reduce UK imports of soy and pea. Vertical farming allows the crop to be grown and harvested year-round. Meanwhile, **Texas A&M AgriLife Research** and **AgriVentis Technologies** scientists are exploring the cultivation of mung beans in Texas. Mung bean, typically grown in South Asian countries, is a drought-resistant legume with great potential as a scalable source for alternative proteins (see GFI's full report on The Untapped Potential of Mung Beans).

Aquatic plant species are increasingly being explored for their utility in plant-based foods. They offer fast-growing protein sources that do not require arable land. However, their commercial cultivation must be adapted to lower ingredient costs. Duckweed (i.e., water lentils, Lemna) is a nutrient-dense, water-floating plant that can contain up to 40 percent of high-quality protein. Recognizing its value, **Sustainable Planet** is focused on utilizing desertified land to grow duckweed in a large-scale production process that allows the plant to be grown in saline water.

For more details about how this protein can be implemented as a binder, see the Subcomponent improvements section.

Seaweed is also a promising aquatic plant ingredient source with great functional properties. To expand seaweed cultivation, **North Sea Farmers** is testing the viability of growing seaweed in between turbines of offshore wind farms in the Netherlands. The project recently received €1.5 million from **Amazon**.

> *Aquatic plants might be key in unlocking one of the world's most sought-after proteins; RuBisCO. A protein that is nutritionally and functionally superior to both animal and plant proteins, is allergen free, and if produced properly, is neutral in taste & color. This protein will be a critical component in the food industry's transition to a sustainable agri-food ecosystem without animal harm and social disruption.*
>
> **Tony Martens**
> *Co-Founder, Plantible Foods*

Ingredient production: Refining and scaling plant protein fractionation

To generate ingredients, crops undergo fractionation, which is the process of splitting them into more enriched components. These components comprise mainly proteins, lipids, carbohydrates, fibers, and small molecules, such as nutrients, colors, or flavors.

Fractionation has historically focused on extracting oils and carbohydrates, but raw ingredient optimization focused on plant protein enrichment is essential to create flavourful and affordable plant-based meat, seafood, egg, and dairy products. The choices in protein fractionation techniques influence protein yield, fraction composition, physicochemical and structural properties, and ingredient functionality, all of which can affect the sensory characteristics, nutrition, and cost of the end product.

Generating protein ingredients from novel sources

In 2023, the plant-based food industry also explored a number of novel aquatic, leguminous, and upcycled protein sources to diversify the library of plant proteins and their resulting functionalities available to food formulators.

While some researchers are optimizing the cultivation of aquatic plants, as mentioned previously, others are also exploring applications of their fractionated components. **HN Novatech** discovered a heme ingredient that is extracted from seaweed and provides a meaty flavor. Four distinct flavors–beef, pork, chicken, and lamb–have been developed, demonstrating the tunability of the ingredient.

Beyond pea, other legume ingredients are also being explored as protein sources, resulting in novel products with unique properties. For example:

- **ChickP** designed chickpea protein isolate-based cheese prototypes to demonstrate the excellent gelation and emulsification capabilities of chickpea proteins.
- **InnovoPro** showcased their chickpea protein ingredient's ability to function as a dairy or egg replacement in plant-based baked goods and chocolate.
- **Haofood** formulated their plant-based pork mince and plant-based chicken products using peanut proteins.
- **Kraft Heinz** announced it is planning to leverage bean diversity to expand their plant-based products portfolio.

Leveraging byproducts for plant-based food production

Circular bioeconomies use renewable natural capital to produce food and other goods more efficiently, affordably, and sustainably and can help cut costs and environmental impacts of agricultural and food losses and wastes.

Alternative protein production offers fantastic opportunities for many commodity crop industries to achieve circular bioeconomies across their supply chains. In fact, soy protein is a popular base for plant-based foods because it is an affordable sidestream of the soybean oil industry. Still, while soy protein is arguably the most established plant protein supply chain, companies continue to seek strategies to optimize sidestream processing of soybean meal. For example, to circumvent the challenges in the transportation of materials from regions of production to processing facilities, **Bunge NA** broke ground on a soy protein concentrate production facility next to their existing soy production plant.

In 2023, the plant-based food industry demonstrated its appetite to continue utilizing sustainable, upcycled protein ingredients by looking beyond soybean meal.

Planetarians uses spent yeast from commercial fermentation facilities with soybean meal, to produce a meat product from just two ingredients.

Other companies are exploring the commercialization of protein production from unique sidestream sources:

- Potato protein: **Branston**, one of the United Kingdom's largest potato suppliers, will begin ingredient production from their new potato protein facility in early 2024. While potato has low protein content, the protein is coveted for its complete essential amino acid profile and excellent binding, gelation, and emulsification abilities. As a result, **Avebe** launched a new potato protein ingredient for use in plant-based dairy and other foods.
- Cabbage protein: **Naylor Farms**, a leading producer of cabbage for coleslaw in the United Kingdom, announced they are investing €35 million in an eco-conscious factory designed to extract plant-based protein from cabbage.
- Broccoli protein: **Upp** company is upcycling protein from broccoli sidestreams while optimizing broccoli harvest by minimizing waste and harnessing machine learning technology.
- Pumpkin seed protein: **Seductive Foods** is making dairy alternatives with regenerative hemp and upcycled pumpkin seeds. Pumpkin seed-based meat is being explored by **More Foods** and **Osem-Nestlè**.
- Stone fruit seed protein: **Kern Tec** makes plant-based milk from stone fruit seeds.

While challenges in technology development, logistics, and lack of established infrastructure remain, sidestream utilization has tremendous potential to increase food production while cutting costs, environmental impacts, and agricultural waste. However, further research into regional byproduct availability, supply chain development, and collaborations across the value chain are required to optimize the use of sidestreams for alternative proteins.

Progressing ingredients from lab to commercial scale

Besides scoping innovative protein sources, the industry is also focused on refining, scaling, and commercializing plant protein production.

NIZO provided a series of helpful insights into protein fractionation for *Food Navigator* on membrane filtration, flavor improvement, polyphenol reduction, and avoiding microbial contaminations, to help protein ingredient producers fine-tune their processes.

In terms of commercial expansion, **ADM** acquired **Prairie Pulse, Inc.**, doubling their pulse crop cleaning, milling, and packaging capacity in Saskatchewan. Moreover, **DIAZ** is leveraging a high-pressure process to germinate whole soybeans, a process they claim elevates the flavor and texture of soybeans without additives, and they plan to use their most recent funding to build a new 40,000-square-foot facility capable of producing 8,000 tons of plant-based meat per year.

For those looking to scope their product's commercial viability, **Burcon NutraScience Corporation** is now offering pilot plant processing and scale-up validation as a service to partners and customers, presenting an opportunity for companies to optimize novel protein fractionation sources and processes.

Component improvements: Advancing the functionality and acceptability of plant-based food formulations

In the vast space between harvesting primary ingredients and creating ready-to-consume products, many enterprises are working to create multi-ingredient components for better plant-based products, including fats, texturized proteins, binders, colors, and more. **Whether created in-house by plant-based meat manufacturers or by B2B-focused companies, these building blocks are crucial to creating plant-based products that meet consumer demand for taste, price, and nutritional value.**

Box 4: Juicing up plant proteins with alternative fats

Fat is an important part of conventional animal-based proteins like meat and dairy products, providing unique benefits for their texture, aroma, juiciness, and taste.

For alternative protein products to reach taste parity, innovative animal-free fat substitutes must be available. Typically, coconut oil is used in commercial alternative meat products, but other animal-free options are being explored as more functional, more sustainable, and healthier substitutes. In 2023, companies focused on formulating plant-based fat ingredients that improve the sensory and nutritional properties of plant-based meat and dairy products, beyond the capabilities of coconut oil (Table 8).

Plant-based fat technology typically relies on using plant oils and either restructuring them by (1) directly modifying the oil structure (e.g., hydrogenation) or (2) using other ingredients to assemble a matrix around native plant oils (e.g., oleogels, emulsions). Most companies listed in Table 8 are focused on the latter strategy as it is often more nutritionally beneficial to apply unmodified unsaturated oils in structured forms to alternative protein products (rather than oils modified to higher saturation levels).

Other animal-free fat technologies are also being integrated into plant-based food products. Fermentation-derived and cultivated fats have the potential to mimic the molecular structures of animal fats more closely than plant-based technologies. For example, **Mycorena**, **Nourish Ingredients,** and **Yali Bio** are innovating precision fermentation-derived fats for inclusion in plant-based meat and dairy products. Additionally, **Upstream Foods** is fabricating a cultivated fat from salmon cells to boost the taste of plant protein-based seafood products.

As the alternative protein industry grows, scaling high-quality alternative fat and oil technologies will be essential to substitute coconut oil applications and accelerate animal-free omega-3-rich oil manufacturing. Cost and raw material availability should be a focus of alternative fat companies targeting long-term impact.

For more information about fermentation and cultivated technologies, please explore their 2023 State of the Industry reports.

Table 8: Company updates for plant-based alternative fat products

Company	Product	Fat type
Shiru	OleoPro	Adipose
CUBIQ and Cargill	Go!Drop	Adipose
Kerry	SucculencePB	Adipose
Lypid	PhytoFat	Adipose (pork belly fat)
Vegetarian Butcher (Unilever)	NoBacon 2.0	Adipose (bacon fat)
KaYama	Not available	Adipose
HIFOOD and Alianza	MirrorTissue	Adipose
Gavan	FaTRIX	Butter
Bunge	Beleaf PlantBetter	Butter
Willicroft	Willicroft Original Better	Butter

Reaching taste parity through protein texturization advancements

Texturization, the process of creating desirable 3D structures from native plant protein ingredients, is essential to match the mouthfeel, appearance, and eating experience of animal-based meat.

