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November 22, 2019

The House Select Committee on the Climate Crisis
U.S. House of Representatives
H2-359 Ford Building
Washington, DC 20024

SUBMITTED ELECTRONICALLY TO CLIMATECRISISRFI@MAIL.HOUSE.GOV

RE: Request for Information on Policies, Strategies, and Innovations to Address the Climate Crisis

The Good Food Institute (GFI) appreciates the opportunity to submit these comments to the House Select Committee on the Climate Crisis in response to your September 5, 2019 Request for Information seeking recommendations for policies, strategies, and innovations to help reduce carbon pollution while stimulating the U.S. economy.

GFI is a 501(c)(3) nonprofit organization building a sustainable, healthy, and just food system.[1] We support science and policy that accelerate progress on alternative proteins, including plant-based and cultivated meat (sometimes called cell-based or cultured meat).

To avoid a significant increase in greenhouse gas emissions from an increasing global demand for meat, we urge the committee to propose legislation to establish and fund an interagency Alternative Protein Initiative. Modeled after the National Nanotechnology Initiative, which has received $29 billion in funding over the past two decades,[2] this effort would bring together the federal government, industry, and academia to identify and perform research to remove technological barriers currently facing the plant-based and cultivated meat industries.

[1] *See* The Good Food Institute, https://www.gfi.org.

[2] Nat'l Sci. & Tech. Council, Comm. on Tech., Subcomm. on Nanoscale Sci., Eng'g, & Tech., *National Nanotechnology Initiative Supplement to the President's 2020 Budget* 3 (Aug. 2019), https://bit.ly/2oV3kDh.

Key components of this initiative would be:

- Intramural research at federal agencies
- Extramural grant programs explicitly for alternative proteins research
- Establishment of alternative protein research centers and academic majors at universities
- Workforce training to support workers during the decarbonization transition
- A nationwide network connecting research nodes, with multidisciplinary funding mechanisms that cut across existing agency boundaries
- A deep collaborative effort with industry

This legislation should direct the Office of Management and Budget (OMB), Office of Science and Technology Policy (OSTP), and relevant agencies to identify new and existing research funds that could be directed to grow these sectors. Interagency coordination would improve efficiency, minimize duplication of effort, and grow workforce talent for this important endeavor.

I. The Case for Alternative Proteins

A. Global Demand for Meat Requires New Production Methods

The Food and Agriculture Organization of the United Nations projects a 52 percent increase in the global demand for meat by 2050 relative to 2012.[3] If there were no change in meat production methods, this would mean greenhouse gas emissions of 10.8 gigatonnes CO2-eq per year from livestock and related activities, such as the production, processing, and transport of feed.[4] Much of this would be in the form of methane, with the remainder roughly evenly split between nitrous oxide and carbon dioxide.

There are two ways that these emissions could be reduced: by reducing the demand for meat or by finding ways to produce meat with fewer emissions. The first approach is dependent upon individual action. Progress on producing meat in alternative ways, on the other hand, can be significantly accelerated by government action.

While traditional meat is produced by slaughtering animals, new ways of making meat have recently emerged. Plant-based meat uses ingredients from the plant kingdom to biomimic the taste, texture, and experience of meat. Recent advances in technology — including an

[3] United Nations, Food & Agric. Org., *The Future of Food and Agriculture: Alternative Pathways to 2050 (Supplementary Material)* 8 (2018), https://bit.ly/2OB7f0z.

[4] This was calculated by increasing 2012 emissions (7.1 gigatonnes CO2-eq) by 52 percent to estimate 10.8 gigatonnes CO2-eq in 2050. P.J. Gerber et al., *Tackling Climate Change Through Livestock: A Global Assessment of Emissions and Mitigation Opportunities*, FAO (2013), https://bit.ly/2XDN2LF.

engineering method developed at the University of Missouri with U.S. Department of Agriculture funding[5] — have made possible the introduction of new foods like the Beyond Burger and have begun to contribute to the American economy in significant ways.[6]

Another approach to producing meat is to grow it outside of the animal. Cultivated meat is produced by taking animal cells and growing them in a tank called a cultivator, which facilitates the same biological process that happens inside an animal by providing warmth and the basic elements needed to build muscle: water, proteins, carbohydrates, fats, vitamins, and minerals. The result is identical to traditional meat at the cellular level, and looks, tastes, and cooks the same.

Alternative proteins are not solely for vegetarians and vegans. Rather, consumer studies indicate that approximately one-third of U.S. consumers are very or extremely likely to purchase plant-based meat. A full 97 percent of this high purchase intent group eat meat: in fact, 34 percent are heavy meat eaters (who eat meat more than twice per day).[7] Similarly, studies indicate that two-thirds of U.S. consumers are willing to try cultivated meat and one-third indicate interest in eating it regularly once available on the market.[8] Due to consumers' demonstrated willingness to eat plant-based and cultivated meat, these alternative proteins represent a viable way to meet the growing global demand for meat.

B. Alternative Proteins Are Much More Efficient than Conventional Meat

Producing meat from plants or directly from cells is more efficient and can conserve natural resources. Using cropland to grow food for humans instead of for feedstocks that are fed to animals would allow American farmers to feed more than twice as many people.[9] That would

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[5] Stephen J. Bronner, *With $72 Million in Funding, the Entrepreneur Behind Beyond Meat Pursues Innovation Over Profit*, Entrepreneur (Jan. 22, 2018), https://bit.ly/37xesr6.

[6] Deena Shanker, Lydia Mulvany, & Mike Hytha, *Beyond Meat Just Had the Best IPO of 2019 as Value Soars to $3.8 Billion*, Fortune (May 2, 2019), https://bit.ly/2XCIxkJ.

[7] Christopher Bryant et al., *A Survey of Consumer Perceptions of Plant-Based and Clean Meat in the USA, India, and China*, Frontiers in Sustainable Food Systems (2019), https://bit.ly/2saeC7N; *see also* The Good Food Institute, State of the Industry Report on Plant-based Meat, Eggs, and Dairy (2019), https://www.gfi.org/industry (also available as Appendix A).

[8] Jo Anderson & Chris Bryant, *Messages to Overcome Naturalness Concerns in Clean Meat Acceptance*, Faunalytics (2018), https://bit.ly/2XCKzBg; Matti Wilks & Clive J. C. Phillips, *Attitudes to In Vitro Meat: A Survey of Potential Consumers in the United States*, PLoS ONE (2017), https://bit.ly/2qt1wlL.

[9] Christian J. Peters et al., *Carrying Capacity of U.S. Agricultural Land: Ten Diet Scenarios*, Elementa Sci. Anthropocene (2016), https://bit.ly/2OAf9Hz; Alon Shepon et al., *The Opportunity Cost of Animal Based Diets Exceeds All Food Losses*, PNAS (2018), https://bit.ly/2rhTf3U.

increase the food supply three times as much as recovering all the food that spoils or gets thrown away before it can be eaten.[10]

In contrast to traditional meat, both the primary ingredients and processing methods for plant-based meats have very low greenhouse gas emissions, and additional processing accounts for only 13 to 26 percent of plant-based meat's relatively light climate impact.[11] Life-cycle analyses of plant-based burgers produced by Impossible Foods and Beyond Meat conclude that they reduce greenhouse gas emissions by approximately 89 percent compared to traditional ground beef.[12] Additional benefits are explained in Table 1.

Table 1: Environmental Benefits of Plant-Based Meat Products[13]

Eating this plant-based meat	instead of this conventional meat	reduces this environmental impact by this much.			
		Land use	**Greenhouse gas emissions**	**Water use**	**Aquatic eutrophication potential**
		m^2-y/kg	kg-CO2-eq/kg	L/kg	g-$PO4^3$-eq/kg
Impossible Burger 2.0[14]	Beef burger*	96%	89%	87%	91%
Beyond Burger[15]	Beef burger**	-	89%	99%	—
Grillers Original Burger[16]	Beef burger*	93%	85%	95%	77%

[10] Alon Shepon et al., *The Opportunity Cost of Animal Based Diets Exceeds All Food Losses*, PNAS (2018), https://bit.ly/2rhTf3U.

[11] Martin C. Heller & Gregory A. Keoleian, *Beyond Meat's Beyond Burger Life Cycle Assessment: A Detailed Comparison between a Plant-based and an Animal-based Protein Source*, Univ. Mich. Ctr. Sustainable Sys. (2018), https://bit.ly/2XIk11I (hereinafter "Beyond Meat LCA"); Jon Dettling et al., *A Comparative Life Cycle Assessment of Plant-based Foods and Meat Foods*, Quantis USA & MorningStar Farms (2016), https://bit.ly/33bVnrh (hereinafter "MorningStar Farms LCA").

[12] Sofia Khan et al., *Comparative Environmental LCA of the Impossible Burger with Conventional Ground Beef Burger*, Quantis USA & Impossible Foods (2019), https://bit.ly/2D6oVMb (hereinafter "Impossible Foods LCA"); Beyond Meat LCA.

[13] This table represents the results of all English-language comparative life cycle assessments of plant-based meat conducted as of May 1, 2019. Because each study differs slightly in its methodology, the results from different studies cannot be precisely compared.

[14] Impossible Foods LCA.

[15] Beyond Meat LCA.

[16] MorningStar Farms LCA.

Eating this plant-based meat	instead of this conventional meat	reduces this environmental impact by this much.			
		Land use	**Greenhouse gas emissions**	**Water use**	**Aquatic eutrophication potential**
		m^2-y/kg	kg-CO2-eq/kg	L/kg	g-$PO4^3$-eq/kg
Spicy Black Bean Burger[16]	Beef burger*	97%	89%	96%	76%
Roasted Garlic & Quinoa Burger[16]	Beef burger*	93%	88%	98%	73%
Grillers Crumbles[16]	Ground beef**	99%	90%	96%	—
Original Sausage Patties[16]	Pork sausage patties*	47%	30%	81%	51%
Original Chik Patties[16]	Breaded chicken patties*	84%	36%	72%	75%

*Sold frozen. **Sold fresh.
Impact reductions are calculated as follows: *(impact of conventional meat − impact of plant-based meat) ÷ (impact of conventional meat).*

While cultivated meat is not yet on the market, all three environmental studies of cultivated meat published so far show very promising results. Cultivated chicken will use 35 to 67 percent less land than current chicken farms do and reduce nutrient pollution by 70 percent. The positive impact of cultivated beef is even greater, reducing land use by over 95 percent, climate change emissions by 74 to 87 percent, and nutrient pollution by 94 percent.[17]

Cultivated meat could also be produced more efficiently than traditional meat. In the seven weeks it takes a farmer to raise a flock of 20,000 chickens, a cultivation facility could theoretically produce a million times as much meat from a starter culture the size of a single egg.[18]

[17] The Good Food Institute, *Growing Meat Sustainably: The Cultivated Meat Revolution* 2 (Oct. 2019), https://bit.ly/2XCITaQ.

[18] Based on a starter cell culture density of 4 x 107 per mL and production values from Mattick et al. 2015, compared with chicken production data in Putman et al. 2017 and an edible weight to live weight ratio of 0.52. Carolyn S. Mattick et al., *Anticipatory Life Cycle Analysis of In Vitro Biomass Cultivation for Cultured Meat Production in the United States*, Enviro. Sci. & Tech. (2015), https://bit.ly/3381FZ3; William B. Putnam et al., *A Retrospective Analysis of the United States Poultry Industry*, Agric. Sys. (2017), https://bit.ly/2OFlm5j.

Alternative proteins show significant potential to serve as environmentally and efficient ways to meet consumers' growing demand for meat. To realize the benefits, the government should fund research to accelerate and refine these technologies.

II. The Role of the United States Government

A. Research Funding Will Speed Progress on Alternative Proteins, Resulting in Reduced Emissions

While some remarkable products are on the market, nearly all plant-based meats widely available today are burgers and nuggets made from soy, wheat, or peas, and cultivated meat is not yet on the market. To have a significant environmental impact, a wide variety of plant-based and cultivated meats (including steaks and fillets) must be available to consumers at affordable price points.

Current alternative protein supply chains and infrastructure experience pinch points that prevent them from operating at maximum efficiency. Challenges include the limited variety of commonly grown crops, lack of crop optimization for functionality as meats, inefficient processing capabilities of specialty crops, lack of economically viable growth media, unavailability of standardized cell lines, and obstacles to cost-effective cultivator scale-up, among others. Addressing these challenges will require research in the following areas:

- Plant-Based Meat
    - Characterizing proteins to assess their suitability as ingredients
    - Screening novel protein-rich crop varieties
    - Developing protein extraction methods
    - Improving protein functionality and structuring
    - Optimizing plant-based food manufacturing methods

- Cultivated Meat
    - Developing stable agriculturally relevant cell lines
    - Optimizing cell culture media for growing meat
    - Exploring novel methods of scaffolding support for muscle cell growth
    - Improving cultivator (bioreactor) designs

Research in these areas would remove barriers and accelerate progress, allowing these sectors to provide food and jobs to the American people with a smaller environmental footprint.[19]

[19] See Appendix B for an overview of the technological research landscape for plant-based and cultivated meat.

