

Plant-Based and Cell-Based Protein Boom: Opportunities Across the F&B Value Chain



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Executive summary

The evolution of plant-based protein — as a substitute for animal meat and dairy products — has been rapid. Two years ago, the prevailing question about the category was “Will it last?” Today, the question for many companies and investors is both “How big can it be?” and “How do we participate in this space?”

In the U.S., plant-based protein penetration is expected to accelerate, reaching approximately 4%-5% of total meat volume consumption by 2025, up from approximately 1%-2% today.¹ “Flexitarians” — those who are incrementally reducing their animal protein consumption for health, climate change or animal welfare reasons, and replacing animal proteins with plant-based substitutes — are the key consumer segment driving this growth.

The COVID-19 pandemic helped accelerate trial and penetration in the retail channel, especially in Q2 2020, when meat supply chain disruptions and shortages sent consumers, who were now eating at home, searching for meat alternatives. Major plant-based meat (PBM) brands such as Beyond Meat seized the moment, shifting their marketing dollars and merchandising focus from foodservice to retail.^{2,3} Overall, U.S. plant-based meat penetration is expected

to peak at ~15% and plant-based dairy at ~22%, depending on whether the three primary barriers — regulation, technology and consumer acceptance — continue to evolve at the expected pace.⁴

To capitalize on this momentum, companies participating in the plant-based protein revolution are focused on iterative product improvements. After all, the key to success with flexitarians, who are less willing to sacrifice the sensory experience of familiar animal meat and dairy, is achieving taste and texture parity with the original. Winning the mainstream flexitarian consumer base is the crucial stage of the flywheel, providing companies with the production volumes and economies of scale that will ultimately lower prices to further increase consumption.

The essential goal is mastering the plant-based protein value chain. While it is complex, it presents multiple opportunities for companies and investors — not all of them obvious. We will examine underlying market drivers and the value chain in more detail in this Special Report.

Take a systematic approach to identifying opportunities

Success in the plant-based protein space depends on several factors. Identifying the right strategy will, of course, vary by segment — strategic considerations for branded food companies will differ from those of upstream protein suppliers, technology providers or foodservice operators. Approaches will also differ by scale — smaller players will need to be precise about the opportunities they target, while for larger players, developing an appropriate portfolio strategy is the primary concern.

But ultimately, upside opportunities emerge from a thorough understanding of the value chain and the potential for taking advantage of needs and gaps in the marketplace.

Many opportunities appear in pockets of investment that are not consumer-facing. Investors in particular may want to focus on emerging technologies (such as fermented dairy proteins as ingredients in plant-based dairy) and on nascent applications (such as plant-based eggs and seafood) in addition to upstream ingredient and production opportunities — the less “sexy” parts of the value chain.

Upstream ingredient innovation. The upstream stages of the value chain offer significant investment and innovation opportunities because they directly impact the taste, texture and nutritional profiles of the end products and can help reduce key barriers to consumer acceptance. There are major opportunities in protein and substrate research and development and production scale-up as companies innovate to lower the cost of raw materials, adjust production technology to improve flavor and mouthfeel, and adjust ingredient characteristics to allow for easy shipping and storage.

When selecting plant-based protein sources and formulating products, companies are primarily concerned with ingredient functional properties and the ability to achieve the desired texture and mouthfeel while maintaining a neutral taste that can be further flavored.

Soy, wheat and pea proteins are the primary protein ingredient sources used across the leading plant-based meat brands. There are trade-offs associated with each protein type, and consumer preference differs based on the meat type being mimicked and the exact form and texture desired. For example, pea protein can present a bitter aftertaste that must be masked; it is slightly more challenging to formulate into whole-muscle texture but can be used successfully in crumbles, sausages and burgers. Wheat protein’s

spongy texture, on the other hand, makes it better suited for creating the “pull-apart” consistency of chicken or deli meat.

Outside of health perception and allergen concerns, wheat and soy outperform pea protein not only on the ability to replicate whole muscle but also on price and supply availability. For most brands, product claims are often secondary concerns during ingredient selection given the mainstream flexitarian consumer target. But wheat and soy are still two of the FDA’s top eight allergens, and most soy is GMO, which could present a concern for consumers who prefer organic or non-GMO foods.

As a result, upstream plant-based protein ingredient innovation has become a clear priority for leading suppliers such as Roquette and Ingredion. These companies have made public investments in R&D and processing facilities to increase protein functionality, nutritional profile and availability, partnering with leading plant-based protein brands to further innovate and refine their formulations.