Of the many texturization methods, extrusion remains the most widely used in the plant-based meat industry for its scalability and adaptability. This year, the scalability of extrusion reached new heights with the release of **Clextral's** high capacity die (HCD) technology that doubles the capacity of the extruder for a throughput of up to 1200 kg/hour. The HCD is equipped with a double parallel outlet, allowing for two product belts to exit the die at the same speed in continuous flow. This level of throughput, previously unachieved by the industry, will be key to expanding global plant-based meat production capacity, especially as even moderate growth may outstrip the industry's ability to meet demand (see GFI's plant-based meat manufacturing capacity and pathways for expansion). Scalability advances continue in shear cell technology as well. Rival Foods, a company spun out of Wageningen University, is pioneering the use of shear cell technology to construct whole-muscle cuts. They announced the launch of their chicken alternatives in food service outlets in the Netherlands.

Spinning and other bottom-up approaches to plant protein texturization hold great potential for recreating the texture and mouthfeel of animal proteins more precisely. Spinning technologies, for example, form thin fibers that can then be assembled into larger structures reminiscent of animal muscle tissue. Even though spinning techniques are widely used in the textile, automotive, and polymer industries, they are notoriously difficult to scale for food applications.

However, **Simulate** is pioneering their chicken breast produced using fiber spinning. Earlier this year, **Project Eaden** announced innovative spinning technology and plans to leverage it to produce marbled steak alternatives. Other bottom-up approaches were unveiled this year, including the

"process-controlled microstructure design" patent-pending technique that **Heura** developed for their plant-based ham. Additionally, **New School Foods** launched their whole-cut salmon produced using a proprietary cold processing technique.

Bringing it all together with binder ingredients

Binders play a big role in texturization, as well as product handling and overall performance. Although commonly used binders include natural and modified starches, methylcellulose, and fibers, there has been a push in recent years for binders that are at once more effective, nutritious, and recognizable on a label.

This rings particularly true for those aiming to replace methylcellulose, a modified version of the natural plant polymer cellulose that has unique gelling properties especially suited to plant-based meat applications. This year, a partnership between **Plantible** and **ICL** rose to the challenge. The partners announced plans to launch ROVITARIS, a methylcellulose alternative that boasts high protein content and functionality through its key ingredient of RuBisCO protein harvested from duckweed. Due to the solubility and gelling behavior of the protein, which forms thermo-irreversible gels below typical cooking temperatures, ROVITARIS may have an even more favorable gelling profile than methylcellulose.

This announcement came on the heels of Plantible's launch of their first product Rubi Whisk, a plant-based egg replacement for baked goods and other applications, which takes advantage of RuBisCO protein's exceptional amino acid profile and emulsification and gelation properties. On top of possibly outperforming traditional ingredients, duckweed is an incredibly sustainable RuBisCO source, as previously discussed.

Motif FoodWorks, known for both innovative ingredients and end products, broke the traditional mold of plant-based binders with their release of APPETEX, a hydrogel-based ingredient that enhances the experience of plant-based foods by providing a more realistic springy, juicy chew. Instead of focusing on gelation, thickening, or binding properties alone, Motif went after recreating the texture of animal connective tissue by using a combination of proteins and carbohydrates.

> *While we are still focused on addressing the two main ingredient challenges for consumers in plant-based foods—taste and texture—we see white space to innovate around fat technology, improved nutrition, and evolved substrates that expand the profile of alternative protein applications.*
>
> **Dilek Uzunalioglu, Ph.D.**
> *Senior Director, Food Discovery and Design, Motif FoodWorks*
>
> **Brennan Burks**
> *Senior Director, Marketing & Investor Relations, Motif FoodWorks*

End product formulation: Producing products consumers love at an affordable price

Though unit sales of most U.S. retail plant-based food categories declined in 2023, a plethora of new products were launched across all outlets.

Several 3D-printed products were launched this year, including **Revo Foods** hybrid plant- and mycoprotein-based salmon filet, **Steakholder Foods** plant-based eel, and six products from **Redefine Meat** including various minced and pulled products such as pulled pork, lamb kofta mix, burgers, and bratwurst.

Important developments in 3D-printing technology and scale-up this year signal exciting product and experience launches to come, including **Foody's** and **Coccus** joining forces to launch the first large-scale facility for 3D bioprinting plant-based meat and **SavorEat** unveiling their custom plant-based-burger-printing robot.

Plant-based companies strove for further taste and experience parity with other new formulation methods such as the cold process technique pioneered by **New School Foods** (described previously), **Nissin Foods'** unique layering process to produce eel, and even **Juicy Marbles'** introduction of edible bones into a plant-based rib product.

Blending with animal-based ingredients could help align products with consumer taste expectations

Blended products, produced using both plant- and animal-based ingredients, continued to advance this year both in conventional meat companies as reported last year, and in newer dedicated enterprises.

Momentum Foods launched their first line of products under their consumer-facing brand **Paul's Table**. The products, such as pulled pork and carne asada, feature 90 percent plant-based ingredients, including soy and brown rice for health and environmental benefits, and 10 percent animal-based ingredients, including collagen and fat for sensory quality and experience.

A second dedicated blended meat company, **Asentia**, emerged from stealth mode with plans to launch a line of unique products including truffle mushroom meatballs and bourbon bacon artichoke sausages. With appropriately nuanced messaging and customer value propositions, along with more research and product development, blended products may hold tremendous potential to bring consumers to the category.

Optimizing products with every tool in the alternative protein "toolbox"

The interplay between plant-based, fermented, and cultivated alternative proteins will improve products across the whole sector. Hybrid products using plant-based and fermented or cultivated components continued to emerge this year with the announcement of several launches and initiatives:

Plant-Based + Fermentation:

- Plant-based cheese maker **Daiya** invested in fermentation technology to create next-generation products.
- Plant-based fish startup **Oshi** and **The Better Meat Co.** successfully co-raised funds for a collaboration to develop hybrid salmon.
- **Beyond Meat** revealed efforts to create whole-muscle steak using fava beans and mycelium.

Plant-Based + Cultivated:

- **SciFi Foods** opened a pilot plant and announced their first product will combine cultivated and plant-based ingredients.
- **Big Idea Ventures** launched **Nexture Bio**, a biomaterials company focused on plant-based scaffolds for cultivated meat.
- **Tender Foods** received National Science Foundation funds to develop whole-cuts of plant-based meat enhanced by cultivated animal cells.

Applying artificial intelligence to plant-based food production

Artificial intelligence (AI) and machine learning (ML) are being used to expedite plant-based product development.

Companies known for applying these technologies announced major partnerships and product launches. **Climax Foods**, makers of ML-optimized plant-based cheese, launched their own blue cheese in select restaurants across the country and teamed up with **Bel Group** to create a new plant-based version of BabyBel which they plan to launch by the end of 2024. **NotCo**, which uses AI to create plant-based products and aims to become a B2B food AI platform, launched mac & cheese and mayonnaise with **Kraft Heinz** this year and announced a new partnership with **Mars Wrigley**.

Nonprofits recognize the potential of AI/ML to advance the entire alternative protein sector, launching initiatives to help companies utilize these technologies. **Protein Industries Canada** launched a virtual, three-month training program for companies to learn how to use and apply AI. **Food System Innovations** announced the launch of GreenProteinAI, an initiative to improve plant protein texturization using AI.

Environmental and social impact

Every stakeholder in the plant-based value chain, from crop cultivators to end-product distributors and consumers, must remain committed to improving environmental and social impact to reap the full benefits of the protein transition.

One powerful way to measure environmental impact is through life cycle assessments (LCA), a systematic research methodology used to compile the flow of materials, energy, and resources associated with a product or service. Because it is difficult to trace each ingredient back to its origins, especially when new and proprietary processes are involved, some of the most telling LCAs come from plant-based meat manufacturers themselves, such as **Beyond Meat** and **Impossible Foods**, who have each commissioned LCAs comparing their products to animal products.

In 2023, Beyond Meat released their second ISO-reviewed LCA which examines the environmental impacts of Beyond Burger compared to animal beef. The study is an update to a 2018 study, both in terms of several data and modeling upgrades as well as the Beyond Burger recipe itself, which now reflects version 3.0 released in 2021. The LCA shows the overwhelmingly positive benefit of substituting beef burgers with plant-based alternatives. According to the results, a Beyond Burger 3.0 patty generates 90 percent fewer greenhouse gas emissions, uses 97 percent less water and land, and requires 37 percent less non-renewable energy than an 80/20 animal beef patty. Alongside the LCA, Beyond Meat released their updated environmental, social, and governance (ESG) report outlining the company's mission and strategy to improve human health, climate change, resource consumption, and animal welfare.

A study released by **Profundo** this year went beyond individual plant-based products to examine the environmental impacts of a broader shift to plant proteins, including a mix of pulses, tofu, plant-based meat, and fermentation-derived meat. It outlines a variety of substitution scenarios, from the producer to the consumer level, in regions with exceedingly high animal protein consumption, namely the Global North and some countries in Latin America and Asia.

The results are striking. For example, substituting just 30 percent of meat in the selected regions with a mix of alternative proteins would:

- Save more than 700 million tons of CO_2 equivalent, or the annual emissions of Canada.
- Free up 3.4 million km^2 of land, roughly equivalent to the area of India, with potential for crop cultivation, habitat restoration, and carbon sequestration.
- Save almost 19 km^3 of blue water, or the equivalent of 7.5 million swimming pools.