B. Private Funding Is Not Sufficient

Currently, the vast majority of U.S. research related to plant-based and cultivated meat occurs in the private sector. While this investment has grown in recent years, the overall amount remains fairly small: as of 2019, around $140 million had been invested in cultivated meat companies[20] and $17 billion in plant-based meat companies[21] — but only a fraction has gone to research. By comparison, investments in the broader food technology sector in 2018 alone totalled $10.4 billion and investment in renewable energy research and development in 2018 totalled $13.1 billion ($7.6 billion from corporations, $5.5 billion from governments).[22]

While private sector research and development is valuable, it should not displace public sector funding. Private research and development is generally proprietary, meaning that it only benefits the companies investing in it, not the bioeconomy as a whole. In comparison, publicly funded research can take on longer-term, more basic research questions with higher risk but also potentially higher (and broader) value to the economy, providing seed knowledge for multiple companies or even spawning entire industries. Such research lowers barriers to entry by enabling startups to focus their limited funds and creativity on the commercialization and scale up of new products.

It is widely acknowledged that agricultural research significantly stimulates economic growth. Indeed, former Secretary of Agriculture Tom Vilsack estimated a return of $20 worth of economic activity for every dollar invested in research.[23] More broadly, two Massachusetts Institute of Technology professors conclude that "almost every major innovation in this [post-WWII] era relied in an important way on federal government support, provided by both Democratic and Republican administrations."[24] Supercomputers, the Internet, and the Human Genome Project, for example, are innovations that grew from federally supported research and sparked new industries that have transformed the world in unexpected and extraordinary ways.

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[20] Elliot Swartz, *Money Raised, A Bit of Science* https://bit.ly/31xWG2N (last updated Oct. 2019).

[21] The Good Food Institute, *State of the Industry Report on Plant-based Meat, Eggs, and Dairy* (2019), https://www.gfi.org/industry (also available as Appendix A).

[22] *Id*. at 31; *Global Trends in Renewable Energy Investment 2019*, Frankfurt School-UNEP Centre & BloombergNEF (2019), https://bit.ly/2XEvpLP.

[23] Press Release, *USDA Secretary Announces Creation of Foundation for Food and Agricultural Research*, USDA (July 23, 2014), https://bit.ly/37u0Vkj.

[24] Jonathan Gruber & Simon Johnson, *Jump-Starting America: How Breakthrough Science Can Revive Economic Growth and the American Dream*, MIT (2019), https://bit.ly/33ebJPY.

In the same way, investing in public research on alternative proteins will have positive impacts on the climate and the economy. Other countries understand this dynamic. Israel,[25] the Netherlands,[26] and Japan[27] have each invested in cultivated meat companies in their respective countries. Canada is investing more than $50 million (Can$75 million) in an effort to secure Canadian leadership in the plant protein sphere (the entire endeavor, funded by a consortium, represents a total investment of $114 million (Can$150 million)).[28] The European Union has approved a four-year research plan investing $9.1 million (€8.2 million) in an effort to develop nutritious plant and microbial protein products.[29] India has given grants to multiple research centers for cultivated meat research totaling about $640,000.[30] Finally, Singapore — the city-state with a population and GDP less than two percent of that of the United States — is investing $535 million in research to position its economy at the cusp of the high technology economy, including research on alternative proteins.[31] The United States should protect our competitive position and technological leadership by investing in research critical to these sectors too.

III. Conclusion

The best way the federal government can address the climate impacts of our food supply is to fund research that will allow Americans to produce meat that people want with a smaller environmental footprint. A federally funded, interagency, multisectoral, multidisciplinary research and development initiative for alternative proteins would accelerate progress and achieve a more climate-friendly food supply faster than the private sector would on its own.

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[25] Niamh Michail, *Aleph Farms CEO on Its 3D Cultured Beef: 'Unlike Other Companies, Our Meat Grows Together Like Real Meat'*, FoodNavigator (May 2, 2018), https://bit.ly/2DXQkT5.

[26] Elie Dolgin, *Sizzling Interest in Lab-grown Meat Belies Lack of Basic Research*, 566 Nature 161-62 (2019), https://go.nature.com/2ShIzii.

[27] Helen Marvell, *Japanese Government Part of $2.7 Million Investment in New Clean Meat Brand*, LiveKindly (June 5, 2018), https://bit.ly/2FJdr2r.

[28] *Program Guide*, Protein Indus. Canada, 5-6 (Apr. 2019), https://bit.ly/2P92vRL.

[29] *Smart Protein for a Changing World*, CORDIS European Comm'n, Grant Agreement ID 862957 https://bit.ly/342y5Fh (last updated Oct. 14, 2019).

[30] Ramya Ramamurthy, *Indian Government Grants Over $600,000 to Cell-based Meat Research*, GFI (Apr. 26, 2019), https://bit.ly/2Le2Sdv.

[31] Yoolim Lee & Joyce Koh, *Singapore Backs Lab-Grown Meat, Robots in $535 Million Push*, Bloomberg (Mar. 27, 2019), https://bloom.bg/2FI4PKu.

We appreciate your consideration of our comments and look forward to working with you to achieve a better future of food through investment in alternative proteins.

Sincerely,

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Appendix A

THE GOOD FOOD INSTITUTE

State of the Industry Report

Plant-based Meat, Eggs, and Dairy

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Bruce Friedrich, Executive Director

Taste is the top driver of consumer food choice,[1] and one thing that has always been clear is that consumers love the taste of meat. Globally, consumers' appetite for meat has been rising,[2] and with the global population projected to reach 9.8 billion by 2050,[3] demand for animal-based foods is expected to rise by nearly 70 percent.[4] In order to meet this demand without exacerbating the numerous and well-documented impacts of animal agriculture on the environment and public health,[5] new and innovative approaches for producing meat are needed.

One such innovative approach is to make meat entirely out of plants. This approach involves understanding the biochemical composition and three-dimensional structure of meat, and replicating those qualities using plant-based ingredients and novel manufacturing techniques. Several products on the market today, such as **Beyond Sausage** and the **Impossible Burger,** have demonstrated that this biomimicry approach can create the flavor, texture, and overall experience of eating meat with a high degree of fidelity and consumer satisfaction.

Although the U.S. plant-based meat industry dates back to the 19th century,[6] and several of today's leading plant-based meat companies were established in the 1970s-90s, the market for plant-based meat has remained small and relatively stagnant until the past decade, with even more dramatic growth in the past few years. There are a few reasons for this. For one, the biomimicry approach only really began when Beyond Meat was founded in 2009 and Impossible Foods shortly after, in 2011. This is when product quality began to dramatically improve, from products that were good enough for vegetarians to products that were simply good. After trying Beyond Meat's plant-based chicken in 2013, Bill Gates said, "What I was experiencing was more than a clever meat substitute. It was a taste of the future of food."[7] It's not only the biomimicry approach that has prompted dramatic improvements in the quality of plant-based meats on the market today. A variety of products also have emerged that make no attempt to precisely replicate the taste and texture of meat, but instead create plant-forward, center-of-the-plate experiences, using ingredients like jackfruit, seitan, mushrooms, beans, and a variety of herbs and spices.

Simultaneous with improvements in taste and texture, shifting consumer values have created a favorable market for plant-based meat. Consumers are increasingly considering such factors as health, sustainability, and social impact in making their food decisions,[8] and nearly one-third of the U.S. population is flexitarian.[9] Rather than confine their profits to the small portion of the population that is vegetarian, plant-based meat companies are using novel marketing strategies to target their products toward flexitarians.

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In 2016, the **Beyond Burger** became the first plant-based meat product to be sold in the refrigerated meat case, where flexitarian consumers are accustomed to shopping for their protein. All these factors combined have led to a booming market for plant-based meat. Between 2017-2018, retail sales of plant-based meat grew 23%, while total U.S. retail food sales grew just 2%.[10]

Plant-based meat's commercial success was preceded by that of plant-based milk, which began to gain popularity in the early 2000s,[11] also due to a mix of improved product quality, rising consumer perception of soy as a health food following a 1999 FDA ruling,[12] and perhaps most importantly, merchandising of plant-based milk products in the refrigerated dairy case in gable-top packaging as opposed to aseptic cartons in center-of-store.[13] In 2018, retail sales of plant-based milk were $1.8 billion, which equates to 13% of the total U.S. retail milk market. Household penetration is currently 37%, meaning more than 1 in 3 U.S. households purchase plant-based milk.[10] Plant-based milk is sold in 89% of retail food stores and 100% of grocery stores (as measured by %ACV).[10]

Several other plant-based dairy categories are also in the beginning stages of the explosive growth that has been observed in the plant-based milk category. For example, retail sales of plant-based creamer have grown 62% in the past year, while retail sales of plant-based cheese grew 41% and plant-based yogurt grew 54%. Due to the alignment of market factors between these emerging categories and the historic trajectory of the plant-based milk industry, we expect to see these other plant-based dairy categories, as well as plant-based meat, reach similar levels of ubiquity in the coming years.

In addition to an increase in sales, there has also been a large influx of investment into the plant-based food industry in the past five years. In total, $17 billion has been invested in the plant-based food industry, including $13 billion in the past two years. Investors include visionary tech entrepreneurs, VCs, accelerators, and multinational food conglomerates like Nestle, General Mills, and Danone. Several leaders in the conventional meat industry have also begun to invest in, acquire, and develop new plant-based meat products in-house, all while rebranding themselves as protein companies that aim to provide the most options to consumers.

To quantify this investment activity, GFI used PitchBook to conduct a custom analysis of investments in plant-based food companies that are based in the U.S. and/or selling products in the U.S. In addition to investment activity, we also examine the current market for plant-based food, including an analysis of the custom data we commissioned from syndicated market research firm

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Nielsen in August 2018, which provides unparalleled insight into plant-based food sales trends and consumer profiles. Also included in this report are an analysis of the current foodservice market for plant-based food and a regulatory update on issues such as labeling and regulatory approvals.

Synthesizing knowledge from all of these sources, The Good Food Institute has produced this first-of-its-kind report to serve as a benchmark for the entire plant-based food industry. To track developments moving forward, we plan to publish a new report each year. We hope this information will help to inform future investments in the plant-based food industry. We're looking forward to acting as a resource to companies and investors in the plant-based food industry as it continues to develop in the coming years.

What is Plant-based Food?

For the purpose of this report, GFI is using the term "plant-based food" to refer to plant-based products that are direct replacements for animal-based products, such as plant-based meat, seafood, eggs, and dairy. This includes products that use the biomimicry approach to replicate the taste and texture of meat, as well as plant-forward products (such as jackfruit, seitan, tofu, and tempeh) that serve as functional meat replacements. Meals that contain direct animal ingredient replacements are also included in our scope. Inherently plant-based foods that do not have an animal-based counterpart, such as chickpeas and kale, are not included. Please note that, although they are not biologically classified as plants, fungi- and algae-based products are included in our definition of plant-based foods.

Tofu & Tempeh

Plant-based Meat

Plant-based Milk

Eggs Substitutes & Mayo

Meals

Other Dairy Alternatives

- Cheese
- Yogurt
- Ice Cream, novelty & frozen desserts
- Butter
- Dips, dressings & sour cream
- Iced Coffee
- Creamers

Section 2: Companies

The leading companies in the plant-based food industry represent a range of heritage brands that have been around since the 1970s-90s, as well as new entrants that have emerged within the past 10 years. These new entrants have generally been leaders in innovation, both in terms of product development and marketing strategies. Their success has set a new standard for the entire category, such that heritage brands have also recently started to invest heavily in innovation. One example of this is the re-branding and product taste and texture improvements made by Kraft Heinz to its BOCA products as part of its Springboard accelerator program in 2018.

Tables 1-3 provide alphabetized lists of the top 10 plant-based meat, milk, and cheese brands according to retail dollar sales as reported by Nielsen. Private-label products comprise 15% of the plant-based milk market and 1.4% of the plant-based meat market. Private-label products do not comprise a significant portion of the plant-based cheese market, indicating an untapped opportunity for plant-based cheese brands to enter into private-label agreements. In the plant-based milk and meat categories, if all private-label products are combined into one private-label "brand," it would fall into the list of top 10 brands in both categories.

Across plant-based categories, retail sales remain relatively concentrated to the top brands, indicating there is still substantial room for new entrants and diversification of options for consumers. The top 9 brands plus private-label comprise 91% and 95% of plant-based meat and milk retail sales, respectively. The top 10 plant-based cheese brands make up 97% of the market. Recognizing the demand for more varied plant-based options, retailers are increasingly devoting additional shelf space to plant-based products, rather than simply swapping out products within the same amount of shelf space. The plant-based ice cream and novelty, yogurt, meals, refrigerated milk, and creamer sets are expanding most rapidly (as measured by Equivalized SKU).[10] This represents an opportunity for increased competition to elevate the category as a whole, rather than cannibalize profits from other plant-based brands.

Several of the brands in the top 10 lists share a common parent company. For example, plant-based meat companies Field Roast and Lightlife are both owned by Canadian meat processor Maple Leaf Foods, and plant-based milk brands Silk and So Delicious are both owned by French multinational food conglomerate Danone. Additional details on mergers and acquisitions in the plant-based food industry can be found in the Exits section.