Product development and refinement for flexitarians.

The category’s prospects for mainstream adoption, especially by flexitarians, will be determined by three factors: taste/texture, price, and consumer awareness and trial. The ultimate goal is a plant-based product that achieves taste, texture and functional parity with its animal benchmark.

With their upstream ingredient partners, brands continue to incrementally refine their formulation to meet the high standards of flexitarians who are less willing to trade off on sensory and functional attributes than their vegetarian and vegan counterparts. A case in point: When Beyond Burger 3.0 launched in May 2021, the ingredients on the label appeared to be largely the same as the old ones, but a significant amount of R&D went into making the product “meatier and juicier,” as the company claims. “Natural flavors” and dried yeast were added to the ingredient deck, but there were notable nutritional changes as well. Overall fat content in Beyond Burger 3.0 decreased from 20g to 14g — a significant improvement against the 22.6g found in an 80/20 beef patty. This iteration also shaved saturated fat from 6g to 5g (80/20 beef has 8.5g), with calories now at 230 compared to the previous 270 (80/20 beef has 287 calories).⁵

Cleaner ingredient decks. Another key area of investment and focus for ingredient suppliers and plant-based brands in the next few years will be the need to reformulate to meet consumer desire for minimally processed products.

Long ingredient decks that include many artificial ingredients and additives are commonplace on many plant-based protein products. To date, the category has been insulated against the macro “clean label” trend that has impacted the food industry as a whole. For now, consumers are still comparing the health profile of plant-based alternatives against animal-based offerings.⁶ But for a sizable number of flexitarians who are choosing to eat plant-based for health concerns, these long ingredient decks and high sodium and carbohydrate counts will become a barrier to further adoption and consumption. While some plant-based meat products might have less fat and more protein than the animal originals, they often contain more sodium and carbohydrates. An Impossible Burger serving accounts for 16% of daily sodium intake and contains 9g of carbs versus 1% and 0g, respectively, for a 90% lean beef burger.⁷

These concerns currently represent risk that is more potential than actual. Even when given unlabeled nutrition facts, 45% of people thought the plant-based burger was healthier, compared with 32% who said it was less healthy and 14% who thought the two products were equivalent. When asked directly, however, 31% said they think ground beef is healthier.⁸ And as the market for plant-based meat substitutes continues to expand, consumer awareness of ingredient- and health-related issues is likely to increase.

The spotlight has begun to shine on these concerns, and opening shots have been fired. Lightlife ran an attack ad against other major plant-based meat brands in August 2020 through an open letter indirectly claiming that its products are cleaner than those offered by Impossible Foods and Beyond Meat.⁹ Impossible Foods responded to Lightlife in a blog post on Medium, calling the letter “a desperate attempt to cast doubt on a company and products against which it can’t compete on quality or value.”¹⁰

Expansion into additional meat and dairy categories. Across animal meat and dairy segments, ground beef, burgers and fluid milk were the early targets for innovation. These categories have seen the highest plant-based penetration to date.

Chicken accounts for roughly half of total meat consumption in the U.S., and the segment has seen heightened innovation activity, especially in foodservice, given the number of chicken-focused menu offerings and major quick-service restaurant (QSR) chains.

Pork and fish are currently underserved with plant-based alternatives in the U.S. and represent significant investment

opportunities — Impossible announced the launch of its Impossible Sausage in retail stores in August 2021. This is especially true for brands with global aspirations, given the relative popularity of pork and fish outside the U.S.

Leading brands are also expanding their portfolios by innovating in other meat and dairy formats, such as breakfast sausages, bacon, deli meat, yogurt and cheese. These formats are critical in further penetrating additional consumption occasions, especially breakfast and lunchtime.

Achieving plant-based growth in dairy categories beyond fluid milk is complex but represents a significant growth opportunity: U.S. sales of vegan cheeses grew 42% in 2020 — more than any other plant-based dairy product.¹¹ Accomplishing growth requires brands to replicate specific cooking and baking functionalities, such as the product’s ability to remain solid at room temperature — like butter in baking applications — or to replicate the tensile and melting properties of cheese.