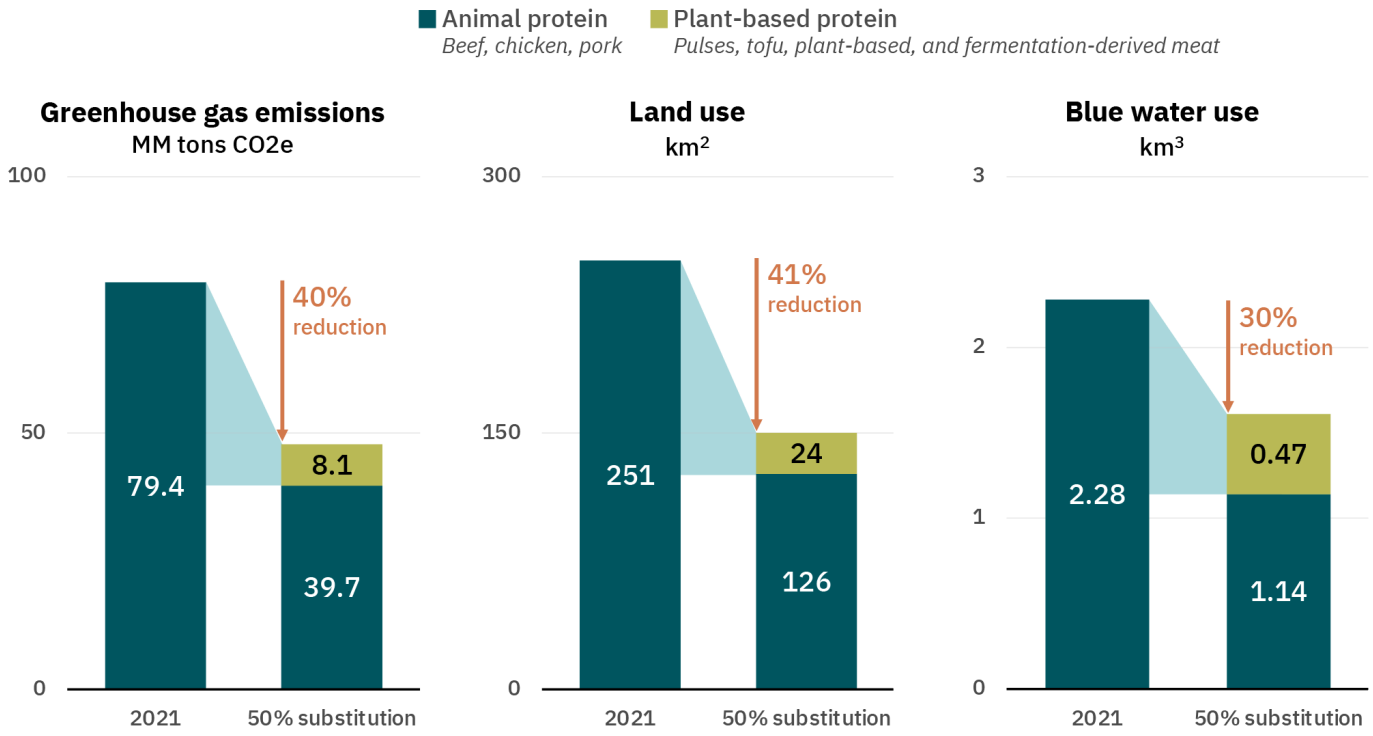
The report also highlights the importance of grocery and foodservice retailers. Just six of the leading grocery and food service providers with international operations–**Carrefour** (France), **Lidl** (Germany), **Ahold Delhaize** (Netherlands), **Tesco** (United Kingdom), **Sodexo** (France), and **CP All** (Thailand)–could have an outsized impact if some meat sales were replaced with a mix of plant proteins.

Substituting 50 percent of beef, pork, and chicken sales with plant proteins by 2030 would save 40 percent of GHG emissions, 41 percent of land use, and 30 percent of the blue water use associated with meat production, as shown in figure 28.

Finally, two seminal studies released in 2023 examined the consequences of land use change if the world shifted to more plant-based products. The impacts of substituting plant-based meat and milk products could be multiplied by afforestation, reforestation, or crop production for human consumption on the land made available from reduced meat production, which had not been discussed at length in LCAs to date.

The studies also examine the implications these changes would have for biodiversity goals, food security, climate change, and more. Future land-use studies should provide nuances for specific geographies and point to alternative proteins as an efficient land-use solution to enhance local and global sustainability goals.

Figure 28: Environmental impact of shifting to plant-based protein
Hypothetical calculation of top 6 global food retailers and foodservice companies shifting 50% of animal protein sales to plant-based protein



The potential impacts of substituting 50 percent of meat sales with plant-based proteins in just six leading grocery and food service companies (Carrefour, Lidl, Ahold Delhaize, Tesco, CP All, and Sodexo)
Source: Kuepper, B., *Impacts of a Shift to Plant Proteins – Effects of reduced meat production on GHG emissions, land, and water use*, Profundo (2023).

Health and nutrition

Though it is increasingly clear and widely accepted that eating plants is important for health, there continue to be research gaps, misinformation, and misconception regarding plant-based meat. However, a healthy diet includes a wide variety of foods and can often benefit from the incorporation of plant-based meat. Developing and sharing clear, understandable nutrition data about plant-based meat is just as critical as product reformulation efforts that improve its nutrition profile.

Public awareness of the NOVA classification system, designed to categorize foods according to their level of processing, continued to spread this year, even touching some parts of regulation (see the Government and regulation section). Though many plant-based meat products fall in the "ultra-processed" category, research released this year suggests that this designation does not consistently speak to the "healthfulness" of the category.

A WHO-backed study published in *The Lancet* examines the link between the consumption of specific categories of ultra-processed foods, including animal-based products and plant-based alternatives, and the risk of multimorbidity from cancer, cardiometabolic diseases, and type 2 diabetes.

Importantly, plant-based meat, breads, and cereals were associated with reduced risk, while animal products and sugar-sweetened beverages presented the highest risk. Most other food categories did not show a risk association. This result is consistent with the fact that plant-based meat does not neatly follow the definition of "ultra-processed" and shows that the designation may be too broad.

Though there is still ample opportunity for further medium- and long-term research, randomized controlled trials investigating the effects of consuming plant-based meat are some of the best indicators of health and nutrition for the category.

This year, the Gardner group from the **Stanford University School of Medicine**, known for their work on the subject, conducted a trial on identical twins to determine the effects of healthy omnivorous versus vegan diets, including meat alternatives (also the subject of a 2023 Netflix documentary series, *You Are What You Eat: A Twin Experiment*). All participants were exposed to vegetables, legumes, fruits, whole grains, nuts, and seeds, with or without the presence of animal products. Over just eight weeks, the vegan diet led to lower low-density lipoprotein (LDL) cholesterol, insulin levels, and body weight, showing the benefit of a healthy plant-based diet. Further research from the **Soy Nutrition Institute** found that plant-based meat can help facilitate and maintain a plant-predominant diet.

Health- and nutrition-related association support for alternative proteins was apparent in 2023 with the first American Heart Association (AHA) certifications for plant-based meat. Both Beyond Steak® and Impossible Beef Lite® were certified by the AHA heart-check program, designed to showcase heart-healthy nutrition profiles.

Beyond Meat showed further commitment to nutrition by launching the GoBeyond RD hub to enhance engagement with dietitians and nutrition experts. The **Physicians Association for Nutrition** (PAN) also released a position paper on plant-based meat products, acknowledging their potential as a healthy, sustainable, and convenient alternative to animal meat. The position paper summarizes research around the nutritional value of plant-based meat, includes recommendations for choosing products with improved nutritional profiles, such as those low in saturated fat and fortified with micronutrients, and concludes with an endorsement for the sector to keep producing products and research that support long-term health and sustainability goals.

Scientific ecosystem growth

Technical hubs across the plant-based scientific ecosystem can accelerate innovation and progress. They can also shorten product supply chains, provide opportunities for early innovators to enter the industry, and minimize duplicative efforts, spurring joint research and development. In 2023, a number of these innovation centers were launched by governments and industry:

- **AAK**, a plant-based oils and food producer, opened the Innovation Center of Excellence in the Netherlands, where researchers are advancing technologies to improve the taste and texture of plant-based foods.
- **Cargill** opened their new European Protein Innovation Hub with a kitchen and modern pilot plant, allowing industry customers to co-formulate and test recipes with Cargill.
- **ADM** established their Customer Creation and Innovation Center in England, which also features a kitchen and flavor development lab available for customer collaborations.
- **Bühler** opened their Application and Training Centers in Switzerland, with each center focusing on critical needs for plant-based processing: flavor creation, food creation, protein application, and energy recovery (joining existing chocolate, extrusion, pasta, and grain centers).
- **The Food Industry Research and Development Institute** of Taiwan established a Plant Milk Research and Development Center to boost Taiwan's protein-rich milk alternative supply chain and innovation.
- **The Technion—Israel Institute of Technology** announced the establishment of the Sustainable Protein Research Center, meant to support innovators across technological readiness levels from research to entrepreneurship and commercialization support.
- Recognizing the importance of centers that bring together experts across disciplines, **UK Research and Innovation** launched a call for proposals to actualize alternative protein research centers.
- The Tropical Food Innovation Lab at the Institute of Food Technology has been inaugurated in Campinas City, Brazil. The Lab is a collaborative space created by a consortium of companies, including Cargill, Bühler, and Givaudan, dedicated to developing sustainable, affordable, nutritious, and tasty solutions based on national biodiversity. As part of this initiative, Bühler provides dry and wet extrusion lines to produce plant-based products, strengthening the Brazilian alternative protein industry.