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Table 1: Top 10 Plant-based Meat Brands in Retail

Company	Parent Company	State	City	Founder/ CEO	Date Founded	Category	Example Products
Amy's Kitchen	N/A	CA	Petaluma	Andy Berliner (Founder, CEO) Rachel Berliner (Founder, VP)	1987	Frozen	 
Beyond Meat	N/A	CA	El Segundo	Ethan Brown (Founder, CEO)	2009	Frozen, Refrigerated	 
Boca	The Kraft Heinz Company	WI	Madison	Max Shondor (Founder) Bernard Hees (Parent company CEO)	1993	Frozen	 
Dr. Praeger's	N/A	NJ	Elmwood Park	Peter Praeger (Founder) Eric Somberg (Founder) Larry Praeger (CEO) Adam Somberg (President)	1992	Frozen	 
Field Roast	Maple Leaf Foods	WA	Seattle	David Lee (Founder) Dan Curtin (President) Michael McCain (Parent company CEO)	1997	Refrigerated	 
Gardein	Conagra	BC	Richmond	Yves Potvin (Founder) Sean Connolly (Parent company CEO)	2003	Frozen	 
Lightlife	Maple Leaf Foods	MA	Turners Falls	Michael Cohen (Co-Founder) Patricia Collins (Co-Founder) Dan Curtin (President) Michael McCain (Parent company CEO)	1979	Frozen, Refrigerated	 
Morningstar Farms	Kellogg	MI	Battle Creek	Steven Cahillane (Parent company CEO)	1975	Frozen	 
Quorn	Monde Nissin		Stokesley, UK	Kevin Brennan (CEO) Henry Soesanto (Parent company CEO)	1985	Frozen	 
Tofurky	N/A	OR	Hood River	Seth Tibbot (Founder) Jaime Athos (CEO)	1980	Refrigerated	 

* Note: This list represents the top 10 plant-based meat brands in retail and does not include foodservice sales. Collectively, private-label products would fall in the top 10, but since private-label represents an aggregate of smaller store brands, it was excluded from this list.

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Table 2: Top 10 Plant-based Milk Brands in Retail

Company	Parent Company	State	City	Founder/ CEO	Date Founded	Category	Example Products
Blue Diamond	N/A	CA	Sacramento	Mark Jansen (CEO)	1915	Refrigerated, Shelf Stable	
Bolthouse Farms	Campbell Soup Company	CA	Bakersfield	Jeffrey Dunn (CEO) Mark Clouse (Parent company CEO)	1915	Refrigerated	
Califia Farms	N/A	CA	Los Angeles	Greg Steltenpohl (Founder, CEO)	2010	Refrigerated, Shelf Stable	
Good Karma	Dean Foods	CO	Boulder	Loren Wallis (Founder) Doug Radi (CEO) Ralph Scozzafava (Parent company CEO)	1996	Refrigerated, Shelf Stable	
Dream	Hain Celestial	MO	St Louis	Robert Nissenbaum (Founder) Mark Schiller (Parent company CEO)	1971	Refrigerated, Shelf Stable	
Pacific	N/A	OR	Tualatin	Chuck Eggert (Founder, CEO)	1987	Shelf Stable	
Ripple	N/A	CA	Emeryville	Adam Lowry (Founder, CEO) Neil Renninger (Founder, CEO)	2015	Refrigerated, Shelf Stable	
Rebbl	N/A	CA	Emeryville	David Batstone (Founder) Palo Hawken (Founder) Sheryl O'Loughlin (CEO)	2011	Refrigerated	
Silk	Danone	CO	Broomfield	Steve Demos (Founder) Emmanuel Faber (Parent company CEO)	1978	Refrigerated, Shelf Stable	
So Delicious	Danone	OR	Springfield	Mark Brawerman (Founder) Emmanuel Faber (Parent company CEO)	1987	Refrigerated, Shelf Stable	

* Note: This list represents the top ten plant-based milk brands in retail and does not include foodservice sales. Collectively, private-label products would fall in the top ten, but since private-label represents an aggregate of smaller store brands, it was excluded from this list.

Section 2: Companies

Table 2: Top 10 Plant-based Cheese Brands in Retail

Company	Parent Company	State	City	Founder/ CEO	Date Founded	Category	Example Products
Daiya	Otsuka Pharmaceutical Co. Ltd.	BC	Vancouver	Greg Blake (Founder), Andre Kroecher (Founder), Kazumichi Kobayashi (Parent company CEO)	2008	Refrigerated	 
Field Roast	Maple Leaf Foods	WA	Seattle	David Lee (Founder) Dan Curtin (President) Michael McCain (Parent company CEO)	1997	Refrigerated	 
Follow Your Heart	N/A	CA	Canoga Park	Michael Besançon (Founder), Bob Goldberg (Founder), Paul Lewin (Founder), Spencer Windbiel (Founder)	1970	Refrigerated	 
Go Veggie!	GreenSpace Brands	RI	North Kingstown	Angelo Morini (Founder) Matthew von Teichman (Parent company CEO)	1980	Refrigerated	 
Kite Hill	N/A	CA	Hayward	Monte Casino (Founder), Tal Ronnen (Founder), Pat Brown (Founder), Rob Leibowitz (CEO)	2010	Refrigerated	 
Lisanatti	N/A	OR	Oregon City	Phil Lisac (Founder), Norma Lisac (Founder)	1978	Refrigerated	 
Miyoko's Creamery	N/A	CA	Petaluma	Miyoko Schinner (Founder, CEO)	2014	Refrigerated	 
So Delicious	Danone	OR	Springfield	Mark Brawerman (Founder) Emmanuel Faber (Parent company CEO)	1987	Refrigerated	 
Tofutti	N/A	NJ	Cranford	David Mintz (Founder, CEO)	1980	Refrigerated	 
Tree Line	N/A	NY	Kingston	Michael Schwarz (Founder, CEO)	2012	Refrigerated	 

* Note: This list represents the top 10 plant-based cheese brands in retail and does not include foodservice sales.

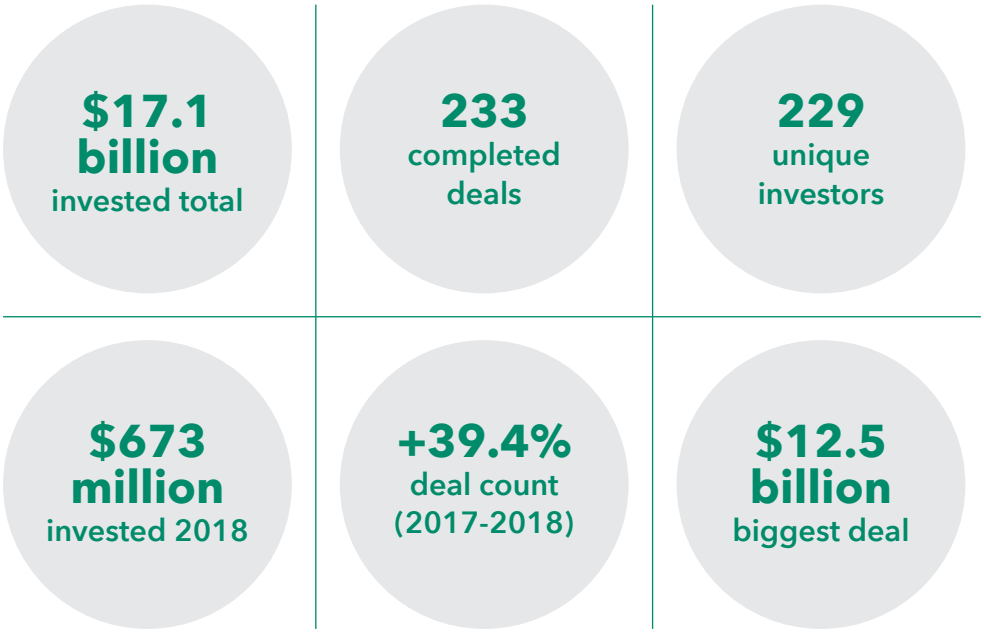
Section 3: Investments

Overview

Using PitchBook, GFI conducted a custom analysis of plant-based food companies that are based in the U.S. and/or selling products in the U.S.[14] Companies were classified as plant-based food companies if at least half their products meet the description in Box 1.

In total, we found that $17 billion has been invested in the plant-based food industry in 233 completed deals involving 229 unique investors (Figure 1). $673 million was invested in the plant-based food industry in 2018. Although capital invested decreased from 2017-2018 due to WhiteWave Foods' staggering $12.5 billion acquisition in 2017, deal count continued to rise, reaching 46 completed deals totaling in 2018, a 39% increase from the previous year.

Figure 1: Plant-based Food Industry Investment Overview



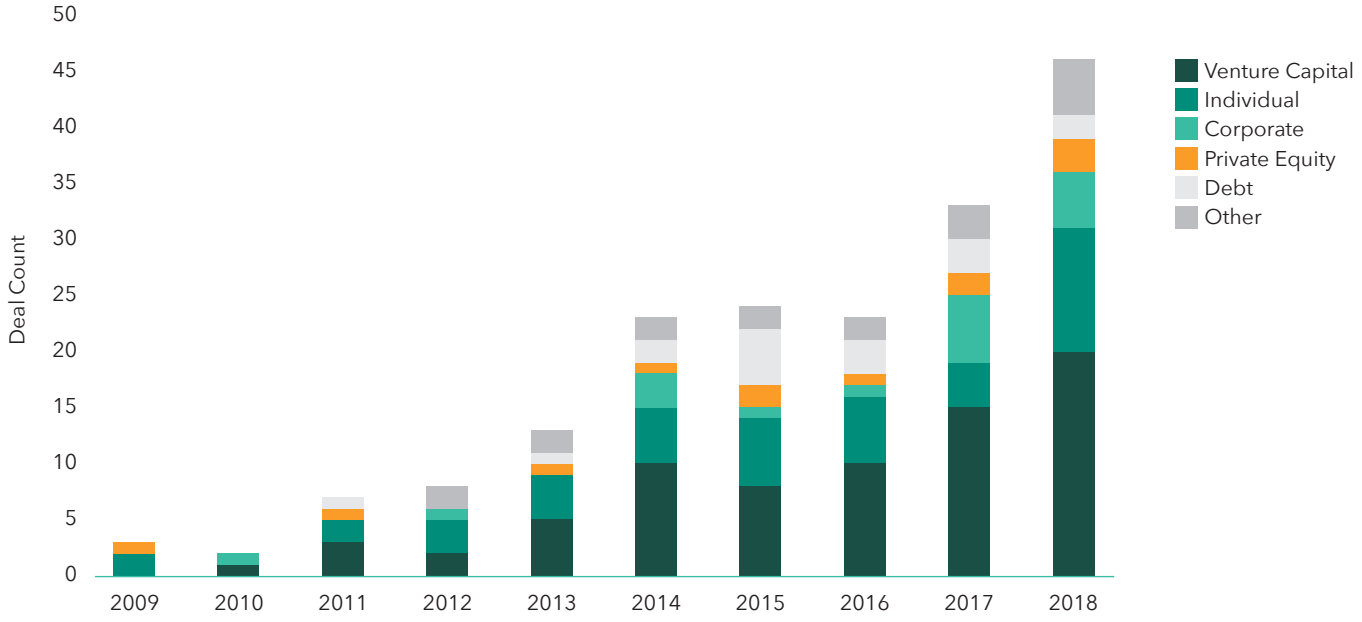
Source: GFI custom PitchBook analysis of plant-based food companies based in the U.S. and/or selling in the U.S.

PitchBook

Section 3: Investments

In 2018, venture capital was the most common type of funding, representing 43% of the total number of completed deals. Individual (angel) investments also were common, comprising 24% of deals, followed by corporate investments (11%), private equity (7%), and debt financing (4%). This distribution is fairly representative of the past five years (Figure 2).

Figure 2: Deal Count by Investment Type (2009-2018)



Source: GFI custom PitchBook analysis of plant-based food companies based in the U.S. and/or selling in the U.S.

PitchBook

Investors

The most active investors in plant-based food companies are impact investors, who focus on companies that have a positive social impact in addition to the potential for financial return (Figure 3). Three of these groups – Blue Horizon, New Crop Capital, and Stray Dog Capital – have each participated in 12 deals. Note that one deal represents participation in one funding round, meaning that an initial investment plus a follow-on investment in a single company would count as two deals.