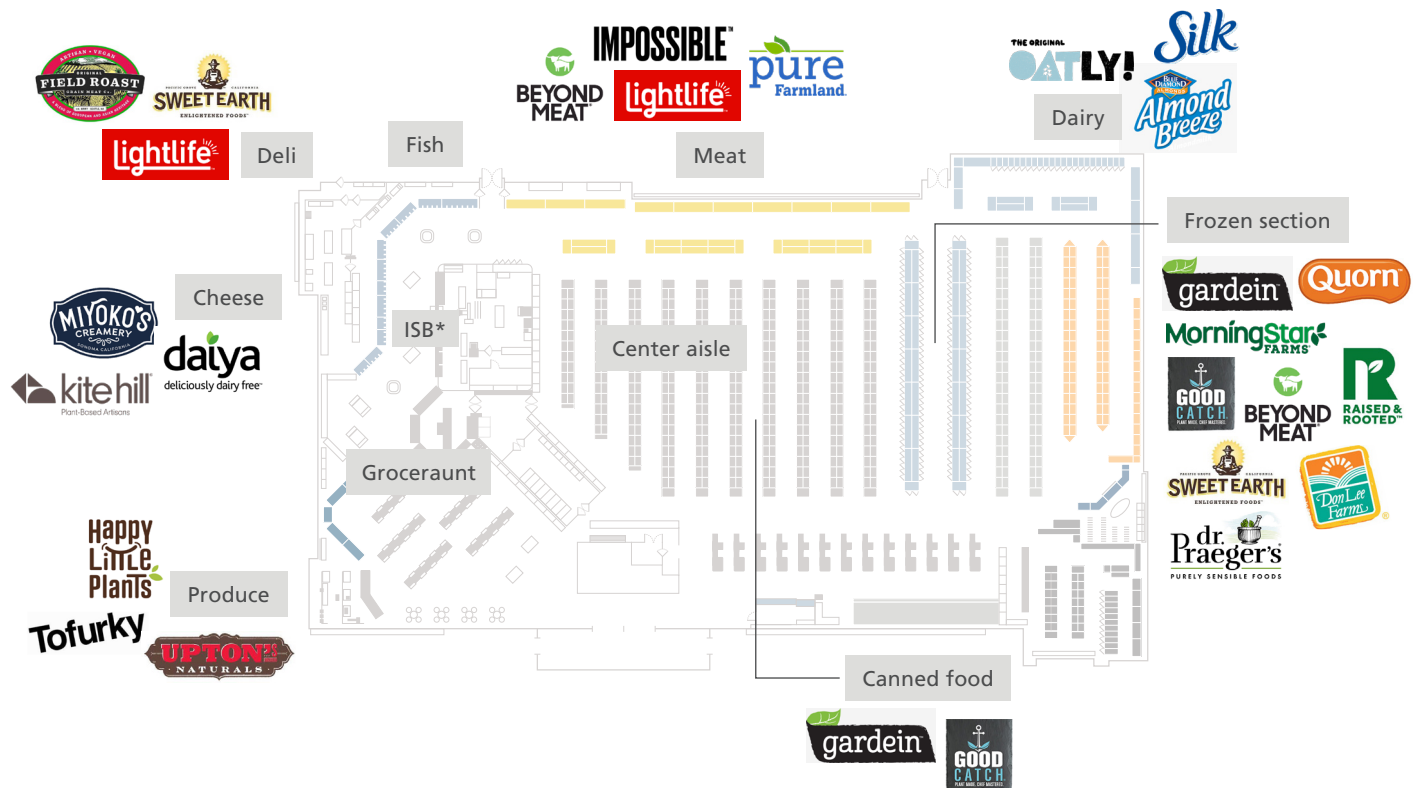
Further retail merchandising optimization. Merchandising and in-store placement to increase product visibility and consumer awareness is also a critical component of the effort to drive plant-based protein awareness and trial. Retailers are continuing to increase shelf space for plant-based offerings and to optimize merchandising across frozen, refrigerated meat and dairy, deli/lunchmeat, and produce sets. This is supported by in-store shopper marketing and trade investments from the leading brands, e.g., Beyond Meat and Impossible, and from large consumer packaged goods (CPGs), e.g., Smithfield Pure Farmland (see Figure 1).