For products to be successful from their research and development stage through commercialization, collaborations between companies and governments are crucial.

As part of their strategy to further position Canada as a global leader in the global food system shift, **Protein Industries Canada** established international research collaborations with **Wageningen University & Research** and **Innovate UK**. Notably, Protein Industries Canada and Innovate UK announced a joint call for collaborative R&D projects focused on plant-based foods and ingredients for $20 million.

Additionally, **Enterprise Singapore** announced a call on alternative proteins for Singaporean startups to partner with companies from Israel, Sweden, and Switzerland on R&D, commercialization, and business expansion projects. More collaborations between multinational governments, academics, and companies like these will help accelerate plant-based meat, seafood, egg, and dairy innovation and production in the coming years.

While significant bottlenecks still exist for the plant-based industry, strategic collaborations and open-access research can help address those bottlenecks, drive innovation, and elevate the industry.

Progress toward price parity

Cost is consistently a main driver for food purchases, and with inflation and rising interest rates, creating affordable products is now more important than ever.

For the plant-based industry to commercially produce protein alternatives at price parity to animal products, much more information is needed to understand what the main cost drivers are across supply chains. Techno-economic analyses (TEAs) project costs for prototypical processes based on standard unit operations, projected capital expenditure, and operating costs. Open-access models based on primary data would be invaluable for the industry, providing insight into what are the most prevalent bottlenecks to reducing plant-based food prices. As mentioned earlier in this chapter, recruitment is underway for GFI's planned survey of industry data to build an open-access TEA for the industry.

In 2023, promising strides were made toward curtailing the costs of plant-based foods by a variety of stakeholder types. Plant-based chicken company **Rebellyous Foods** manufactured equipment designed for plant-based meat production with automation and estimated that their implementation reduces energy costs by 80 percent, material waste by 99 percent, and workforce costs by 90 percent. In 2024, Rebellyous plans to partner with USDA or FDA food processing facilities to install their patented system. German retail food market chains **Lidl**, followed by **Kaufland,** dropped prices of their plant-based products to that or lower than their animal counterparts to spark consumer interest in sustainable alternatives.

To appeal to the majority of consumers, it is critical for plant-based meat, seafood, egg, and dairy products to reach or beat price parity compared to their conventional animal-based counterparts. A variety of factors across the value chain affect the cost of production, and thus retail price, for plant-based foods, from how much financial support farmers have to cultivate crops to the scale, labor, energy, and other resource costs associated with ingredient and end-product production. Moreover, the public funding provided for the research, commercialization, and promotion of alternative proteins can actively lower production costs by alleviating capital expenditures and operating costs while enhancing demand for plant-based foods.

Rebellyous Foods Kickin' Nuggets
Photo credit: Rebellyous Foods

Progress toward taste parity

The plant-based industry remains determined to achieve widespread taste and experience parity as shown by the many advancements outlined in this section.

However, sensory gaps between plant and animal proteins remain a barrier to consumer adoption, particularly in the plant-based meat category. In addition, Rabobank insights show that possible oversaturation of the space with derivative and low-quality products has left the plant-based industry vulnerable.

Moving forward, R&D and production efforts must refocus on high-quality, nutritious, innovative products that meet or exceed consumer expectations. This requires a deep focus on understanding consumer experience through well-designed sensory evaluation studies conducted at all stages of product development and beyond.

To that end, several efforts to improve sensory experience understanding were announced across the technology stack this year:

- **Bell Flavors & Fragrances** invested in a new state-of-the-art consumer science sensory center set to open in 2024.
- Flavor and fragrance giant **Givaudan** partnered with **Thimus**, a neuroscience company, to uncover hidden dimensions of consumer experience including emotion, motivation, and subconscious processes.
- *Food Navigator* covered the merits of time-based sensory experience mapping with input from **CampdenBRI**.
- Researchers at the Sensory Science Evaluation Laboratory at Texas A&M University conducted a "mouth behavior study" to understand how consumers' meat preferences are influenced by how they eat their food.
- Canadian researchers announced a collaboration to use the mid-IR beamline at the Canadian Light Source to develop a deeper understanding of the chemical groups and microstructures that influence the texture and taste of plant-based foods.
- The European Cooperation in Science and Technology (COST) launched FLAVOURsome Action to stimulate the creation of shared knowledge on flavor research and boost innovation in the plant-based food industry.

Moving forward, AI may play a useful role in tailoring plant-based products to consumer preferences. Companies developing products in this space include **Bite.ai**, **Gastrograph**, and **Tastewise**, who announced the launch of TasteGPT this year and discussed plans for TastryAI, a novel chemistry and AI-enabled consumer preferences prediction system.

Government and regulation

Government and regulation

Overview

Governments around the world bolstered their support of plant-based proteins in 2023. The year also saw an increase in global confidence that these new foods could impact jobs, economic growth, climate change, and public health. As global leaders like Canada, Denmark, and Singapore recommitted to expanding their domestic plant-based food industries, newer players such as France, the United Kingdom, South Korea, and Germany allocated significant resources to plant-based proteins.

Governments are recognizing plant-based proteins as a promising solution to reducing greenhouse gas emissions from food systems. The United Nations Climate Change Conference, COP28, in Dubai focused on food system transformation as essential to meeting global climate goals (and two-thirds of the food provided was plant-based). Meanwhile, the United Nations Environment Programme released a report at COP28 that confirmed plant-based foods' potential to benefit the climate, environment, and global health, and provided a comprehensive list of supportive policies governments might adopt to speed their development and deployment.

Governments also invested in plant-based foods as an economic driver to bolster local agricultural sectors and incentivize farmers to cultivate nutritious and profitable protein-rich crops for new, high-value markets. Canada, the global leader, affirmed its strategy of public support with another nine-figure investment in Protein Industries Canada, which largely focuses on plant protein development, over the next five years, while both Denmark and South Korea released national action plans for building their own industries.

Globally, plant-based foods were increasingly recognized as benefiting both the economy and the environment in 2023. Government strategies for supporting these technologies matured and grew, bringing new types of public investment and supportive policies.

Global public funding

Americas

Governments across the Americas invested in plant-based proteins, working to advance both the science and the commercial capacity of the industry.

The leader in the Western Hemisphere is Canada, which has invested hundreds of millions of dollars in its domestic industry through **Protein Industries Canada (PIC)**, a supercluster of companies, research institutions, and nonprofits working on every aspect of plant-based proteins from crop development to product marketing. In early 2023, the federal government renewed PIC's funding for the next five years with CAD 150 million ($110 million), bringing the country's total committed funding to CAD 353 million ($260 million) from 2018 to 2028. Canadian public funding also supported multiple research projects at the **University of Saskatchewan** seeking to perfect proteins made from pulses, legumes, and oilseeds—all Canadian agricultural specialties.

The United States also supported plant-based proteins through research, including **National Institute for Food and Agriculture**-funded research projects at **Virginia Tech** and **North Carolina A&T State University**, as well as an almost $1 million grant from the National Science Foundation for a collaboration between the **Tufts University Center for Cellular Agriculture** and a plant-based food startup, **Tender Foods**, to evaluate hybrid cultivated/plant-based products. Finally, the **Department of Energy's Advanced Research Projects Agency** (ARPA-E) awarded $1.7 million to **Umaro Foods**, a California-based startup that makes plant-based protein from seaweed, to evaluate how processing their seaweed could sustainably produce valuable rare earth elements and platinum group metals, in addition to delicious and healthy food.

In 2023, Brazil bolstered its alternative protein research ecosystem, including through an ongoing research project to develop a hybrid plant-based and cultivated sausage at the Brazilian state research agency, **Embrapa**.

Europe

Europe continued to support plant-based alternatives through research and development and commercialization projects, recognizing the sector's potential benefits for the climate, economy, and farmers.

As part of an ongoing effort to lift up algae as a resource, the EU's **European Maritime and Fisheries Fund** funded a €2 million ($2.2 million) "Seafood Alg-ternative" project to develop seafood derived from microalgae and other sources.

The regional leader in plant-based foods, Denmark, followed 2022's announcement of the world's largest fund for plant-based foods with the world's first National Action Plan for Plant-Based Foods, including increased funding for research and development. The first round of applications for the country's previously announced $195 million plant-based fund, **Plant Foundation**, received "overwhelming" interest with over 100 applications from industry, startups, and research centers in its first year.

France was not far behind in 2023, significantly increasing the amount of research funding available for developing the country's pulse crop into alternative protein products through projects such as SOYSTAINABLE, AlinOVeg, LETSPROSEED, Just Adopt pulses from Cook to forK (JACK), and more. The French government also supported plant-based protein companies in developing commercial capacity: in late 2022 the government awarded €7.4 million ($7.9 million) to help French company **Umiami** purchase and retrofit an agricultural production facility outside Strasbourg as part of their "Première Usine" ("First Factory") program, which helps pioneers of new technologies establish commercial viability at an industrial scale. The project also received €3 million ($3.2 million) in incentives from France's Grand-Est region. In 2023, two government-funded seed funds led a funding round to help Umiami launch their whole-cut plant-based products in the United States.