Section 3: Investments

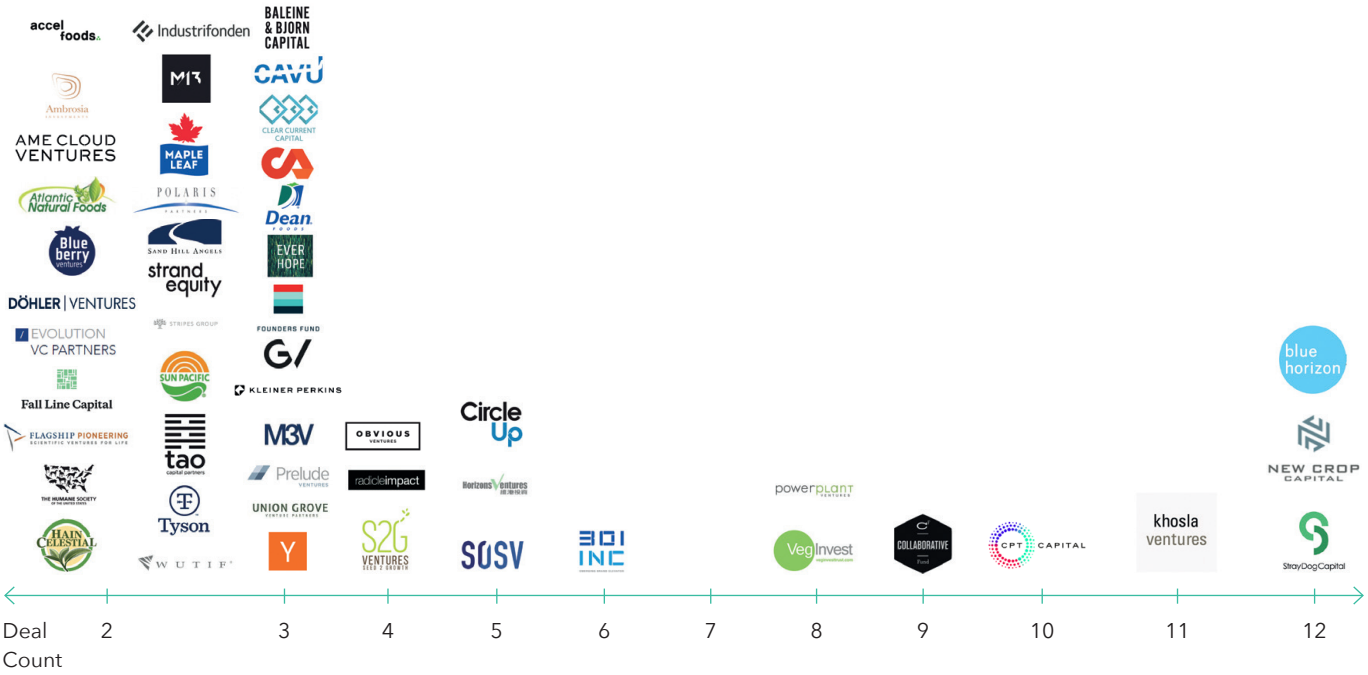
"This investment reinforces our focus on protein and enables us to support Beyond Meat's efforts to produce new, leading edge products. What we're most excited about is that we can do all of this while continuing to provide the great tasting, high quality food that is the hallmark of our company."
Justin Whitmore, Chief Sustainability Officer, Tyson Foods[15]

Investment activity from strategic investors like corporate VCs (e.g., General Mills' 301 Inc.), CPG investors (e.g., AccelFoods), and leading meat and dairy companies (e.g., Maple Leaf Foods and Danone), indicate that the broader food industry is recognizing the plant-based market opportunity. For example, Tyson Ventures, the VC arm of Tyson Foods, first invested in a 5% stake in Beyond Meat in 2016, and made a follow-on investment the next year as part of Beyond Meat's $55 million Series G round. These types of partnerships will enable plant-based brands to tap into leading food industry players' product development expertise, distribution networks, and production infrastructure.

Another investment trend we've observed is that a subset of companies within the plant-based food industry has begun to attract investors through their technology platforms as opposed to more traditional CPG metrics like sales, brand equity, and distribution. This shift has solidly aligned certain plant-based companies with the food-tech industry. In the future, we expect to see increasing involvement from strategic investors that have subject-matter expertise in relevant technical fields, such as crop biotechnology, biomaterials, and synthetic biology. GFI's **Plant-based Meat Mind Maps** explore these opportunity areas in further detail.

Section 3: Investments

Figure 3: Most Active Investors in the Plant-based Food Industry



Source: GFI custom PitchBook analysis of plant-based food companies based in the U.S. and/or selling in the U.S.

PitchBook

Photo credit: Tofurky

Section 3: Investments

Table 4: List of Investors in Plant-based Food Companies

Investor Name	Investments	Investor Type	HQ Location
Blue Horizon (Zurich)	12	Venture Capital	Zürich, Switzerland
Stray Dog Capital	12	Venture Capital	Leawood, KS
New Crop Capital	12	Venture Capital	New York, NY
Khosla Ventures	11	Venture Capital	Menlo Park, CA
CPT Capital	10	Venture Capital	London, UK
Collaborative Fund	9	Venture Capital	New York, NY
Powerplant Ventures	8	Venture Capital	Manhattan Beach, CA
VegInvest	8	Venture Capital	New York, NY
301 Inc.	6	Corporate Venture Capital	Minneapolis, MN
CircleUp Network	5	Other	San Francisco, CA
Gates Ventures	5	Venture Capital	Kirkland, WA
Horizons Ventures	5	Venture Capital	Hong Kong
SOSV	5	Venture Capital	Princeton, NJ
Obvious Ventures	4	Venture Capital	San Francisco, CA
Radicle Impact	4	Venture Capital	Oakland, CA
S2G Ventures (Seed 2 Growth)	4	Venture Capital	Chicago, IL
Baleine & Bjorn Capital	3	Other	New York, NY
CAVU Venture Partners	3	Venture Capital	New York, NY
Clear Current Capital	3	Venture Capital	Vero Beach, FL
Cleveland Avenue	3	Venture Capital	Chicago, IL
Dean Foods (NYS: DF)	3	Corporation	Dallas, TX
Everhope Capital	3	Venture Capital	Providence, RI
Founders Fund	3	Venture Capital	San Francisco, CA
GV	3	Corporate Venture Capital	Mountain View, CA
John Foraker	3	Angel (individual)	San Francisco, CA
Kleiner Perkins	3	Venture Capital	Menlo Park, CA
M3 Ventures	3	Venture Capital	New York, NY
Prelude Ventures	3	Venture Capital	San Francisco, CA
Union Grove Venture Partners	3	Venture Capital	Chapel Hill, NC
Y Combinator	3	Accelerator/Incubator	Mountain View, CA
AccelFoods	2	Venture Capital	New York, NY
Ambrosia Investments	2	Growth/Expansion	Luxembourg
AME Cloud Ventures	2	Venture Capital	Palo Alto, CA
Atlantic Natural Foods	2	Corporation	Nashville, NC
Bill Gates	2	Angel (individual)	Seattle, WA

Section 3: Investments

Investor Name	Investments	Investor Type	HQ Location
Blueberry Ventures	2	Venture Capital	Tiburon, CA
Döhler Ventures	2	Venture Capital	Darmstadt, Germany
Evolution VC Partners	2	Venture Capital	New York, NY
Fall Line Capital	2	Venture Capital	San Mateo, CA
Flagship Pioneering	2	Venture Capital	Cambridge, MA
Humane Society	2	Other	Washington, DC
Industrifonden	2	Venture Capital	Stockholm, Sweden
M13	2	Venture Capital	Beverly Hills, CA
Maple Leaf Foods (TSE: MFI)	2	Corporation	Mississauga, Canada
Polaris Partners	2	Venture Capital	Boston, MA
Sand Hill Angels	2	Angel Group	Sunnyvale, CA
Seth Goldman	2	Angel (individual)	Bethesda, MD
Strand Equity	2	Growth/Expansion	Los Angeles, CA
Stripes Group	2	Growth/Expansion	New York, NY
Sun Pacific	2	Corporation	Pasadena, CA
Tao Capital Partners	2	Venture Capital	San Francisco, CA
The Hain Celestial Group (NAS: HAIN)	2	Corporation	New York, NY
Tyson Ventures	2	Corporate Venture Capital	Chicago, IL
WUTIF Capital	2	Angel Group	Vancouver, Canada

Source: GFI custom PitchBook analysis of plant-based food companies based in the U.S. and/or selling in the U.S.

PitchBook

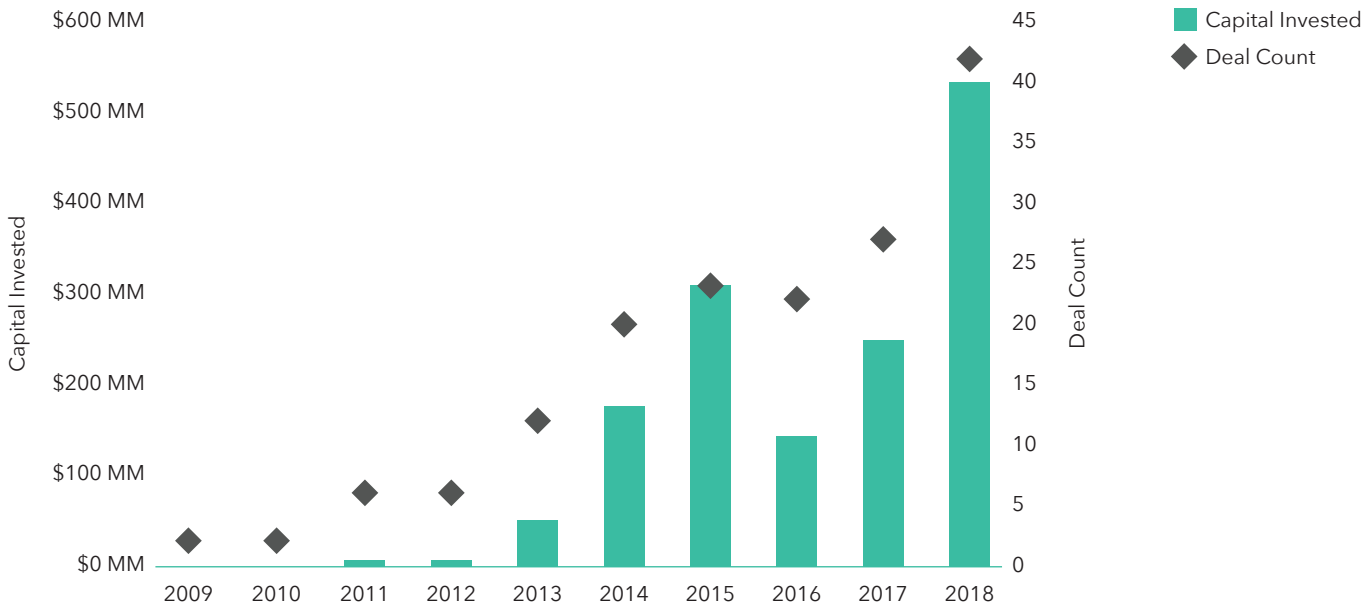
Pre-Exit Investments

Among pre-exit companies, there has been a clear upward trend in capital invested in the past 10 years, reaching more than $535 million in 2018 (Figure 4). The largest minority investments of 2018 were Impossible Foods' $189 million late-stage VC round (plus an additional $50 million in debt financing earlier in the year), Ripple's $65 million Series C round, Beyond Meat's $50 million Series H round, and Califia Farms' $50 million private equity round (Figure 5).

"In the pursuit of more protein consumption, the majority of that growth in North America will come from plant-based proteins, not animal proteins. We view ourselves as a protein company."
Michael McCain, CEO, Maple Leaf Foods[16]

Section 3: Investments

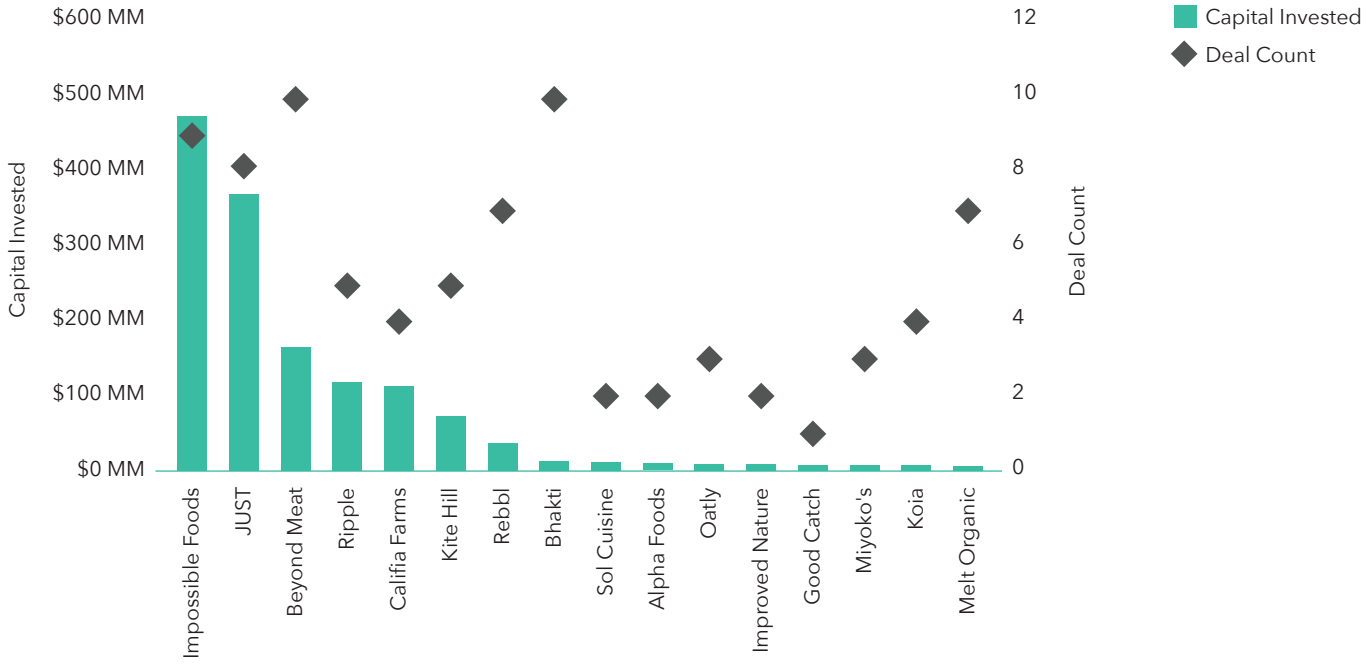
Figure 4: Investments in Pre-Exit Plant-based Food Companies (2009-2018)



Source: GFI custom PitchBook analysis of plant-based food companies based in the U.S. and/or selling in the U.S. excluding IPO, Merger/Acquisition, and Buyout/LBO

PitchBook

Figure 5: Top Funded Pre-Exit Plant-based Food Companies



Source: GFI custom PitchBook analysis of plant-based food companies based in the U.S. and/or selling in the U.S. excluding IPO, Merger/Acquisition, and Buyout/LBO

PitchBook

Section 3: Investments

Exits

The most common exit strategy within the plant-based food industry has been acquisition. There were four acquisitions of plant-based food companies in 2018. Maple Leaf Foods acquired Field Roast Grain Meat Company for $120 million and GreenSpace Brands acquired Galaxy Nutritional Foods, the creator of Go Veggie! plant-based cheese, for $17.8 million. The plant-based ice cream company JAWEA and flax milk company Good Karma Foods were acquired for undisclosed amounts by Affinity Beverage Group and Dean Foods, respectively. In October, Maple Leaf Foods announced the launch of **GreenLeaf Foods**, an independent subsidiary that will build a portfolio of plant-based brands, starting with Field Roast and Lightlife, which Maple Leaf had acquired in 2017 for $120 million and $140 million, respectively (Figure 6).

