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JOSE B. ALVAREZ

NATALIE KINDRED

Impossible Foods

If you want to capture carbon, you can build some crazy expensive equipment that is going to take years—or you can just let photosynthesis happen. That's what makes the Impossible Burger the best carbon-capture technology in the world.

— Pat Brown, CEO, Impossible Foods

"We are going to replace animals in the food system by 2035," said Pat Brown, founder and CEO of Impossible Foods (Impossible), in a small office at the company's Silicon Valley headquarters in late August 2019. He was not joking. In 2011, at the age of 57, the medical doctor and biochemist had given up a professorship at Stanford University to found Impossible and pursue this singular mission. In his view, climate change was the biggest threat facing the planet, animal agriculture—especially beef—was the top contributor to climate change, and the way to avert ecological catastrophe was to offer meat-loving consumers a plant-based alternative that they enjoyed just as much.

In 2016, after $80 million in research and development (R&D), Impossible had launched its first product: a plant-based imitation of ground beef that, compared to the real thing, generated about 89% less greenhouse gas (GHG) emissions, and required 74% less water and 95% less land. The product's "magic ingredient" was heme, the molecule that carried oxygen in blood and gave meat its red color, fueling press reports about "the veggie burger that bleeds." With heme, the Impossible Burger looked and tasted so similar to beef that, in taste tests and in restaurants, some consumers thought they had been tricked. (See **Exhibits 1** and **2** for a photo of the "Impossible Burger" and nutritional content.)

By August 2019, Impossible had launched its "2.0" product—better tasting and even more sustainable, requiring 89% fewer GHGs, 87% less water, and 96% less land. The next-generation Impossible Burger was on the menu of some 17,000 restaurants in the U.S. and in Hong Kong, Macau, and Singapore. The company planned to debut its first grocery product in September. By almost any conventional business metric, Impossible was in an enviable position. It had a powerful brand, and there was huge demand for its product. It was a darling of investors, having raised—easily, according to Brown—more than $750 million, valuing the firm at $2 billion. And it was a sought-after employer, having recruited top talent from Apple, Google, and the like.

But commercial success was not the only end goal. Brown wanted Impossible to expand, fast, but mission urgency was sometimes in tension with the necessities of judicious management. Impossible aimed to launch substitutes for other animal proteins and enter new markets in the near term, but the

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costs were daunting and capital plans uncertain. The firm already faced growing pains, notably manifesting in a much-publicized product shortage in mid-2019. Its executives, while united in the mission, were not always aligned on how to achieve it. For example, there were unresolved questions about competitive strategy, about whether Impossible had the right food-industry know-how, and about how to best leverage Brown's visionary leadership style while reeling in his academic (less commercial) leanings. For his part, Brown worried about how Impossible's growth would impact its culture. He also worried about investors' patience: his audacious goal required them to take a long-term perspective.

Pat Brown

Brown and his wife, Sue Klapholz, Impossible's vice president of nutrition and health, were longtime vegans, environmentalists, and animal advocates. Klapholz described herself as the "kind of vegan" who "wouldn't even swat a mosquito."[1] At the University of Chicago, where Brown earned doctorates in medicine and biochemistry, he was the first student to refuse to participate in experiments on dogs that were required in the physiology course. At Stanford, colleagues knew him as a principled contrarian who relished an argument. Once, he opened a presentation to fellow medical researchers with an opening slide titled: "Eating meat, publishing in *Nature* [a scientific journal], and other asinine things you dumb [expletives] keep doing."[2]

Early in his career, Brown and his research partners defined the mechanism by which HIV incorporated its genes into infected cells. Later, he helped pioneer methods and technologies for understanding the human genome and gene expression. This led to additional groundbreaking work in classifying and predicting the progression of cancers. Brown, an advocate for free and open access to scientific research, also co-founded the Public Library of Science (PLoS), a nonprofit publisher devoted to this cause.

In 2009, while on sabbatical, Brown decided that climate change, rather than medicine, was the cause to which he should devote the rest of his life. He left his tenured position soon after with the goal of ending humans' consumption of animals.