The United Kingdom, which also increased support for alternative proteins in 2023, funded three research projects on plant-based alternative proteins through a program supporting low-emission food production systems. Four plant-based technology companies were selected through **Innovate UK's** Better Food for All competition as well. Innovate UK also funded a two-year project to derive plant-based protein from amaranth leaves, which are easy to grow in vertical farming operations in the United Kingdom. The government of Ireland also supported research on plant-based foods, with the Department of Agriculture, Food, and the Marine awarding over €1 million ($1.1 million) to a project at **University College Cork** and **Technological University Dublin** to evaluate fermentation as a tool in plant-based food processing.

Germany announced €38 million ($41 million) in federal funding for a sustainable protein transition in 2024, including funding for innovating in alternative protein production, promoting the nutritional value of alternative proteins, and aiding farmers and companies to transition from animal agriculture to plant-based, cultivated, or fermented protein production.

On the sub-national level, the state of Catalonia in Spain invested €7 million ($7.32 million) in a **Center for Innovation in Alternative Proteins (CiPA)**, which will help alternative protein businesses scale up production.

Asia Pacific

Governments in the Asia Pacific region continued supporting plant-based foods, though new initiatives among the region's top alternative protein funders were few.

Singapore, the regional leader, continued investment in plant-based food research and development through the well-funded **Singapore Food Story 2.0**

research program. In 2023, **Enterprise Singapore**, a government agency focused on small and medium businesses, launched a Food Technology Program to help alternative protein startups, including plant-based foods, enter the market in mainland China.

South Korea and Japan both announced new support for plant-based food in 2023. The national government of South Korea released a plan for plant-based foods, including a research center and an initiative to develop plant-based proteins from domestic crops. At the end of 2023, **Japan's Ministry of Agriculture, Forestry, and Fisheries** announced a small business grant of ¥917 million ($6.5 million) to Umami United, a Japanese startup making plant-based eggs, to help with product development and expansion into the U.S. and European markets.

In 2023, two of Australia's six state governments boosted their local plant protein industries by supporting farmers and food producers with targeted public investments. The government of Western Australia allocated A$5 million ($3.3 million) to support the construction of a factory that will produce oat milk enriched with lupin protein, both from locally grown crops. New South Wales allocated A$2.2 million ($1.6 million) for an Alternative Protein Application Centre that will develop large-scale processes and conduct R&D on all pillars of alternative proteins, including fermentation, cultivated meat, and plant-based foods.

The New Zealand government's Endeavour Fund awarded almost NZ$12 million ($7 million) in funding to a project called "Plant-Based Food Ingredients: a Systems Approach to Sustainable Design," which will develop alternative protein products made from domestic crops such as green peas, oats, and hemp.

Regulation by country/region

Food regulations and labeling laws worldwide continue to affect where and how plant-based foods can be sold. In the United States and other countries, plant-based meat and dairy producers face censorship from national and local regulators. Some of these policies have been suspended, while others have been successfully challenged in court.

Australia/New Zealand

In 2022, an Australian Senate inquiry into the appropriate terminology for plant-based meat published results recommending that labeling restrictions be introduced to prevent plant-based producers from using meat-like terms such as "beef" and "chicken." Following that inquiry, in April 2023 the **Alternative Proteins Council (APC)** published updated Industry Guidelines for the Labelling of Meat Alternative Products in Australia and New Zealand, and in August 2023 the APC developed an equivalent set of guidelines for plant-based dairy alternatives. Both sets of guidelines are voluntary.

The guidelines for plant-based meat recommend that producers use qualifiers such as "plant-based" or "meatless" to describe their products. The guidelines also recommend that producers do not use animal imagery or terminology on their plant-based products that may be confusing for consumers. The guidelines for dairy alternatives recommend similar qualifiers such as "plant-based" or "dairy-free." The dairy alternative guidelines also recommend that producers use the characterizing ingredient of the product in its name (for example, "*soy* ice cream" or "*almond-cashew* milk").

Brazil

Brazil does not yet have specific regulations focused solely on plant-based products, but the **Brazilian Health Regulatory Agency (Anvisa**) and the **Ministry of Agriculture, Livestock, and Food Supply (MAPA)** both steer the regulatory agenda for plant-based products in the country.

In 2022, regulatory studies on plant-based products prepared throughout 2021 by the **Institute of Food Technology** at the request of GFI Brazil were finalized and delivered to the responsible authorities

as a basis for constructing regulatory text to be submitted for public consultation in 2023. Following this, in July 2023 the Secretary of Agricultural Defense of MAPA published Ordinance #831/2023, launching a public comment period on a regulatory proposal for plant-based foods in Brazil.

The regulatory proposal would establish minimum requirements of identity and quality for plant-based meat alternatives, as well as visual identity and labeling rules for these products. It would require plant-based product labels to include (at minimum): 1) the name of the product; 2) on the main panel of the product, the phrase "vegetable equivalent to [corresponding product]"; and 3) a notice that the product does not replace its animal equivalent in nutritional or functional terms. The public comment period on this regulation closed on September 15, 2023, and there has been no further legislative action on the regulation at the time of this report.

Canada

In October 2023, the **Canadian Food Inspection Agency (CFIA)** updated its guidance on "simulated" meat and poultry products, which include plant-based products. CFIA clarified that it is permissible for plant-based products to use meat-like descriptive terms such as "burger," "sausage," or "jerky" so long as the food does not resemble a meat or poultry product and is not likely to be mistaken for a meat or poultry product.

European Union (EU)

The European Union prohibits companies from labeling plant-based dairy products with terms such as "milk," "cheese," and "butter" unless the products also contain animal-derived dairy. Plant-based dairy manufacturers are allowed to label their products as, "alternative to [milk, butter, yogurt, etc.]." Similarly, manufacturers are allowed to use dairy-adjacent descriptive terms such as "creamy" or "buttery" to describe plant-based products.

While EU consumers largely embrace plant-based products, some countries within the European Union have introduced label censorship legislation for plant-based foods.

Following pressure from Polish agricultural organizations, the outgoing Polish government proposed a draft decree in 2023 that would censor the use of terms such as "ham," "smoked meat," and "sausage" for plant-based products. Similar attempts to censor meat-adjacent terms on plant-based products have also been made in France and Italy. The French government introduced a bill in 2023 that would ban common meat terminology on plant-based products, and the Italian government passed a bill that would ban the production of cultivated meat and ban common meat terminology on plant-based products.

Despite these labeling setbacks, other EU countries are embracing plant-based products. Denmark launched an Action Plan for plant-based foods in October 2023. The plan provides an overview of various initiatives that would strengthen the prevalence of plant-based foods throughout the value chain. It also addresses funding and subsidies, advice for startups, and initiatives to attract investment and strengthen Danish plant-based exports. Specific actions include a five-year plant-based eco-scheme that will pay 580 million Danish kroner ($85 million) in bonuses to farmers who grow plant-based protein crops for human consumption, training chefs on how to prepare more plant-based meals, and increasing the focus on plant-based diets in the education system.

The Netherlands and Finland are also taking measures to encourage the consumption of plant-based foods. The Health Council of the Netherlands presented an advisory report to the Dutch government in 2023 recommending that policy measures be taken to guide the population to adopt an increasingly plant-based diet. A Finnish Innovation Fund issued a report in 2023 on the role of plant-based and cellular agriculture in the transformation of the Finnish food system, which included suggested pathways for decreasing land use and energy consumption by increasing

plant-based protein sources. These initiatives may help pave the way for positive regulatory developments regarding plant-based proteins in the European Union.

India

The **Food Safety and Standards Authority of India (FSSAI)** finalized Vegan Foods Regulations in 2022, establishing a regulatory framework for foods and food ingredients that are free from animal products. Under these regulations, plant-based food producers must apply to FSSAI for approval of their products to be labeled as vegan, and once approved, products must use a government-designated logo. It became mandatory for vegan product producers to comply with these regulations starting in January 2023.

Norway

In 2023, Norway published the sixth edition of the Nordic Nutrition Recommendations (NNR2023), which constitute the basis for national dietary guidelines and influence nutrient recommendations and other health policies in the Nordic and Baltic countries. The result of five years of work by several hundred researchers and experts, the NNR2023 recommends a predominantly plant-based diet as being best for both human and environmental health. Specifically for each food addressed, the recommendations evaluated not only the food's human health effects but also its environmental impact, to find that plant-based foods tend to be the better option in both categories.

South Africa

In 2022, South Africa announced that it would enforce a ban against the use of "meaty" terms such as "burger" and "nugget" on plant-based products. However, enforcement of the ban was halted in 2023 by a reprieve that the Johannesburg High Court granted to plant-based food manufacturers to allow them to continue to sell their products until May 2023. At the time of this report, enforcement of the ban remains halted.

In another win for plant-based labeling in South Africa, in 2023, plant-based food company **Fry Family Foods** won an appeal initiated in 2022 against the **Food Safety Agency (FSA)** and **Red Meat Industry Forum** after these groups objected to a direction issued by the FSA declaring the naming and labeling of six of Fry's products to be in contravention of South Africa's processed meat regulations for using meaty terms. After this win, the Appeal Board ruled in August 2023 that the **Department of Agriculture, Forestry, and Fisheries** should be directed to develop regulations specifically for alternative meat products.

South Korea

In November 2023, South Korea's **Ministry of Food and Drug Safety** published Alternative Foods Labeling Guidelines prescribing standards and methods for labeling plant-based products. The guidance restricts the use of animal food names such as "beef" and "milk." The guidance does permit the use of words that describe the nature of the product (such as "bulgogi" or "hamburger") on plant-based product labels. The guidance also permits the inclusion of the name of the substitute raw material used to make the product, instead of animal meat. So, labeling a product as a "plant-based hamburger" or "bulgogi made from soybeans" is allowed.