Overall, there has been an uptick in acquisition activity in recent years. In the past 10 years, there have been 19 acquisitions of plant-based companies, 10 of which occurred in the past two years. The largest acquisition to date was the $12.5 billion acquisition of the plant-based milk market leader WhiteWave Foods by Danone in 2017. The second-largest deal was the $726 million acquisition of mycoprotein-based meat company Quorn Foods by Monde Nissin in 2015.

Figure 6: Recent M&A Activity in the Plant-based Food Industry

Source: GFI custom PitchBook analysis of plant-based food companies based in the U.S. and/or selling in the U.S.

PitchBook

Historically, IPOs have been rare in the plant-based food industry. However, we may begin to see this exit strategy become more common. In November 2018, Beyond Meat filed for an IPO to raise $100 million, which will be the first IPO by a plant-based meat company. Previously, WhiteWave Foods raised $391 million in its 2012 IPO at a $2.9 billion valuation.

Section 4: Retail Market Overview

Retail Sales

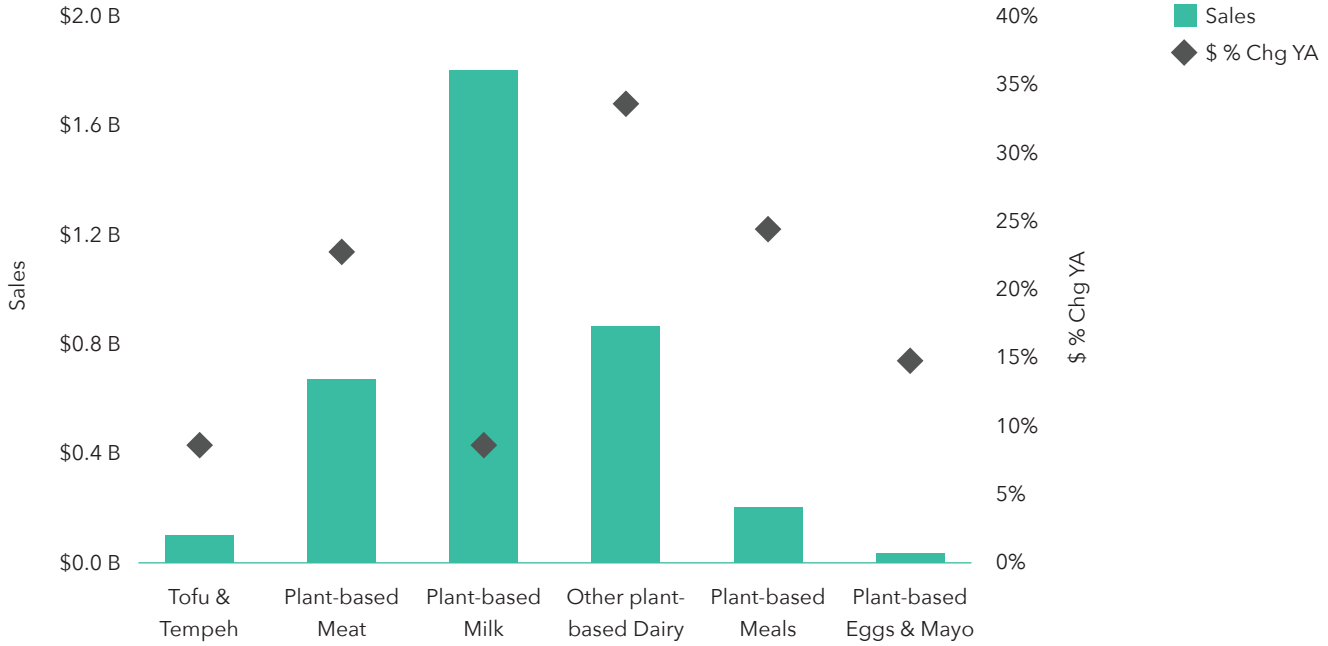
U.S. retail sales of plant-based food have grown 17% in the past year to more than $3.7 billion (Table 5). In comparison, total U.S. retail food sales grew just 2% during the same time period. The largest and most developed plant-based category is plant-based milk, accounting for $1.8 billion in sales. This represents 13% of the total U.S. retail milk market. The "other plant-based dairy" category, which includes non-milk dairy alternatives like ice cream, cheese, and yogurt, is the fastest growing, suggesting that these categories are following the upward trajectory of plant-based milk (Figure 7). Plant-based meat is the second-largest category at $684 million and is quickly growing, up 23% in the past year. This represents just under 1% of the total U.S. retail meat market.

Retail Market Data Collection

To size the U.S. retail market for plant-based foods, GFI commissioned retail sales data from market research firm Nielsen and developed custom categories at the SKU level. This data covers the scope and product categories described in Box 1. This data was obtained over the 52-week period ending August 11, 2018, from Nielsen's Expanded All Outlets Combined (xAOC) channel, which includes grocery stores, drug stores, mass merchandisers, club stores, dollar stores, and military stores, plus Whole Foods Market. This is generally considered the broadest view available of retail food sales, although not all retailers are represented, as some do not report their scanner data to Nielsen. Sales data for natural retailers is also not included, as that data is only available separately through market research firm SPINS.

Section 4: Retail Market Overview

Figure 7: Retail Plant-based Food Market Overview



Source: Nielsen custom defined data set, xAOC + WFM, 52 weeks ending 8/11/18.

nielsen

Table 5: Retail Plant-based Food Sales by Category

Category	Sales	$ Sales Chg vs. YA
Plant-based Milk	$1.82 billion	9%
Plant-based Meat	$683.7 million	23%
Plant-based Ice Cream and Frozen Novelty	$232 million	40%
Plant-based Meals	$209.7 million	25%
Plant-based Yogurt	$174.1 million	55%
Plant-based Butter	$168.8 million	6%
Plant-based Cheese	$133.2 million	41%
Plant-based Creamer	$124.5 million	62%
Tofu and Tempeh	$107.2 million	9%
Plant-based Eggs and Mayo	$42.4 million	15%
Plant-based Ready-to-Drink Coffee	$34.1 million	-12%
Plant-based Dressings, Sour Cream, Dips	$12.4 million	29%
Total Plant-based	**$3.7 billion**	**17%**

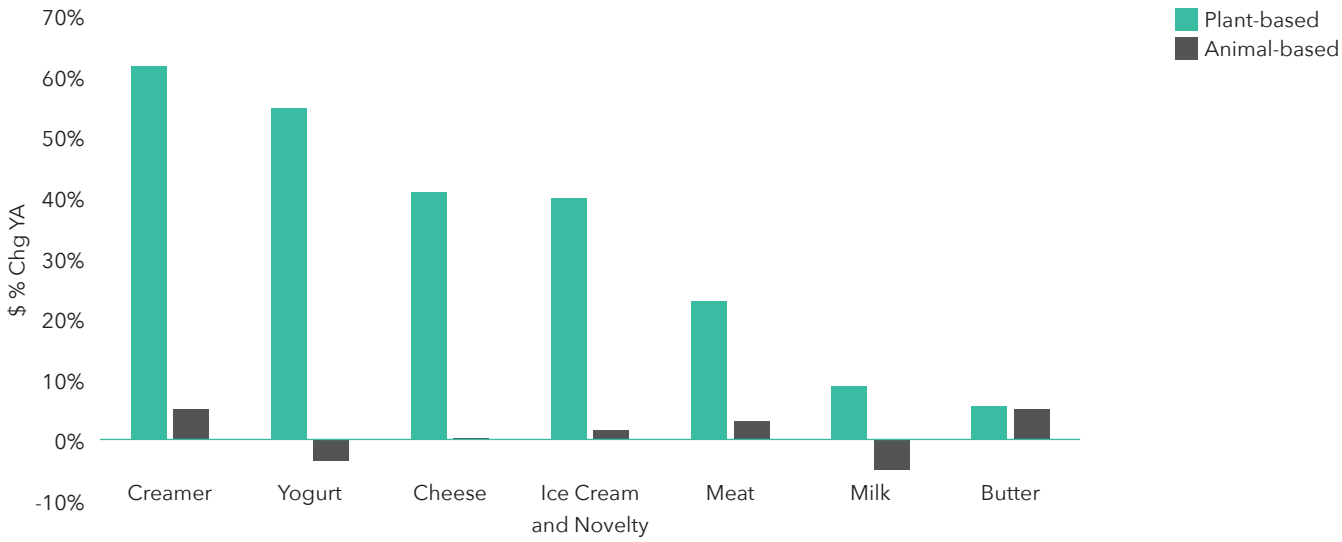
Source: Nielsen custom defined data set, xAOC + WFM, 52 weeks ending 8/11/18.

nielsen

Section 4: Retail Market Overview

Across individual product categories such as meat, milk, cheese, and yogurt, plant-based foods are significantly outpacing the sales growth of animal-based foods (Figure 8). In contrast, the animal-based categories of yogurt and milk are in decline. This trend isn't limited by region – the strong growth of plant-based foods remains consistent across the country, with double-digit dollar sales growth in all nine U.S. census regions for plant-based foods. Plant-based meat specifically shows even stronger sales growth across the U.S., with the top three regions growing at or above 24% (Figure 9).

Figure 8: Growth in Plant-based Categories Compared to Animal-based Categories



Source: Nielsen custom defined data set, xAOC + WFM, 52 weeks ending 8/11/18

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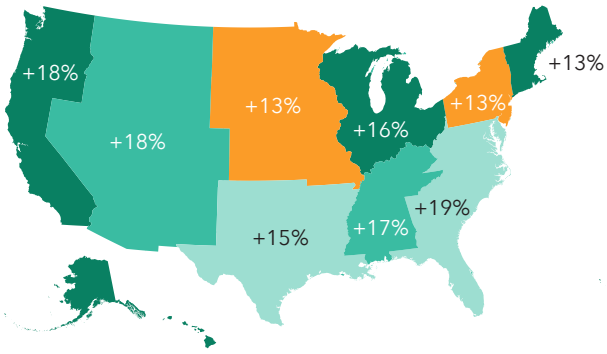
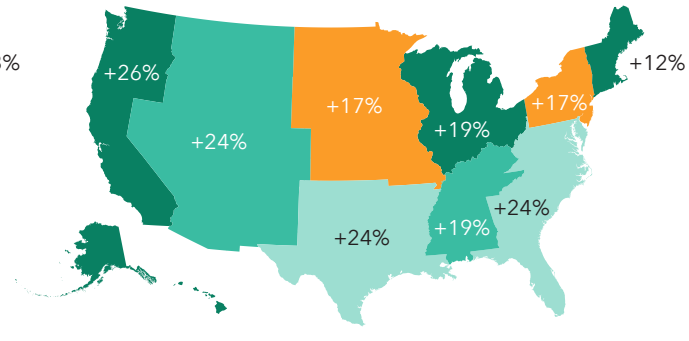
Figure 9: Plant-based Dollar Sales Growth by Region

Plant-based Food



Plant-based Meat



Source: Nielsen custom defined data set, xAOC + WFM, 52 weeks ending 8/11/18

nielsen

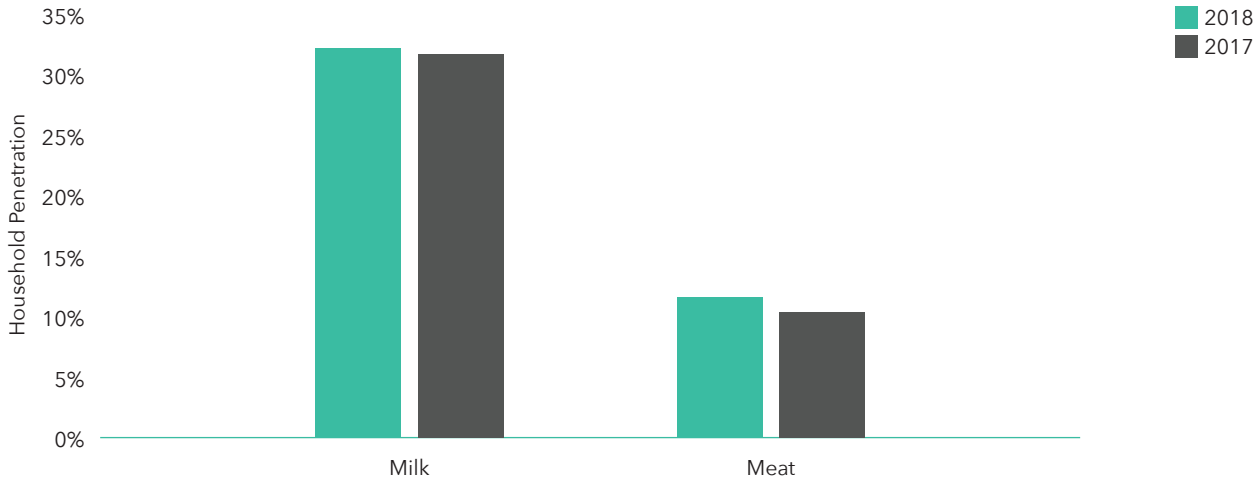
Section 4: Retail Market Overview

Consumer Insights

In addition to retail sales data, GFI obtained household panel data from Nielsen for two custom defined categories: plant-based meat and plant-based milk. This data provides insights into purchase dynamics and consumer demographics.