Meat

Population and income growth were the main drivers of global demand for meat, a market valued as high as $1.8 trillion in 2019 (other estimates were lower).[3] More than 330 million metric tonnes (MT) of meat were produced globally in 2017, up from 70 million MT in the early 1960s.[4] Roughly 60 billion farm animals were raised for food each year, two-thirds in efficiency-centric systems.[5] (See **Exhibits 3-5** for more on markets and trends.) Per-capita meat consumption was highest in the U.S.[6] Beyond supplying protein, meat was part of familial and cultural traditions in many markets. In Argentina, barbeques were cherished social events; in China, pork symbolized economic advancement; in the U.S., hot dogs were associated with baseball games, turkey defined Thanksgiving, and bacon was the ultimate "comfort food." Meat was also a source of livelihoods in many communities (see **Exhibit 6**). In the U.S., the animal protein industry employed about 530,000 people and was "broadly responsible" for 5.4 million jobs and $257 billion in wages, according to an industry analysis.[7] The study also said the industry represented about $1 trillion in total economic output, equating to over 5% of U.S. GDP.[8]

Agriculture and Climate Change

Since the mid-20th century, the increased production of food, fiber, and fuel alongside population growth and economic development had put tremendous strain on natural ecosystems, biodiversity, and the climate. Agriculture accounted for about 70% of freshwater use globally.[9] Livestock production systems used between 37% and 45% of the global land surface, with crop production using another 12% (see **Exhibits 7** and **8**).[10] According to the Intergovernmental Panel on Climate Change (IPCC), convened by the United Nations, agriculture, forestry, and other land uses were responsible for nearly a quarter of global GHG emissions, or as high as 37% when accounting for pre- and post-production activities.[11] GHG emissions occurred across the value chain, such as in clearing habitat for crops and grazing, which reduced carbon-capturing biomass and, if involving burning, emitted toxins; plowing, which released carbon in soil; and operating farm equipment, which used fossil fuels.

Agriculture-related GHG emissions and land use, along with other factors, had contributed to a vast reduction in global biodiversity. The conservation group World Wildlife Fund reported that from 1970 to 2012, wildlife populations shrunk by an average of 58%.[12] In 2019, the United Nations reported that one in four species of flora and fauna was vulnerable to extinction risk in the decades ahead.[13]

Notwithstanding collaborations such as the Paris Climate Agreement and more localized efforts by many governments, firms, and individuals, experts cautioned that action to curtail climate change was far outmatched by the threat. Without systemic change, the manifestations and consequences of climate change—warming temperatures, rising seas, and increased frequency, intensity, and duration of phenomena such as droughts and flooding; as well as food insecurity, poverty, migration, and other impacts—would accelerate (see **Exhibit 9**). Experts also warned that the options for mitigating and adapting to climate change would grow costlier and less effective over time.

Livestock

The livestock sector accounted for nearly 15% of global GHG emissions, according to the United Nations Food and Agriculture Organization (FAO). Within that, feed production and processing (including land conversion) accounted for 45%, enteric fermentation (a methane-emitting digestion process) from ruminants 39%, manure storage and processing 10%, and processing and transportation of animal products for the rest. On a commodity basis, the FAO estimated that beef cattle accounted for 41% of livestock emissions, cattle milk 20%, pig meat 9%, buffalo milk and meat 8%, chicken meat and eggs 8%, and small ruminant milk and meat 6%. (The remainder was attributed to other poultry species and non-edible products.) Beef also had the highest emissions intensity (kilograms [kg] of carbon-dioxide-equivalent per kg of protein produced).[14] An analysis of lifecycle GHG emissions from beef production in the U.S. Midwest found that producing 1 kg of live-weight beef emitted 14.8 to 19.2 kg of GHGs (carbon dioxide-equivalent).[15] Another analysis reported a global average of 46.2 kg of GHG emissions per 1 kg of beef produced on a carcass-weight basis.[16]

Beef was also implicated in a 2014 U.S. study in the *Proceedings of the National Academy of Sciences* that analyzed the environmental cost of producing one mega-calorie (a unit of energy equal to 10^3 kilocalories) of meat. It found that beef—compared to the average resource cost of dairy, pork, poultry, and eggs—required 28 time more land, 11 times more irrigation water, five times more GHG emissions, and six times more nitrogen fertilizer. It also noted that about 40% of the land area of the U.S. was used in livestock production (pastureland and land used to grow crops and roughage used in feed), and that beef accounted for 88% of this land while supplying just 7% of calories in the average American's diet.[17]

The IPCC identified dietary change as an important lever for lessening livestock GHG emissions. "Balanced diets, featuring plant-based foods, such as those based on coarse grains, legumes, fruits and vegetables, nuts and seeds, and animal-sourced food produced in resilient, sustainable and low-GHG emission systems, present major opportunities for adaptation and mitigation while generating significant co-benefits in terms of human health," said an August 2019 IPCC report.[18]

Calls for dietary change were echoed by another international group of scientists, the EAT-Lancet Commission, which in 2019 described a "necessary shift" towards increased consumption of plant-based foods.[19] The Commission defined an environmentally sustainable and nutritionally comprehensive "planetary health diet" that included 14 grams per day (range of 0-28 grams) of beef, pork, and lamb.[20] (See **Exhibit 10** for the diet's guidance, **Exhibit 11** for the potential impact on food production, and **Exhibit 12** for another dietary guideline, "Healthy Eating Plate.")