Kroger began stocking plant-based meat in the meat aisle in December 2019 in a three-month trial. The company found that this drastically boosted its sales: While plant-based meat sales were up 13% in control stores, the stores with integrated setups saw a 32% increase.¹²

Kroger took what the Good Food Institute (GFI) referred to as an integrated-segregated approach, where the product is located in the meat section but is separated from meat products with clear signage. The same approach was used for organics and natural foods as well and generally fits customer preferences.¹³ Overall, GFI found that more than 100 plant-based meat products are being offered at leading retailers, with 65% of them having at least one item in the meat aisle.¹⁴

Figure 1

Plant-based meat merchandising in grocery stores across frozen and fresh has also driven visibility and growth as retailers prioritize the category



*In-store bakery

Source: L.E.K. interviews, research and analysis

Opportunities on foodservice menus. As foodservice operators adapt in the post-pandemic era, plant-based meat opportunities on menus and trial outside of the home will return. Overall, plant-based burger and chicken trial in foodservice was negatively impacted by the pandemic, but QSRs and limited-service restaurants, especially those with drive-thrus, which were more protected from the loss of customer traffic, still represent an attractive co-branding and trial-driving opportunity for leading manufacturers.

Foodservice has been a winner-takes-all model to date, with operators relying on menu co-branding with leading plant-based meat brands to drive consumer awareness and marketing. But major chains are investing in developing their own formulations and recipes. In addition to McDonald's ending its Beyond Meat collaboration and developing its own plant-based burger,¹⁵ the

fast-food operator also released the McVegan in 2017 and the McAloo Tikki in 2018.¹⁶ Chains are still working through operating adjustments. For example, both Burger King and McDonald's have faced issues when frying on the same grill as their meat options, which makes their plant-based burgers non-vegan.¹⁷

Co-packer manufacturing facilities. There are opportunities for companies and investors to generate returns by supporting plant-based protein manufacturing efforts. Production of plant-based protein ingredients and branded products is demanding and expensive, especially for new entrants. Co-manufacturing facilities that relieve manufacturers, particularly those new entrants, from the capital and operational hurdle of building their own production facilities from scratch are a little-noticed niche — but one that could generate significant returns on investment.

Next-generation cell-based and fermented proteins. While the market for meat and dairy alternatives is currently dominated by plant-based proteins, an entirely new approach that may challenge the current order is under development. A new generation of plant-based alternatives produced by culturing cells from animal sources and via microbial fermentation is expected to be in market at commercially viable prices by 2030 (see Figure 2).

Like other innovations that generate opportunity, cell-based and fermented proteins are a response to a marketplace need. Despite all efforts, the current generation of plant-based alternatives is still unable to achieve true taste and texture parity with animal protein. In addition, new technologies utilizing animal proteins without the ethical and environmental externalities of farmed meat and dairy promise to meet the needs of most consumers, with the exception of strict vegetarians (see Figure 3).