Plant-based milk has a household penetration rate of 37%, meaning more than 1 in 3 U.S. households purchase plant-based milk. Plant-based meat has a household penetration rate of 12%, up 1.4 points from just one year ago – an additional 1.8 million households (Figure 10).

Figure 10: Household Penetration of Plant-based Meat and Plant-based Milk



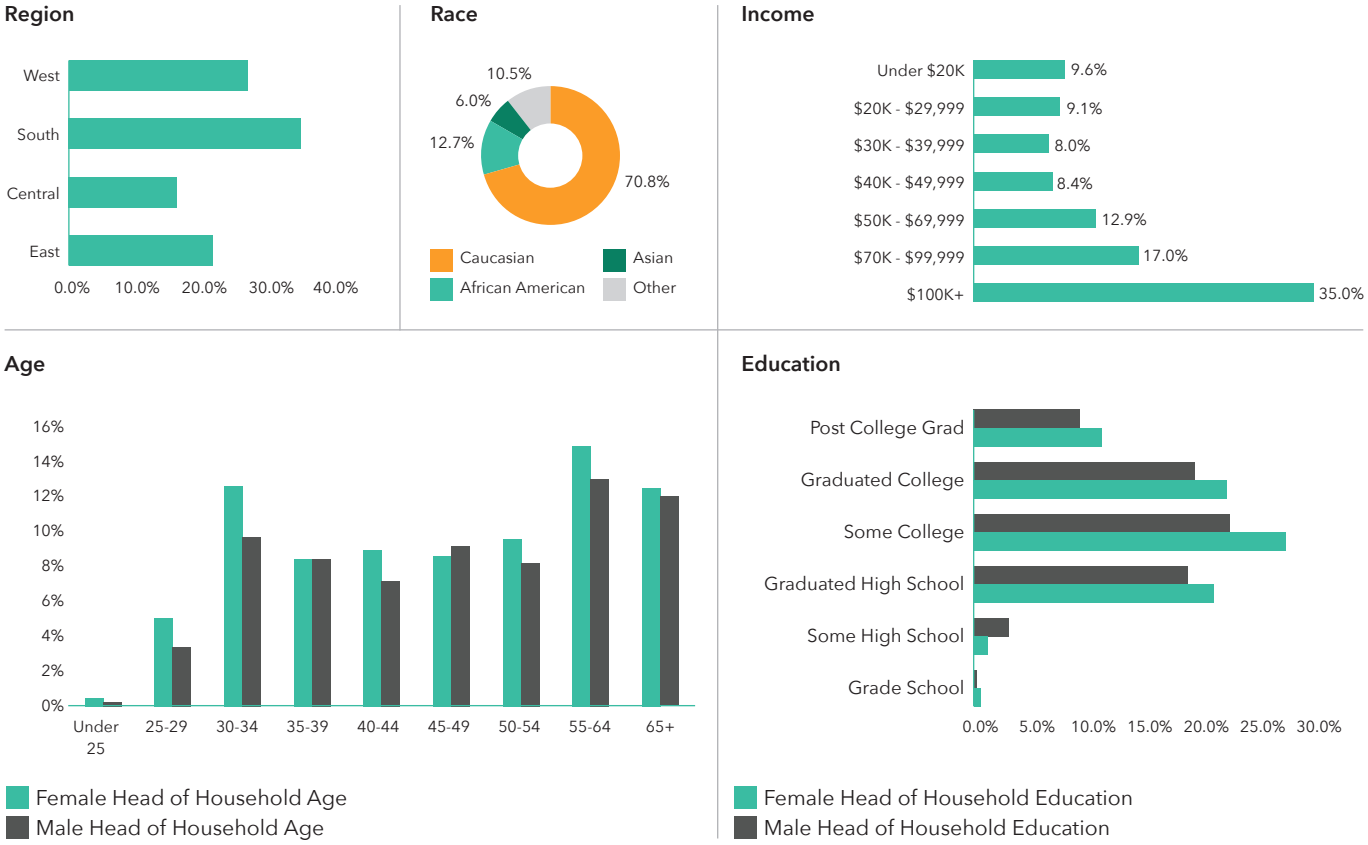
Source: Nielsen custom defined data set, xAOC + WFM, 52 weeks ending 8/11/18

nielsen

Section 4: Retail Market Overview

Consumer demographic data shows that while plant-based milk is purchased by all consumer groups, the category does over-index with a few demographic groups, including households with children under age 6; households earning more than $70,000 a year; households with a head of household between 25-49 years of age; college-educated households; and households in suburban and urban areas (Figure 11). Plant-based meat consumers follow a similar demographic skew, over-indexing even more significantly with millennials and higher-income households (Figure 12). These demographic attributes represent an opportunity for retailers to attract high-value consumers and increase average basket size by featuring a wide assortment of plant-based milk and meat options on shelf.

Figure 11: Plant-based Milk Consumer Demographics

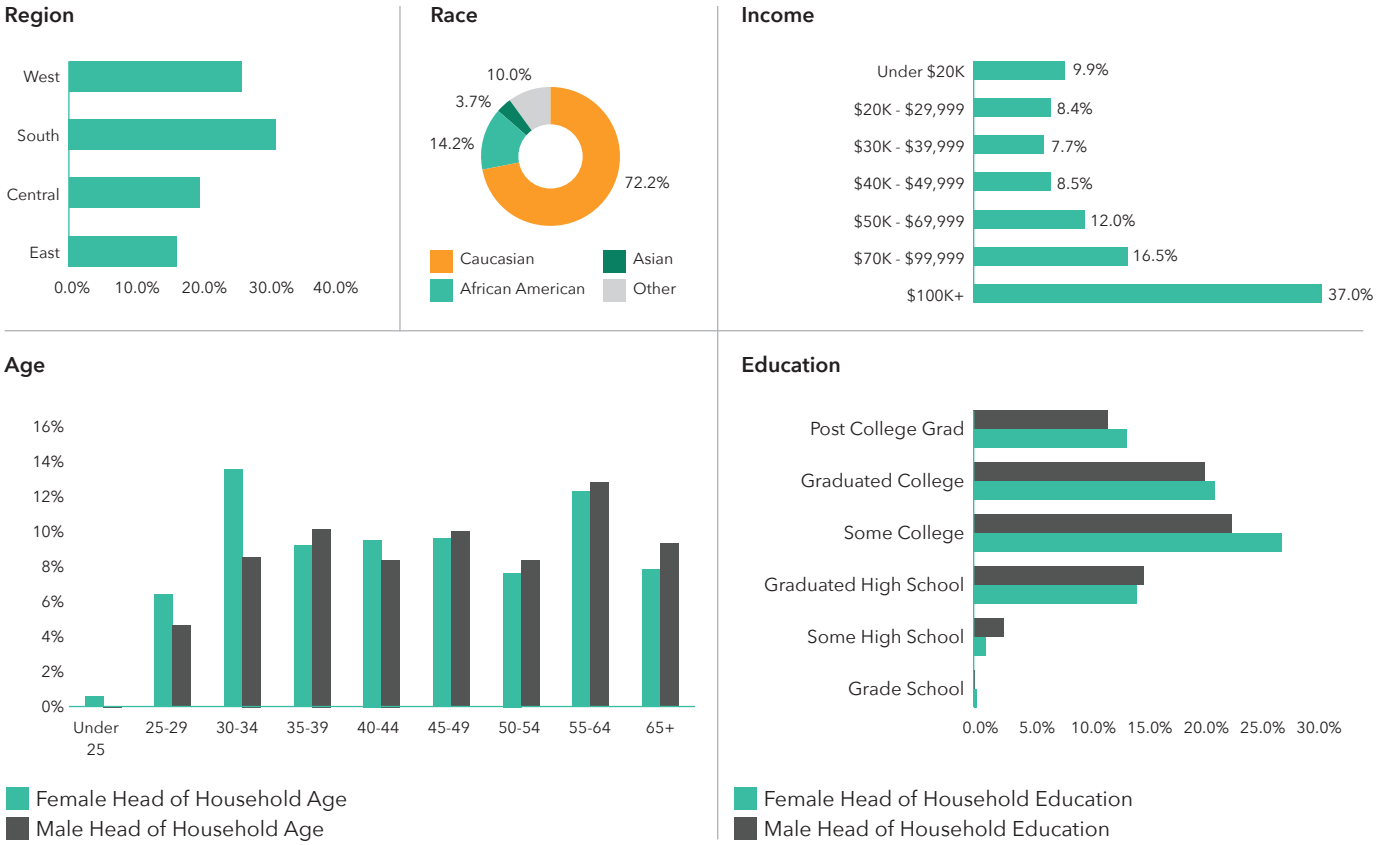


Source: Nielsen custom defined data set, xAOC + WFM, 52 weeks ending 8/11/18

nielsen

Section 4: Retail Market Overview

Figure 12: Plant-based Meat Consumer Demographics



Source: Nielsen custom defined data set, xAOC + WFM, 52 weeks ending 8/11/18

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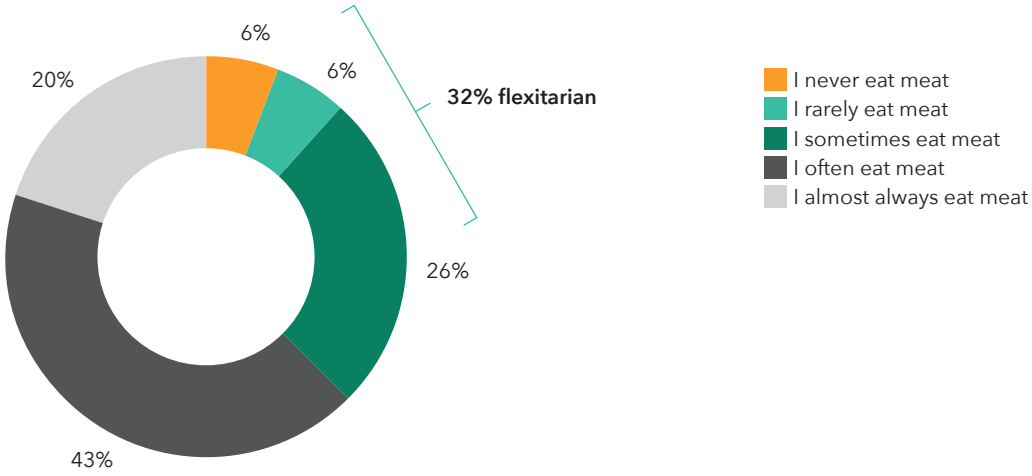
Aside from demographic factors, plant-based consumers can also be classified by psychographic factors such as dietary habits. Plant-based companies have been increasingly targeting their marketing toward flexitarians, who comprise nearly one-third of the U.S. population (Figure 13).[16] Interest in plant-based meat is likely to grow further, as one-third of U.S. consumers report that they have lowered their meat consumption over the past year (Figure 14).[17] The increasing adoption of plant-based products by flexitarians has been one of the primary driving factors in increased demand. For example, Beyond Meat estimates that more than 70% of Beyond Burger consumers are flexitarians.[18] 2018 U.S. consumer studies indicate that approximately one-third of U.S. consumers are very or extremely likely to purchase plant-based meat.[17,19] Among this high purchase intent group, 3% were vegan or vegetarian, 13% were light meat eaters (less than once per day), 50% were medium meat eaters (1-2 times per day), and 34% were heavy meat eaters (more than twice per day).[19] Thus, the trend for flexitarians – and even traditional omnivores – to seek out plant-based meat is projected to grow.