Switzerland

Current legislation in Switzerland does not provide clarity about the correct naming of plant-based foods. It simply mandates that a product label provides sufficient information so that customers can "distinguish it from products with which it could be confused." However, a court case in Switzerland could construe it as banning the use of animal meat names in conjunction with plant-based products.

The **Zurich Cantonal Laboratory**, which oversees food and water safety in the canton, objected to the plant-based company **Planted Foods** using the words "chicken" and "pork" on their pea-based products, despite these products also being clearly labeled as vegan. A Zurich court decided in November 2022 in favor of Planted Foods, but the case is now moving to federal court after Swiss authorities refused to accept the cantonal ruling. At the time of this report, there has been no decision from the federal court.

United Kingdom

Having left the European Union in 2020, the United Kingdom has made no changes to retained EU regulations which preclude the ability of plant-based dairy products to use protected dairy terms like "whey" and "milk." As of February 2024, UK trading standards officers are continuing to consider tightening their interpretation of these regulations to forbid brands from using deliberate misspellings (such as M!lk) and play on words (such as Sheese).

The United Kingdom has diverged from the European Union in passing new legislation on precision-bred plants in 2023. This Act will create a new regulatory framework for crops produced using new genetic technologies, but only for genetic changes that could have occurred naturally or been created through traditional breeding techniques.

United States

Federal regulations

In February 2023, the **U.S. Food and Drug Administration (FDA)** released draft guidance on plant-based milk labeling. The non-binding guidance recommends that plant-based milk companies label their products with the term "milk" and clearly state the plant source of the milk, such as "soy milk" or "cashew milk."

The guidance correctly recognizes that plant-based milks are not trying to convince consumers that they are the same as dairy milk, and that consumers are not confused by the use of the word "milk" on plant-based products. Rather, using the term "milk" for plant-based dairy beverages helps consumers understand the taste, texture, and potential uses for those beverages. The FDA guidance, however, also includes an unnecessary labeling scheme that recommends adding nutritional statements to plant-based milk products that compare them to cow's milk, despite the fact that FDA does not have nutritional standards for cow's milk and plant-based milk products (like all packaged food products in the United States) already include a Nutrition Facts Panel on their labels.

Although the draft guidance does not have the force of law, it reflects FDA's thinking on the laws and regulations it may eventually implement. Companies often interpret FDA guidance as being similar to binding FDA regulations. Moreover, draft guidance that sets forth a labeling scheme provides a hook for opportunistic class action lawsuits challenging any product label that does not comply with the scheme. Given these realities, companies are unlikely to risk noncompliance with the draft guidance. FDA accepted public comments on the draft guidance through July 31, 2023, and has yet to issue any final rule on plant-based dairy labeling.

State regulations

Some states have introduced laws to censor or prohibit the use of conventional meat and dairy terms on plant-based product labels. Many of these laws have been challenged in court or amended to include safe harbor provisions to clarify that conventional meat and dairy terms can be used on plant-based products along with appropriate qualifiers. Several other states have introduced label censorship bills that would prohibit plant-based product labels from including terms traditionally associated with animal agriculture, but so far, these bills do not seem to be moving forward in the legislative process.

GFI, along with other organizations, continues to carefully monitor label censorship bills that are introduced and fight label censorship laws that place unfair restrictions on plant-based products:

- In Louisiana, GFI and co-counsel **Animal Legal Defense Fund (ALDF)** sued the state on behalf of **Tofurky**, arguing that the state's label censorship law violates the First Amendment right to freedom of speech and the Fourteenth Amendment right to due process. In April 2023, a federal appeals court upheld the law but narrowly interpreted it to find that the law only applies to cultivated meat companies that intentionally try to mislead consumers about the nature of a product.
- In Missouri, a federal district court declined to grant Tofurky and GFI a preliminary injunction (a halt on enforcing the law while the case is pending) on the grounds that Missouri's label censorship law was not likely to apply to Tofurky's product labels. In 2021, a federal appeals court upheld this ruling. The case returned to the district court where it is currently pending with an amended complaint.
- In Oklahoma, ALDF brought a new challenge to the state's label censorship law on behalf of plaintiffs Tofurky and the **Plant Based Foods Association** after a district court had denied a motion to prevent enforcement of the law. The complaint alleges that Oklahoma's law is vague, overly burdensome, unconstitutional, and is preempted by federal law. At the time of this report, the case remains pending in federal court.
- In Texas, GFI and co-counsel ALDF challenged the state's label censorship law on behalf of plaintiff Tofurky. The complaint argues that Texas's law is vague, unreasonably burdensome, preempted by federal law, and unconstitutional under the First Amendment right to freedom of speech. This litigation is continuing in the district court.

Global cooperation and coordination

Codex Alimentarius Commission (CAC)

In April 2023, the Codex Secretariat issued a circular letter seeking comments from member countries and observers on specific topics that would require the development of a Codex standard related to new food sources and production systems (NFPS), which includes plant-based foods. The circular letter also sought comments about the appropriate procedural methods within Codex to address NFPS. Members and observers, including GFI, commented on whether the current Codex procedural mechanisms are appropriate to address NFPS issues and raised aspects relevant to NFPS standard-setting that had not yet been considered by the Commission. The topic of NFPS was discussed at the 46th convening of the entire Commission (CAC46) in December 2023, and it was decided that current Codex procedural mechanisms were sufficient to address any future NFPS issues that may arise. Several Codex members indicated an interest in submitting specific proposals for new work related to NFPS in the future.

Food and Agriculture Organization

In November 2023, the **United Nations Food and Agriculture Organization (FAO)** hosted the Food Safety Foresight Technical Meeting on New Food Sources and Production Systems in Rome. The main objective of the meeting was to evaluate food safety issues associated with innovative food sources, including plant-based products. The meeting concluded that the food safety implications for plant-based foods vary depending on the types of plants being utilized and how they are harvested, stored, transported, and processed. The meeting also noted that the food safety risks present in plant-based foods can likely be mitigated through proper labeling, consumer education, and other regulatory mechanisms.

COP28

The year also brought new ideas on how governments might collaborate on alternative protein development, not only for their mutual gain but also for advancing the common good.

The **United Nations Environment Programme** released a report at COP28 in Dubai that assembled a strong list of potential actions governments could take individually and in concert. **In a section on multilateral cooperation, the report suggests that governments embark on cooperative research efforts, evaluate and revise trade policy to be more supportive, develop international food safety standards, and collaborate with development finance institutions to build capabilities worldwide.**

Also at COP28, 159 countries, including the United States, China, the EU27, and Brazil, signed the Emirates Declaration on Sustainable Agriculture and Food Systems, committing to addressing emissions from food systems in their 2025 Nationally Determined Contributions (NDCs). While the declaration does not mention alternative proteins outright, supporting alternatives to animal agriculture will be necessary to keep the world within 1.5°C of warming.

Outlook

Outlook

Overview

To better understand the plant-based meat, seafood, egg, and dairy sectors' current state, it's useful to contextualize the plant-based market's performance in the broader food and agriculture ecosystem. According to Euromonitor, the global market for plant-based meat experienced slight growth in 2023 as did the global market for conventional meat and seafood. That said, both sectors faced notable challenges in 2023 that helped define the near-to-medium-term outlook for the categories.

Just as select companies in the plant-based meat sector fell short of forecasts in 2023, several large conventional meat companies also underperformed relative to expectations. Tenuous consumer financial standing worked to depress demand for many animal protein types, particularly in U.S. retail. Plus, supply-side pressures, like Highly Pathogenic Avian Influenza (HPAI), mixtures of over-and-under supply in various markets, and elevated input costs squeezed meat producers' margins. These factors and others led to a decline in animal meat volume sales at U.S. retail in 2023, according to SPINS data.

As a result, conventional meat leaders like **Tyson Foods**, **Hormel Foods**, **JBS USA**, **Smithfield Foods**, and others took cost-cutting actions and/or lowered their 2024 forecasts in reaction to 2023's financial performance. Specific sectors, like the U.S. pork market, saw retail dollar sales fall by roughly 10 percent from 2022 levels, largely in response to elevated prices. Last year's struggles weren't unique to the meat sector, as dairy companies and even grocery chains also shifted their strategies to respond to the current environment.

Despite recent struggles for conventional meat companies, the FAO expects global meat consumption to rise by at least 50 percent from 2012 levels by 2050. Plant-based meat can play a crucial role in addressing the growing demand for meat while improving personal, public, and planetary health outcomes. To do so, the category needs to make a clear and convincing value proposition to consumers while navigating current economic headwinds.

What does the future hold for the plant-based meat industry? The remainder of this section will explore the category's near- and long-term outlooks, along with expert insights and external forecasts.

2024 outlook

Words such as "shakeout," "normalization," and "stabilization" were frequently used to describe the dynamics of the plant-based meat sector in 2023. The factors that shaped the environment in 2023 are likely to extend into 2024.

Tight consumer budgets were a key challenge for both animal- and plant-based protein companies in 2023. Elevated prices across sectors squeezed consumers' willingness to spend on higher-priced protein products, impacting demand for plant-based meat—which, on average, remains at a premium to most conventional meat products. And grocery bill anxiety doesn't seem to be subsiding: U.S. consumers cited food prices as their top economic concern—ahead of labor, housing, and national debt—as 2023 came to a close.