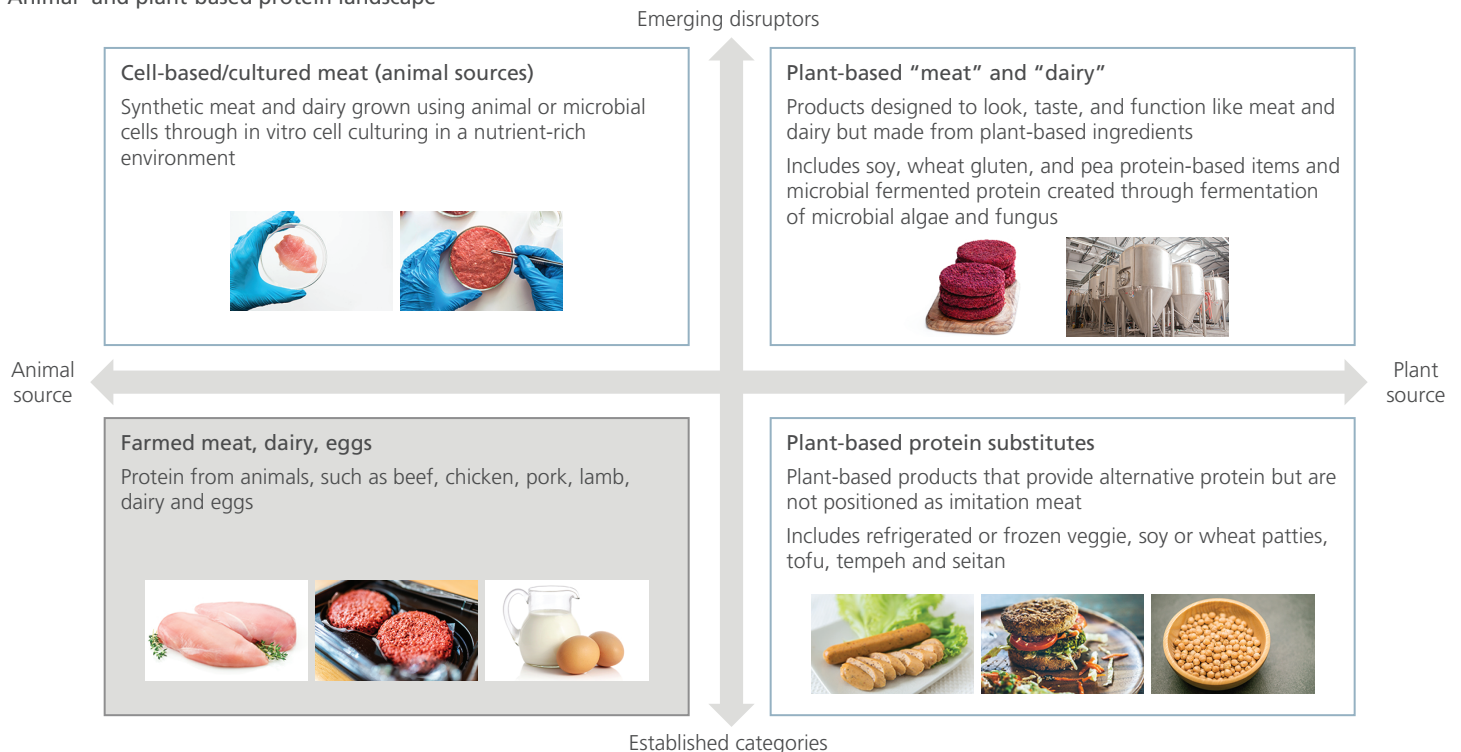
Globally, investment in cell-based or cultured meat (CBM) increased significantly in 2020, with technological advancements in upstream inputs (e.g., basal medium input) and processing technologies (e.g., medium formation and cell line development) lowering the estimated production cost of CBM as low as ~\$150 per lb from ~\$325,000 per lb in 2013. Estimates vary, with some reports projecting that prices could drop as low as \$2.57/lb by 2030.^{18,19}

Leading CBM companies such as Memphis Meats, Mosa Meat, BlueNalu and Shiok Meats all face price, regulatory and consumer acceptance hurdles in the face of their commercialization plans but have announced goals of launching products in their regional markets within the next three to five years.

Multiple initiatives are underway. Memphis and Mosa are using their most recent round of funding to prepare manufacturing plants.

Figure 2
Disruptors have created three new alternatives designed to compete directly against animal products in appearance, taste, nutrition and functionality

Animal- and plant-based protein landscape



Source: L.E.K. research and analysis

Figure 3
The improved taste, texture and nutritional profile of cell-based/cultured meat (CBM) is expected to 'unlock' additional consumer demand

U.S. consumer decision drivers regarding meat	Animal meat	Plant-based	Cell-based	Commentary
"Push" drivers	Concerns with farmed meat that push consumers to consider alternatives			
Animal welfare	Low	High	High	CBM uses animal cells, limiting appeal to vegans
Environmental sustainability	Low	High	High	Both technologies have lower energy and resource requirements
Food safety	High	High	High	Contained production environment improves standards
Health concerns	High	High	High	Some plant-based proteins have allergen implications
"Pull" drivers	Features of meat alternatives that pull consumers toward them			
Flavor profile	High	High	Low	Current limitations on PBM's ability to replicate meat taste
Texture and mouthfeel	High	High	Low	PBM texture often distinguishable from animal meat by consumers
Nutritional value	High	High	High	PBM relies on fat and salt for taste, but CBM can design macros
Functionality	High	High	High	CBM can better re-create complex meat muscle structures
Pricing	High	High	Low	PBM price coming down toward parity, but CBM still much higher

Relative performance
Low High

Source: L.E.K. research, interviews and analysis

Future Meats expects to have a facility by 2022, and New Age Meats plans to have one in 2025.²⁰ Israeli startup Super Meat is also aiming for a 2022 start date.²¹ Aleph Farms expects to be selling in 2023²² and is building a facility to be ready in 2022. Avant Meats from China is building a facility in Singapore.²³ Shiok is aiming for 2021,²⁴ and BlueNalu is aiming to launch food channels in late 2021.²⁵

The path for these market entrants is not straightforward, however. In the U.S., regulatory barriers are expected to present a major hurdle; the USDA and the FDA provisionally agreed in 2018 to create a joint regulatory framework on CBM, but the guidance anticipated in 2019 never came.²⁶ The timeline to regulation and the form those parameters will take are still unclear.