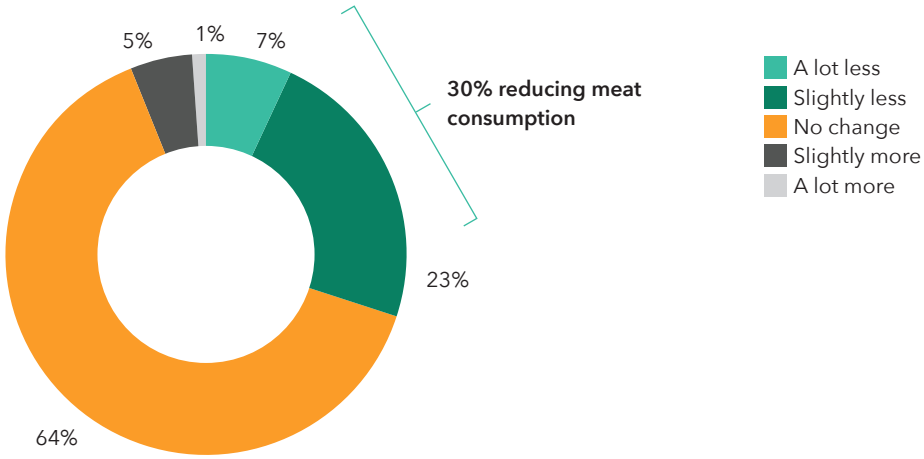
Section 4: Retail Market Overview

Figure 13: Current Meat Consumption of U.S. Consumers



Source: Szejda 2019

Figure 14: Changes in Meat Consumption of U.S. Consumers



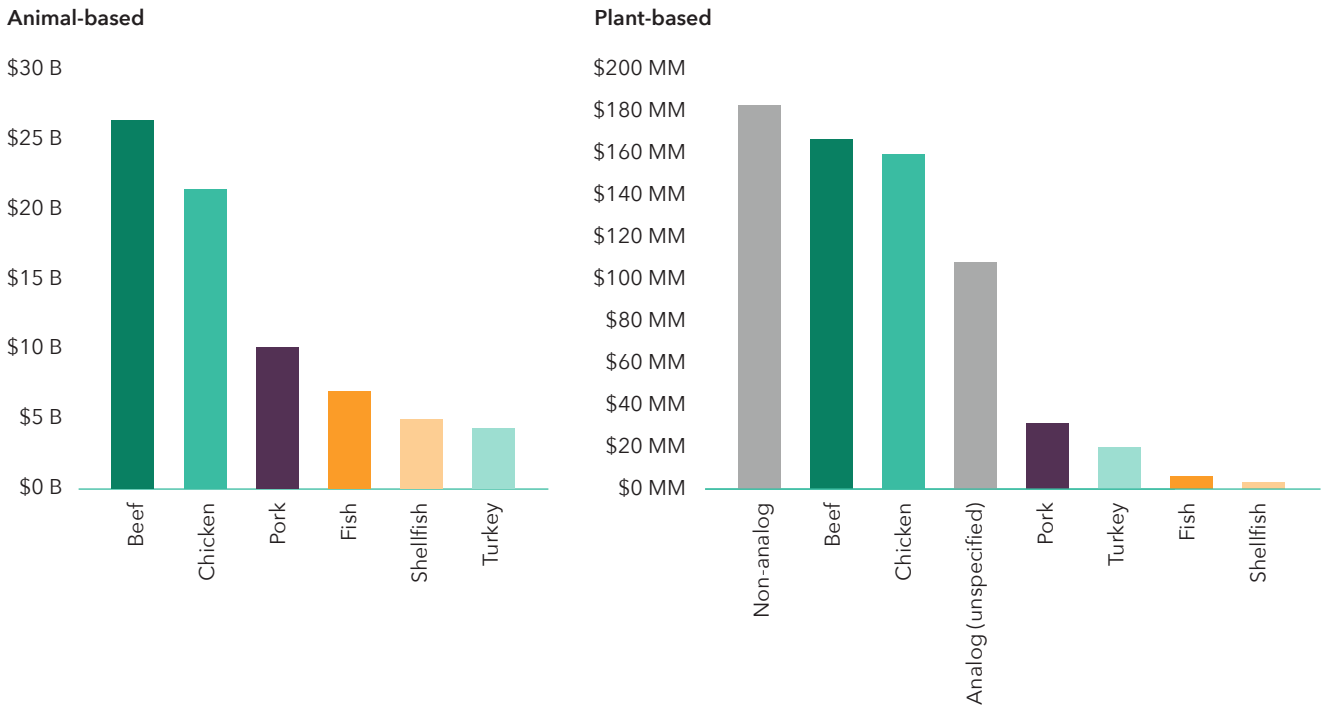
Source: Szejda 2019

Section 4: Retail Market Overview

White Space Product Opportunities

The increasing demand for plant-based foods presents an opportunity for startups and established brands to develop new products to fill current white spaces in the market. While plant-based beef and chicken products are relatively common, categories like pork, turkey, fish, and shellfish are underrepresented in the plant-based market (Figure 15). While retailers carry an average of 41 plant-based milk products (28 refrigerated and 13 shelf stable), they carry an average of 24 plant-based meat and seafood products (19 frozen and 5 refrigerated) as measured by Equivalized SKU. Increasing the number of options and diversity of products in less-developed plant-based categories could help grow the market share of plant-based products in various categories. In addition to product diversification, there is also still significant room across categories for product quality improvement, including both the biomimicry and plant-forward approaches.

Figure 15: Animal-based and Plant-based Product Retail Sales



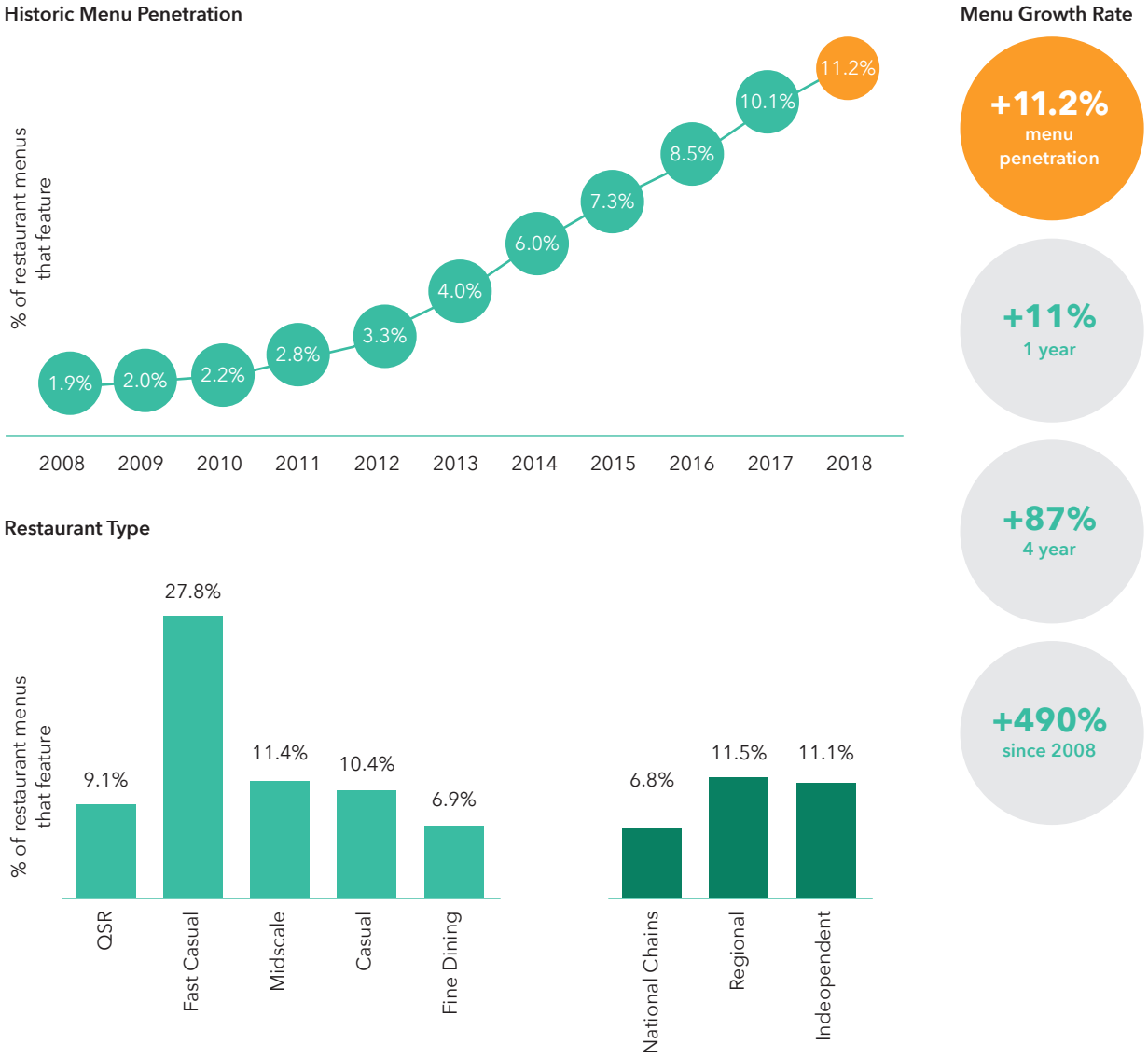
Source: Nielsen custom defined data set, xAOC + WFM, 52 weeks ending 8/11/18.
Note: The analog (unspecified) category was used to categorize plant-based meat products like hot dogs, chorizo, and sausage links when animal terms like "pork sausage" or "beef hot dog" were not used on the package.

nielsen

Section 5: Foodservice Market Overview

Many consumers first encounter new trends at restaurants.[20] Thus, the foodservice market is an important target for producers of innovative products, including plant-based foods. Market research firm NPD reports that plant-based protein shipments from distributors to foodservice operators increased by 20% in the year ending November 2018, with double-digit growth sustained across all U.S. regions.[21] According to GrubHub, plant-based dishes saw a 19% increase in orders in 2017[22] and plant-based bean burritos were the fastest-growing item of 2018.[23] The continued demand for plant-based offerings is having a long-term effect on restaurant menus. Datassential's MenuTrends database shows that menu penetration of "vegan" on U.S. menus has grown 490% since 2008, up to 11.2% of U.S. menus (Figure 16).[24]

Figure 16: Vegan Menu Penetration Over Time



Source: Datassential's MenuTrends Database

Section 5: Foodservice Market Overview

In 2018, several restaurant chains launched plant-based burgers on their menus. In March, Bareburger began offering both the Beyond and Impossible Burgers at all locations (Figure 17). The Impossible Burger was incorporated into menus at Fatburger, Umami Burger, Wahlburgers, and White Castle, while A&W Canada, Carl's Jr., and TGI Friday's added the Beyond Burger to their menus.

Figure 17: Restaurant Case Studies

UMAMI BURGER

"Since introducing Impossible to our menu last year, it's been in the top 3 burgers sold in nearly all locations, increased overall sales by 27% during first 6 weeks of launch (began in 9 locations in LA, now at 20) and representing ~20% of overall sales."
Daniel del Olmo, CEO

TGI FRIDAYS

"The Beyond Burger was a 6-7% sales lift compared to our previous meatless burger, which was a black bean patty... It's definitely bringing in new people. We have been trying to 'age down' our brand, and the Beyond Burger has been brining in a lot of younger people."
Davide Spirito, Senior Director Culinary Innovation

ORGANIC Bareburger

"The amount of first-time guests we have gotten through the doors because of our plant-based burgers is amazing; and these guests become repeat/ loyal customers. Not only is it great for guest aquisition, it's also a dream for press and word-of-mouth marketing"
Euripides Pelekanos, CEO

Photo credit: Impossible Foods

Section 5: Foodservice Market Overview

"It's clear by the growth in plant-based protein case shipments to foodservice and restaurant operators that this category has mainstreamed beyond those who choose a meatless diet. Food manufacturers and operators have really improved the quality and taste of plant-based foods over the past several years and these foods are appealing to a variety of consumer segments for a variety of reasons."
David Portalatin, industry advisor for NPD's Food Sector[26]

Even with many restaurants offering plant-based entrees, there is abundant opportunity to increase variety and draw in customers with craveable plant-based dishes. Beef alternatives such as burgers comprise more than 40% of the plant-based category in foodservice,[25] leaving room for plant-based versions of chicken, pork, seafood, egg, and dairy to become top trends over the next few years. Outside of restaurants, there is also opportunity for plant-based companies to pursue distribution in other foodservice channels – for example, K-12 schools, universities, and hospital cafeterias. Companies like **Seattle Food Tech** and **Improved Nature** have begun to target these non-commercial foodservice markets.

For a comprehensive look at the plant-based protein products on the market, GFI maintains a **product database,** which catalogs hundreds of items available through foodservice distributors.