At the same time, consumer credit continues to rise and personal savings rates remain near their lowest levels in over a decade, putting additional strain on household finances. Similar challenges persist in the European Union, the Middle East, Asia Pacific, and elsewhere. Projected slower growth in animal protein production in 2024 poses an opportunity for plant-based brands to close the price gap relative to conventional products (while also meaning consumers will likely continue to pay more at the grocery store). These headwinds don't dictate how plant-based brands will perform in 2024, but they do highlight the importance of plant-based companies communicating to consumers the unique value their products can provide.

On the other side of the supply-and-demand equation, shifts in the plant-based ingredient supply chain are likely to affect the plant-based meat, seafood, egg, and dairy sectors in 2024. For example, high protein content (HPC) pea protein—a key ingredient in several plant-based products—is poised to face countervailing duties of 112 to 270 percent on imports from China into the United States. The change is expected to have ripple effects across the sector. If imposed, these duties could push North American companies to either source more pea protein from the United States and Canada or reformulate certain products while potentially causing an influx of Chinese pea protein into Europe. Plus, some ingredient suppliers are rethinking previous plant protein expansion plans, potentially putting a lid on U.S.-sourced ingredient availability. The net effect on the industry is uncertain, but companies will need to adjust their strategies in response to the change, especially as they offload existing inventory over the year.

The environment for private funding will also play a role in the plant-based market in 2024. With interest rates likely to remain elevated in the United States and Europe, companies may have more difficulty accessing financing than they did a few years ago, and investors and stakeholders will expect the capital that companies do raise to go further and last longer. To fill this gap, governments around the world must step in to support businesses across the plant-based supply chain through investments in R&D, grants, loans and loan guarantees, and other forms of financing.

On that front, the progress made in 2023 with governments prioritizing plant-based foods as climate and food security solutions bodes well for the future of the sector. However, more work needs to be done to close the gap between investments in alternative proteins and other climate solutions, which have received many multiples more funding.

In the face of these challenges and opportunities, plant-based companies continue to innovate to offer tastier, more accessible, and healthier products to consumers. Progress on those metrics will persist in 2024, and brands will aim to reach consumers about the benefits of their products. But to make market expansion a reality, governments, investors, and companies around the world need to increase their commitments to plant-based proteins by continuing to invest in R&D, infrastructure, and tasty, affordable, and delicious plant-based products.

Long-term outlook

About half of the world's habitable land is used for agriculture, which means that global food system change is necessarily an enormous, intensive, and lengthy pursuit.

Scaling a sector from virtually nonexistent to commercial is a monumental task. Through that lens, the alternative protein sector has already made significant progress: The plant-based milk, meat, and egg industries captured 14.5 percent, 0.9 percent, and 0.4 percent, of the U.S. retail market in 2023, respectively.

But progress is not linear, and it is not guaranteed. The plant-based meat, seafood, egg, and dairy industries still face hurdles on the path to robust, long-term growth. Brands must continue to reach consumers on the value of their products, and the category needs to continuously work to improve product taste and texture. Companies will have to do so in what looks to be a tighter private capital funding environment than in recent years. They'll also need to contend with a likely impending manufacturing capacity squeeze, relatively nascent plant-based meat ingredient supply chains, and continued regulatory battles over labeling.

Meeting the challenge of producing affordable, accessible, and tasty plant-based meat will require continued innovation and investment from companies, governments, and investors. By making products consumers want in a way that's healthier for people and the planet, plant-based companies can chart the path toward long-term growth. The support of governments around the world will also be crucial to the industry. Countries like Germany—where there has been a rapid rise in plant-based meat consumption—provide a proof of concept for the global plant-based meat industry.

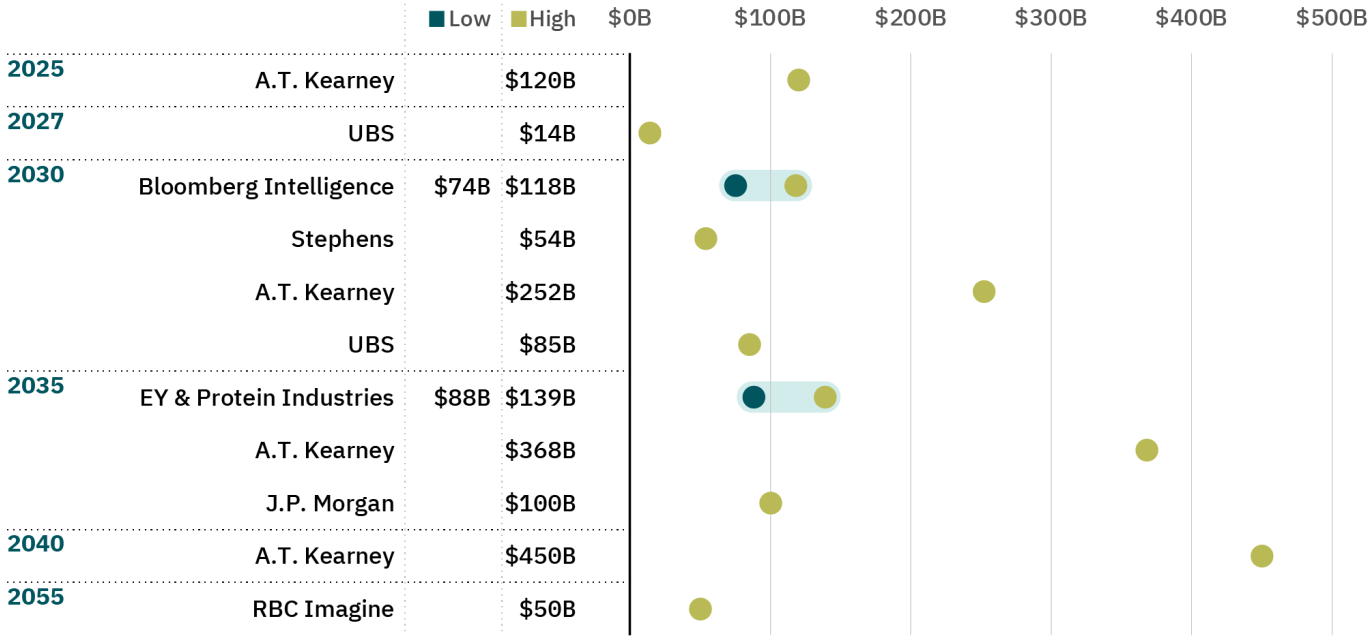
The European Union, too, expects increased plant-based demand over the next decade.

Considering these factors, plus the size of the $1 trillion global meat market, the opportunity for the plant-based sector remains immense. With plant-based meat household penetration still hovering around 15 percent in the United States—and much lower globally—there exists a sizable runway for expansion both in the United States and around the world. In the coming years, brands can win over consumers, improve their products, and create self-sustaining growth. Doing so will require investment, collaboration, and commitment. Given the challenges facing our planet and global food systems, progress is not only possible, it is necessary to meet international goals.

External projections

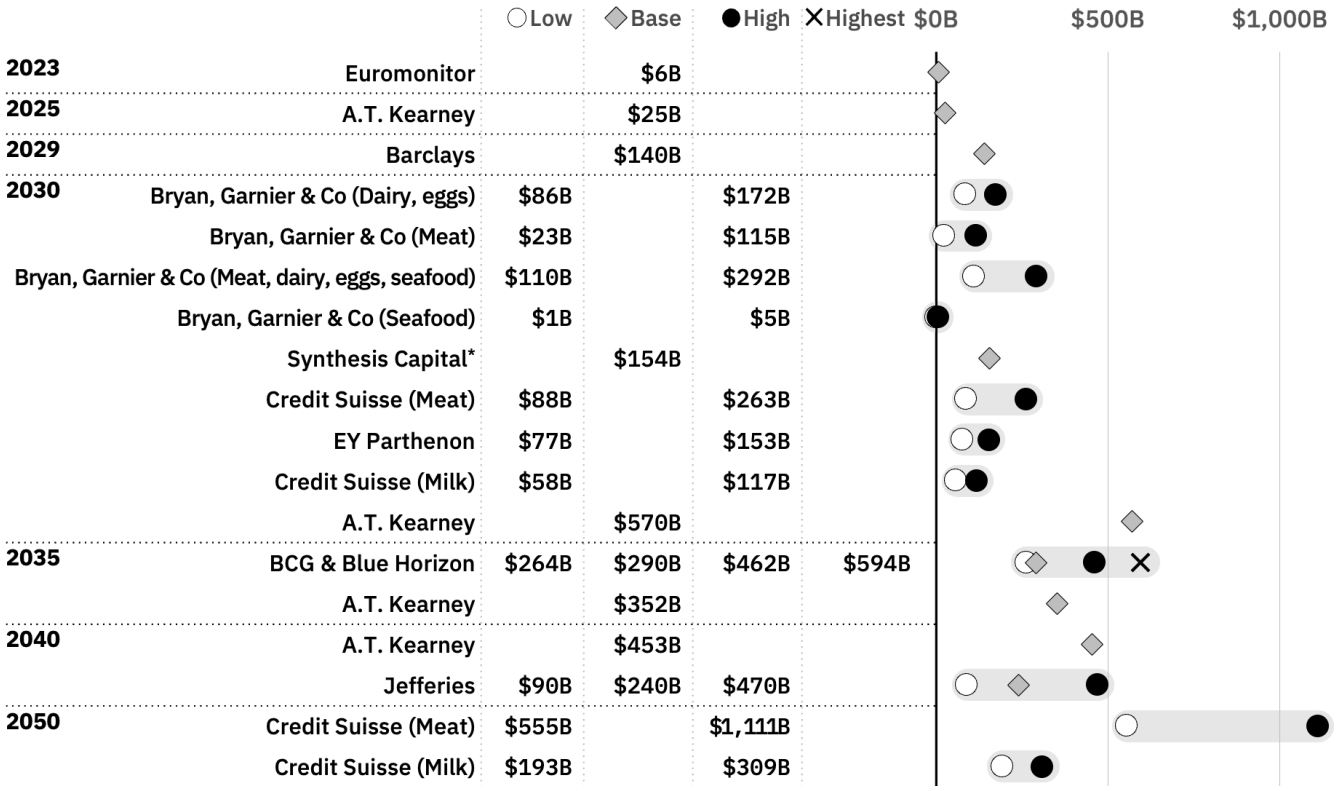
External forecasts of the plant-based meat, seafood, egg, and dairy markets from consulting firms, think tanks, and research organizations vary widely in their estimates of the potential future of the industry, but they all project robust growth from today's market size. Forecasts for 2035 range from ambitious estimates of $88 billion to $368 billion for the plant-based meat market alone, though some of these forecasts were published several years ago and no longer reflect probable outcomes for 2035. That would represent a 14x to 58x increase from today's market size. Combined alternative protein (plant-based, fermentation, and cultivated) market forecasts for the same year range from $87 billion to $594 billion.