Regulation is a significant factor worldwide, in fact — with the added complication that regulatory environments vary around the world. Singapore has given approval to the startup Eat Just to sell its cultured chicken.²⁷ Europe has an explicit 18-month process for review in which the company must demonstrate safety. Asia has less-

developed regulations but would likely approve if other places like the EU give approval.²⁸ Entry into China may be less complex — it may be possible to use China's existing petition process for approving "new food ingredients" to gain regulatory permission.²⁹

In addition to CBM, microbial fermentation has emerged as a technological solution that is gaining ground. It seems particularly promising in the production of dairy, egg and collagen proteins, potentially providing an ingredient solution for plant-based brands given its ability to replicate the mouthfeel and nutritional content of animal protein. Impossible uses two microbes to make its burgers³⁰ and is seeking to double its R&D team in working on Impossible Milk.³¹

In microbial fermentation as in CBM — and in the mainstream of plant-based protein production — many opportunities can be found upstream. Companies such as Clara Foods are still focused on upstream value chain activities such as strain development (selection and optimization of a target molecule and the proper host strain) and the fermentation, purification and extraction stages.

Uncertainties lead to several possible growth scenarios

There are clearly a number of uncertainties in the development of all animal-product alternatives that have the potential to impact growth. Unanswered questions about technology, price and consumer acceptance, and about the timeline to the realization of innovations such as fermented protein and cell-based meat, lead to several possible growth trajectories (see Figure 4).

In the U.S., plant-based meat penetration is expected to reach ~4%-5% of total meat volume consumption by 2025F (from ~1%-2% today) and accelerate to ~10%-15% by 2030F, depending on technological advancements, regulatory considerations and whether consumer acceptance momentum continues at its current pace.

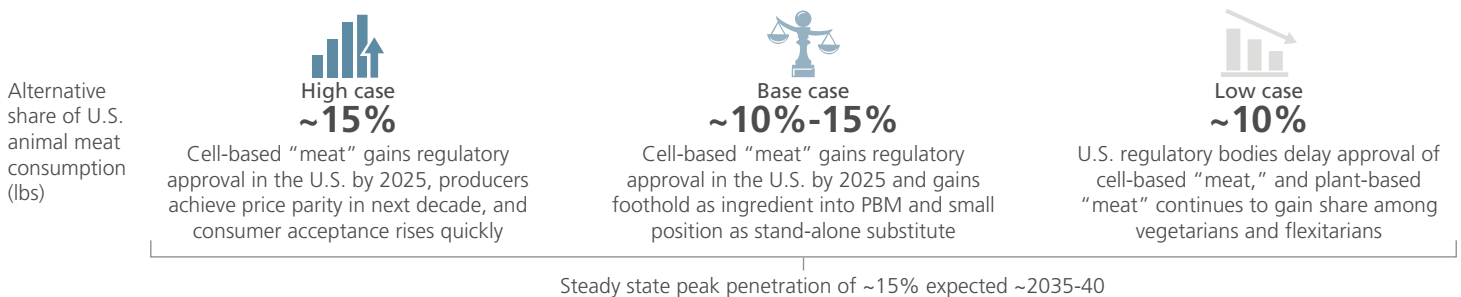
Plant-based penetration in dairy is more advanced given the history of fluid milk alternatives in the U.S., currently at ~14%-15% of all retail milk sales.^{32,33} But achieving plant-based growth in dairy categories beyond fluid milk will require brands to replicate specific cooking and baking functionalities such as the product’s ability to remain solid at room temperature — as butter does — or to replicate the tensile and melting properties of cheese.

Ultimately, technology will be the main factor determining growth trajectories. Regulation will have a significant impact on cell-based meat but is less of a factor for fermented proteins (and therefore dairy) or established plant-based proteins (see Figure 5).