Section 5: Foodservice Market Overview

Good Food Restaurant Scorecard

The **Good Food Restaurant Scorecard** annually ranks the Nation's Restaurant News Top 100 Restaurants according to the breadth and depth of their plant-based entrées and their promotion of plant-based eating. As with retail, plant-based eating is a rapidly growing trend in restaurants, with 24% of the top 100 restaurants improving their plant-based options scores from 2017 to 2018. This includes a 7-point jump for Dave & Busters and a 6-point increase for White Castle on the 10-point scale. Other restaurants have yet to incorporate plant-based dishes into their menus, with 55 of the top 100 chains scoring a zero on our rubric, indicating that there is still ample opportunity for foodservice operators to capitalize on this market shift.[27]

U.S. Regulatory Update

Plant-based foods generally do not require premarket approval unless they incorporate a novel ingredient or processing method. For plant-based foods that do have novel aspects, the regulatory approval pathways are well-established, as is the alternative "generally recognized as safe" (GRAS) process. In 2018, Impossible Foods obtained a critical FDA "no questions" letter regarding its conclusion that its soy leghemoglobin ("heme") ingredient is GRAS with respect to restaurant preparations.[28] A separate "color additive" petition by the company with FDA approval will be required for grocery sales. In 2017, JUST received GRAS status for its use of mung bean protein isolate as an egg replacement.[29]

A key legislative battleground for plant-based foods is in labeling: ensuring that producers are able to communicate with consumers using terms that meaningfully communicate what products are and how they can be used. Some key points from 2018:

Executive actions

The U.S. Food and Drug Administration does not currently prohibit the use of dairy terminology on plant-based dairy labels, but in **July 2018,** FDA Commissioner Scott Gottlieb indicated that FDA will seek to revise how it applies its Standards of Identity for dairy products. FDA subsequently requested comment on the use of labels for plant-based products with descriptors that include the names of dairy foods such as "milk," "yogurt," and "cheese."

Legislative (in)action

With bills like the **CURD Act** and the earlier **DAIRY PRIDE Act,** animal-based dairy industry supporters in the U.S. Senate continue to seek to prevent competing plant-based products from using dairy-related terms on their packaging. While such efforts have come up short to date, they have demonstrated significant political power.

Judicial affirmation

Related attempts in the courts have failed. For example, in December 2018, the U.S. Court of Appeals for the Ninth Circuit affirmed a lower court decision in Painter v. Blue Diamond, unpersuaded by arguments that almond milk is "imitation" milk.

State of play

Legislation has been introduced in a number of states that would prevent the use of "meat" terminology on labels for plant-based meat. Where these bills become law, as happened in Missouri in 2018, we can expect to see **challenges** based on the **First Amendment.** Companies have a right to communicate clearly with consumers, and GFI remains dedicated to fighting for a transparent and level playing field for plant-based products.

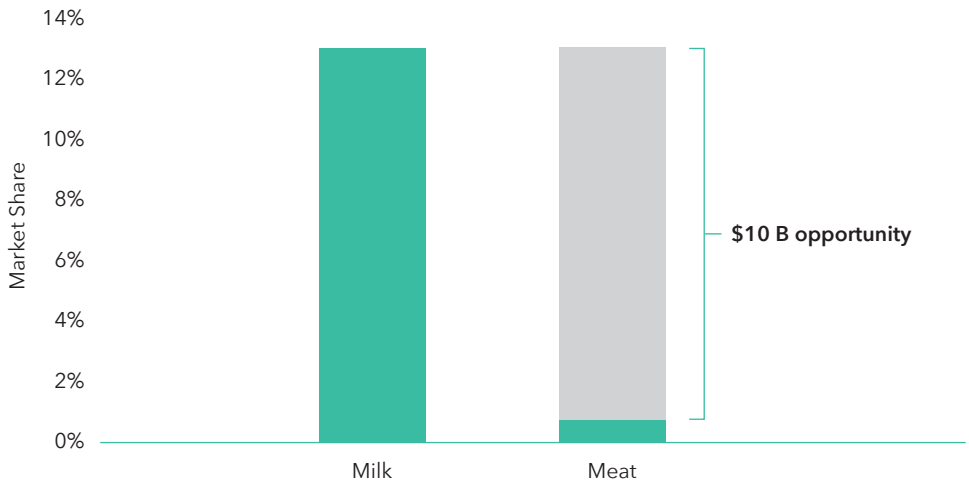
Section 6: Conclusion

"Remaking meat is one sector of the food industry that is ripe for innovation and growth."
Bill Gates[30]

As we have seen throughout this report, improvements to the product development of plant-based meat have yielded more satisfying products for consumers, which, in turn, have led to increased investment in the space, an uptick in valuable exits, and fast-paced growth across retail and foodservice markets in 2018. This recent acceleration of a decades-old industry reinforces plant-based meat as a feasible and attractive solution to meet the world's growing protein demands.

Plant-based milk, the plant-based category with the highest sales and market share, can help frame the opportunity for plant-based meat and other plant-based categories to follow. Plant-based milk currently represents 13% of the milk market in retail, compared the the 1% of the meat market that plant-based meat has captured to date. If the plant-based meat category were to continue its rapid growth to reach a market share comparable to that of plant-based milk, it would have a value of more than $10 billion (Figure 18). An increasing emphasis on merchandising products alongside their animal counterparts, and similarities in sales trends and consumer demographic data between the two categories, indicate a strong potential for plant-based meat to continue along this trajectory.

Figure 18: Market Share of Plant-based Milk and Meat



Source: Nielsen custom defined data set, xAOC + WFM, 52 weeks ending 8/11/18

nielsen

Section 6: Conclusion

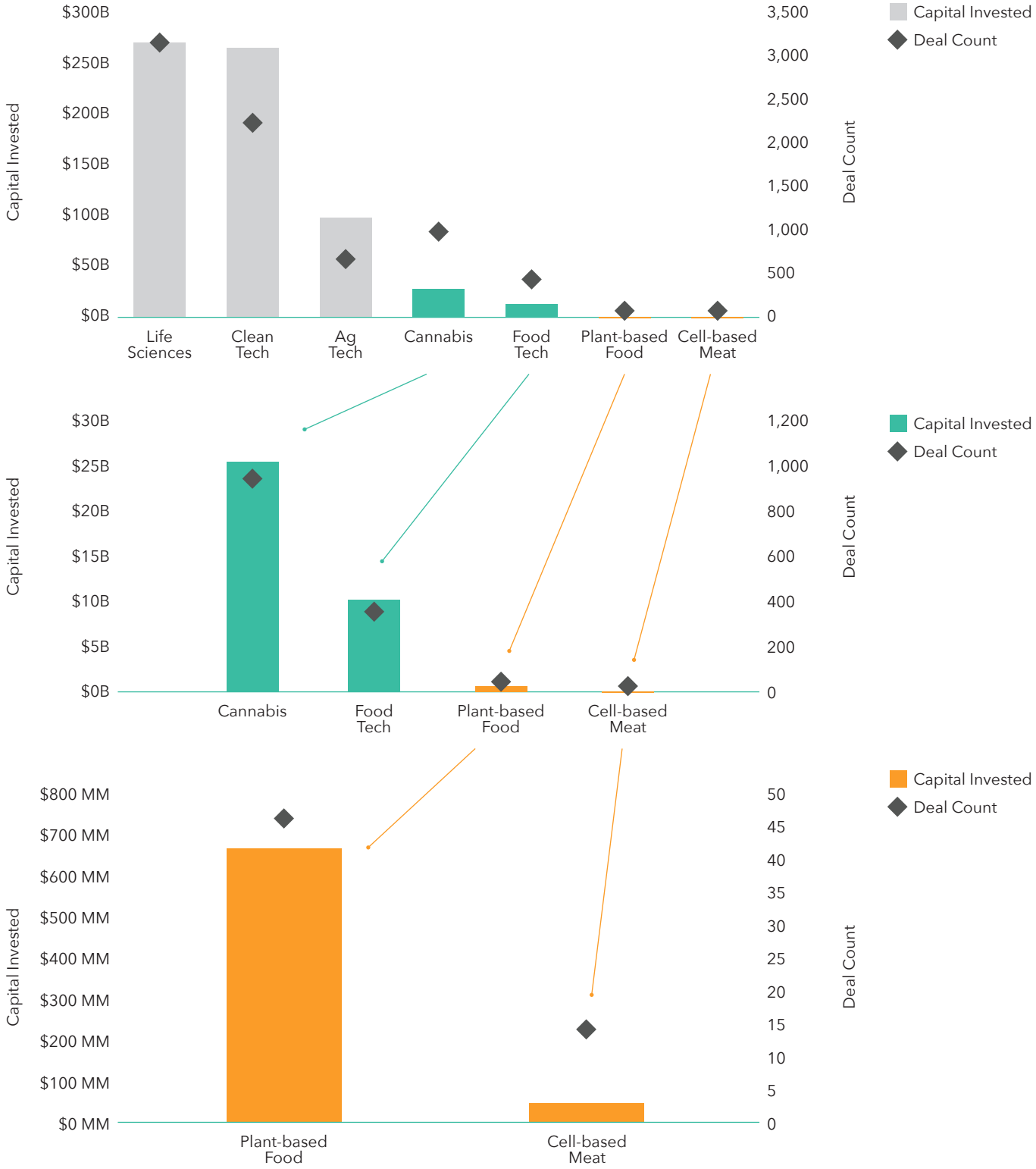
Despite strong growth in sales, distribution, and investments, the total number and value of investments in the plant-based food industry is relatively small when compared to other industries. To put this into perspective, investments in plant-based food were 6.5% of those made in the FoodTech and 0.7% of those made in the AgTech industries in 2018, $10.4 billion and $96.6 billion respectively (Figure 19). These comparisons highlight that the plant-based food industry is still very early from an investment standpoint, indicating ample opportunity for investors, entrepreneurs, and strategic partners to get involved at the early stages and capitalize on this global shift in the way meat is produced.

In the coming years, we expect plant-based food companies to continue to invest in innovation to create products that are increasingly analogous to their animal-based counterparts, both in terms of taste and functionality. However, we also anticipate that plant-based companies will increasingly allocate funds toward scaling production capacity and expanding distribution reach. This view is consistent with Beyond Meat's $100 million IPO filing, which expresses an intent to allocate the funds toward "innovation, supply chain capabilities, manufacturing and marketing initiatives."[31]

Just as we've seen the plant-based milk industry evolve from a hippie health food to a mainstream staple, we're looking forward to seeing the evolution of the plant-based meat industry. Already, we've seen leaps and bounds of progress from the veggie burgers of the past to today's innovative but relatively limited product offerings. In the future, we're looking forward to seeing plant-based meat reflect the full variety and flavor of animal-based meat products – and seeing them shelved side-by-side in the meat aisle. GFI looks forward to supporting the growth of this young industry as this vision becomes a reality in the coming years.

Section 6: Conclusion

Figure 19: Funding Invested in Various Industries in 2018



Source: GFI custom PitchBook analysis of various industries. Life Sciences, Clean Tech, Ag Tech, Cannabis, and Food Tech industries are PitchBook-defined verticals. Plant-based food is a GFI custom list of plant-based food companies based in the U.S. and/or selling in the U.S. Cell-based meat is a GFI custom list of global cell-based meat companies, and does not include companies that are pursuing cell-based meat as one aspect of a larger business.

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Interested in learning more about the future of meat? Check out our counterpart report, Cell-based Meat: State of the Industry Report, which includes a custom analysis of investments in cell-based meat companies across the globe as well as an overview of technological and regulatory progress in this emerging industry.

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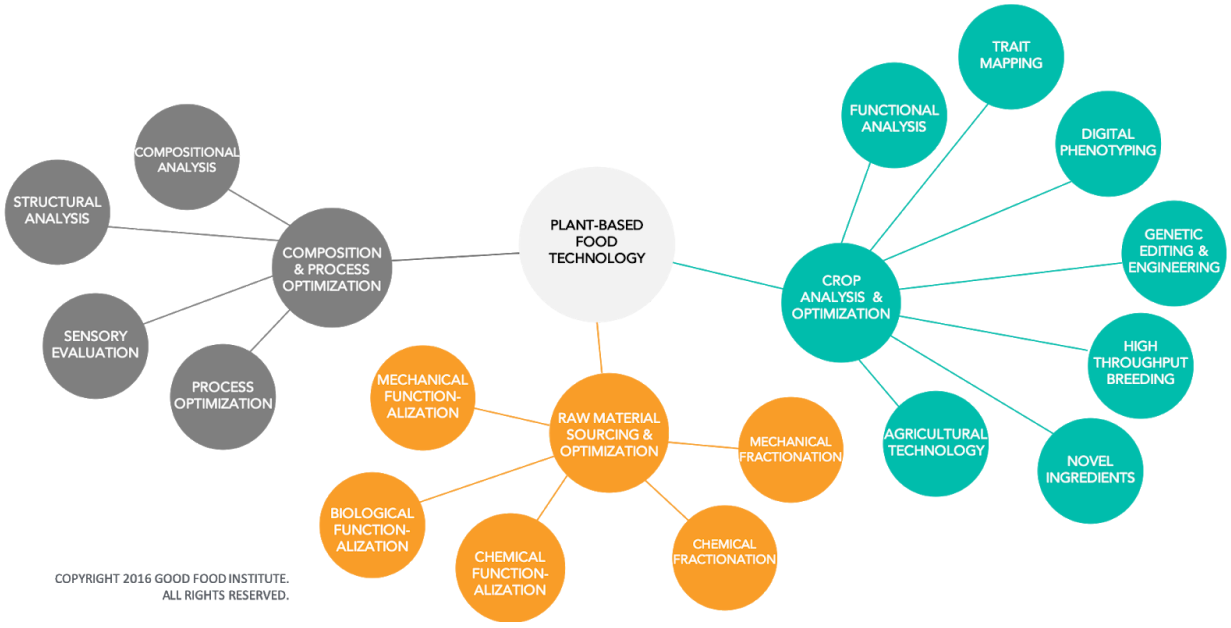
Appendix B

Plant-based Food Technology Mind Map



Cultivated Meat Technology Mind Map