Figure 29: Forecasts for global plant-based meat industry market size



Source: A.T. Kearney; UBS; Mintel; Bloomberg Intelligence; Stephens, Inc., Research Brief (3/18/2021); EY & Protein Industries; RBC Imagine.

Figure 30: Forecasts for global alternative protein industry market size



*Some forecasts projected a share of the total meat market rather than the industry in dollars. For those forecasts, we estimated the dollar size of the alternative protein sector using EY's forecast for the total 2030 meat market.
Source: A.T. Kearney, Barclays, BCG & Blue Horizon, Bryan, Garnier & Co, Credit Suisse, Euromonitor International Limited 2023 © All rights reserved., EY Parthenon, Jefferies, Synthesis Capital

It's difficult to overstate the scope of investment and innovation such market growth would demand. GFI's plant-based meat production volume modeling analysis estimated that the industry would require $27 billion in investment to build more than 800 extrusion facilities to capture even six percent of the global meat market—in addition to significant growth in the ingredient supply chains.

Will the plant-based meat market achieve these projections by 2035? Meeting even the low-end estimate would require a 25 percent compound annual growth rate (CAGR) from Euromonitor's estimate of today's market size. Since 2019, the global industry has grown at a CAGR of roughly 15 percent. Given the current environment, these estimated market sizes are possible, though they would necessitate levels of public and private investment many times higher than today's norms.

Vast increases in support for alternative proteins are justified by their potential climate, public health, and food security benefits. Companies need to continue to innovate to meet consumers' wants and needs while bringing costs down.

While consumers' financial standing, the health of individual alternative protein companies, and the media's sentiment regarding alternative proteins are constantly changing, the challenge before us is not. Animal agriculture, including the crops and pastures to feed those animals, accounts for between 11 and 20 percent of all emissions (FAO, Nature Food), and if governments and investors around the world are serious about meeting key climate benchmarks, they must step up to position the sector for long-term success.

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Conclusion

In 2023, plant-based meat, seafood, eggs, and dairy offered consumers a healthy, sustainable alternative to their conventional equivalents everywhere from fast-casual restaurants to schools, and even, for the first time, at a steakhouse chain. Over the year, plant-based protein products not only met consumers in diverse aspects of their lives but also advanced in their sophistication. New, refined product launches included plant-based steaks, sushi, and boiled eggs. Total global retail sales reached $29 billion, up 34 percent from five years ago.

Despite this progress, plant-based proteins faced economic headwinds as the global economy continued to slow and private investments tailed off their previous highs. These products also do not yet consistently meet consumer expectations for taste, price, and nutrition. In spite of these sobering facts, we remain optimistic about the future of plant-based meat as a promising agricultural innovation with far-reaching implications for planetary and public health, a strong bioeconomy, and more resilient global security. In that spirit, we offer these reflections and calls to action for the year ahead.

A global protein transformation will require strong, system-wide participation.

Where do you see yourself?

By delivering delicious, affordable alternative protein products to mainstream consumers, companies can realize a significant market opportunity to satisfy a growing consumer interest in sustainable foods. The research community can lean in by encouraging more scientists, from varied disciplines and at different points in their careers, to jump into the alternative protein field. The world's policymakers can invest in critical R&D to advance alternative protein science, manufacturing incentives to help scale up, and policies that level the playing field to allow alternatives to compete on taste, price, and convenience. And philanthropy can advance the alternative protein ecosystem by unlocking early breakthroughs and greater investment from governments and the private sector. System-wide participation can address the industry's biggest technical challenges, inspire research, create growth opportunities, and ensure these sustainable foods can benefit everyone.

We always keep the long view in sight.

What steps can you take toward a long-term goal?

The alternative protein industry is still developing, and yet we see the growing recognition that plant-based meat and other alternative proteins are a solution to reducing greenhouse gas emissions from food systems and feeding more people with fewer resources. Advances in plant-based meat are escalating, and the policy and regulatory landscape is looking brighter as more governments and agencies look to alternative proteins to offer solutions to serious global issues like food security and environmental degradation. Consumers want sustainable options, but they don't want to compromise on taste, price, or convenience. Navigating and building the path to scale and adoption will take years. Staying on this path while overcoming obstacles and headwinds will be critical to success.

Believe change is possible.

What inspires your vision?

At GFI, we bring determination and informed optimism to our work because we know a better food future is achievable. We see these same traits in those who pushed plant-based meat forward this year, many of them highlighted in this report. Across sectors and regions, there is a growing understanding of the importance of finding viable alternatives to conventional animal agriculture and huge opportunities for companies who get involved in this space. Just as the world is changing how energy is made, we need to change how meat is made. Alternative proteins can satisfy growing demand, reduce pressure on the planet, and create future-resilient jobs and livelihoods. Alongside other advances and innovations, alternative proteins can help write the next chapter for food and agriculture around the world.

To those who are in this work already, we hope GFI's 2023 State of the Industry Report, *Plant-based meat, seafood, eggs, and dairy* gives you a detailed look at this rapidly evolving sector. For those new to the field, welcome. Stay a while, grow with us, and change the world.

Expert predictions

Sherene Jagla
Chief Demand Officer, Impossible Foods

This industry has come a long way over the last several years, but we're just getting started. The plant-based meat category is $7.5 billion globally, and the global animal meat category is $1.4 trillion. If we as an industry want to seriously compete, we have to keep innovating and delivering products that are as good or better than their animal meat counterparts. This includes creating new products as well as evolving existing offerings to be even more delicious and nutritious, which is something the animal can never compete with.

Tony Martens
Co-Founder, Plantible Foods

It goes without saying that we will continue to see major food supply disruptions in the coming decade and that therefore an overhaul of our supply chain is not only a tool to combat climate change, but a tool to combat resource scarcity and prevent global famine. We believe that plant-based foods will become the standard and not the exception 10+ years from now, but we need to be realistic in our projections and need to make sure that we focus on the right market opportunities in the near-term, to make sure that we get where we must be in the long-term.

Roberta Alessandrini, PhD
Physicians Association for Nutrition

In the short term, I hope to see a greater diversification of plant protein ingredients used in plant-based products. Consumers want to eat a variety of plant proteins throughout the day. Diversification might also be beneficial from the nutritional standpoint as variety is one the most important pillars of healthy diets. Looking ahead in the long term, I see the plant-based protein industry expanding more into public catering. Alternative protein will be served in schools, prisons, and hospitals. Plant-based protein will be recognized as a healthier, more environmentally sustainable, and hopefully cheaper option than conventional meat.

Lucho Lopez-May
CEO, NotCo

For Kraft Heinz and Kraft Heinz Not Company, our ambition is to lead the future of food and we can't do it alone. We are accelerating innovation and growth with partnerships and bringing outside expertise to augment what we can do. The Kraft Heinz partnership with NotCo is a perfect example of this. Less than two years ago, we announced our joint venture and today we've launched delicious, quality products at record speed. It's incredible.

Jay Margolis
CEO, SPINS

Looking ahead, I'm particularly excited about the larger potential for plant-based nutrition and protein for kids, and the opportunity to satisfy additional nutrition and dietary needs with plant-based products, such as kosher and allergen-free—combinations we are increasingly seeing in our data as resonating.

Of course, as the plant-based market enters the mainstream, there is a natural slowing of growth in some categories, which we are already seeing. This has been exacerbated by inflation pressure and an overall decline in purchase volume, creating a real imperative for brands to keep the engine of innovation and alignment to customer needs and expectations strong.

Neeru Ravi
Principal, Boston Consulting Group

Innovation is critical to drive the industry forward. In recent years, companies have significantly improved the taste, texture, and price of alternative meat, but many consumers believe that there is still a gap between it and traditional meat. Beyond closing this gap and reaching parity, alternative protein companies should aim to surpass traditional products in meeting consumers' core needs such as taste and health.

Dilek Uzunalioglu, PhD
Senior Director, Food Discovery and Design

Brennan Burks
Senior Director, Marketing & Investor Relations, Motif FoodWorks

As an ingredient innovation company, we are always thinking about what comes next. While we are still focused on addressing the two main ingredient challenges for consumers in plant-based foods—taste and texture—we see white space to innovate around fat technology, improved nutrition, and evolved substrates that expand the profile of alternative protein applications.

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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 gfi.org.

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