Figure 4
Growth for alternative protein in U.S. based on pricing, consumer acceptance and regulation scenarios

Growth scenarios — U.S. alternative protein penetration: meat (2030F)

DIRECTIONAL

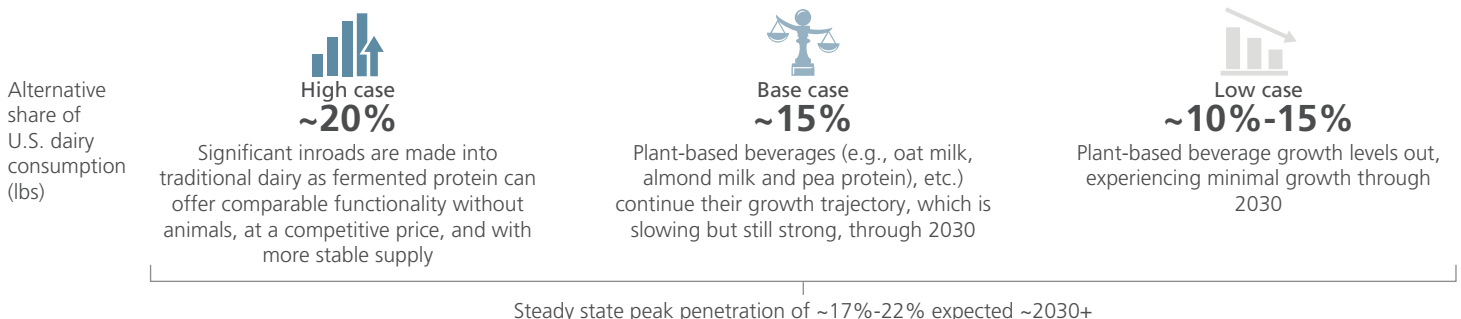


Source: L.E.K. research, interviews and analysis

Figure 5
The effect of the three factors varies by technology, with regulatory concerns lower for fermented protein, and therefore for dairy, than for cell-based meat

Growth scenarios — U.S. alternative protein penetration: dairy (2030F)

DIRECTIONAL



Source: L.E.K. research, interviews and analysis

Conclusion: A trend, not a fad

Plant-based protein products may have started as a fad niche category targeting vegetarians and vegans, but the category is considerably more than that now — it is a significant mainstream market segment with high upside opportunity.

How big that opportunity will be — and what direction the category's growth will take — remains uncertain. But it is safe to say that consumer interest is likely to continue.

For companies and investors that can master consumer trends and capitalize on the right emerging technologies — those that deliver taste, texture, favorable pricing, scale and profitability — the reward is there for the taking.

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About the Authors



Maria Steingoltz
Managing Director and Partner, Chicago

Maria Steingoltz is a Managing Director and Partner in L.E.K. Consulting's Chicago office. Maria joined L.E.K. in 2003 as an Associate and works in the consumer sector with a special focus in food and beverage as well as beauty and personal care. She advises clients on a range of critical strategic issues, including growth strategy, consumer segmentation, international expansion, pricing, and mergers and acquisitions. In 2014, Maria was selected as a Rising Star of the Consulting Profession by Consulting Magazine. She holds a B.A. in economics and mathematical methods in the social sciences from Northwestern University. Maria also received an MBA from the Kellogg School of Management and returned to L.E.K. as a Consultant in the Chicago office.



Rob Wilson
Managing Director and Partner, Chicago

Rob Wilson is a Managing Director and Partner in L.E.K. Consulting's Chicago office. Rob specializes in the consumer sector and leads the Food and Beverage practice. He advises clients on a range of critical strategic business issues, including growth strategy, price pack architecture strategy, trade spend optimization, merger and acquisition support, profitability enhancement, and organizational transformation. Rob received his Bachelor of Science in engineering in industrial and operations engineering from the University of Michigan and his MBA, with honors, from the University of Chicago Booth School of Business. He has many years of experience as an instructor at Merger Week, the premier executive program focused on acquisition best practices at the Kellogg Graduate School's executive education center.



Jen Wu
Principal, Chicago

Jen Wu is a Principal in L.E.K. Consulting's Chicago office. Jen focuses on food and beverage growth strategies and mergers and acquisitions within the firm's Consumer Products and Retail practices. In her eight years at L.E.K., she has advised corporate and private equity clients on strategic projects ranging from investment screens, buy- and sell-side diligences, new market entry, and corporate five-year growth strategies. Jen also spent two years at General Mills in marketing and general management focused on ecommerce and natural/organic foods strategy. She holds an A.B. from the University of Chicago and an MBA from Harvard Business School.