The Plant-Based Meat-Alternative Trend

While vegetarians and vegans were a small segment of most markets—e.g., less than 3% of consumers in Western Europe[21]—a growing number of consumers were buying plant-based foods, which were often priced at least 50% higher than the animal-based version. The U.S. retail market for plant-based substitutes for animal products was valued at $4.5 billion in mid-2019, with plant-based "milk" accounting for 41% and "meat" 18%.[22] A study found that sales of plant-based milk alternatives accounted for 13% of the U.S. retail milk market and increased 6% from April 2018 to April 2019, versus a 3% decline in cow's milk. Trends were similar in other plant-based categories (see **Exhibit 13**). (Brown founded a plant-based milk and yogurt company, Kite Hill, before starting Impossible.)

Sales of plant-based meat alternatives benefited from the growing "flexitarian" diet trend of eating less meat, while not swearing it off. A 2019 analysis by Euromonitor showed a correlation between meat reduction and concern about climate change (see **Exhibit 14**).[23] The report surveyed consumers in several large markets and found that 60% of all respondents were worried about climate change, 77% tried to positively impact the environment, and 27% wanted to eat less meat.[24] A 2018 Mintel survey found that 46% of Americans thought plant-based proteins were healthier than meat.[25]

Some consumers of plant-based proteins were motivated by animal welfare concerns and general discomfort with how meat was produced. "It doesn't matter how much of a meat lover you are—most people don't *value* the idea that your meat is made from the carcass of an animal," said Rachel Konrad, Impossible's chief communications officer. "Consumers aren't invested in perpetuating the system for its own sake; they are just invested in the taste." Impossible cited third-party research showing that consumers of plant-based meat substitutes placed moderate importance on the fact that no animals were harmed in production. In another study of U.S. men, 48% agreed with the statement, "When I eat meat, I value that an animal had to die to produce the food on my plate."

The Meat-Alternative Market

U.S. retail sales of plant-based meat alternatives were valued at $810 million in mid-2019, up almost 10% for the year, though still representing only about 2% of U.S. retail packaged meat sales and 1% of all U.S. retail meat sales.[26] Unlike vegetarian and vegetable-forward food products that had been marketed for years—black-bean veggie burgers, meatless chili, tofu "nuggets," etc.—the new wave of products more closely simulated meat on taste, function, and other dimensions. Newer players sought to distinguish themselves from past meat substitutes that consumers had found to be lacking in flavor and strangely textured. Brown called low expectations the "biggest hurdle" in getting consumers to try Impossible's product. "This isn't a new concept per se," said Ravi Thakkar, head of product

management, about plant-based alternative meats. "Others have had plant-based alternatives, they've just epically failed at what we are trying to do. There's never been anything like this—a product that is truly emulating the most important attributes of the animal-based version." Both Impossible and Beyond Meat, the other plant-based alternative-meat leader, said over 90% of their consumers also consumed meat.[27]

The meat-alternative category was part of a broad ecosystem of companies and products seeking to disrupt the food system through innovation in production, nutrition, distribution, and consumer experience. The trend had brought together a mix of enterprises and industries, such as startups, private investors, nonprofits, technology firms, retailers, and food incumbents. One expert described a shift in the focus of "food-tech" from "technologies that were primarily beneficial to the producers" to "what does the consumer want."[28] In the first half of 2019, "food-tech" attracted $5.4 billion in venture capital across 163 deals worldwide.[29] Many firms in the space were young, R&D-centric, and backed by venture capital early on. Because most were private, not much firm-specific financial data was available except for Beyond Meat, which went public in May 2019.

In addition to tech-focused startups, several large meat and packaged foods players had invested in or acquired meat-alternative brands and technologies, including Tyson Foods, Nestlé, and Hormel Foods. The segment appealed to strategic and financial investors in part because of the potential to patent innovations, unusual in food, with the prospect of preserving margins and creating barriers to entry. (See **Exhibit 15** for large food companies' investments and **Exhibit 16** for more on Beyond Meat.)

The Politics of Meat . . . and Fake Meat

In the U.S., climate change and environmental regulation were often flashpoints in political debates. In 2019, when a group of Democrats introduced an environmentally driven economic plan called the Green New Deal, Republican opponents said it would "take away your hamburgers."[30] In this context, the rise of plant-based foods had become something of a political topic, interpreted by some as an elitist indictment of a way of life. "This is a fundamental market that is part of everyday life for every person," said David Lee, chief financial officer. "Not many examples exist of disrupting a market like that. Just consider the identity politics every person has with food." Pointing to Impossible's and its peers' higher prices relative to commodity beef products, critics called the meatless movement an out-of-touch trend emanating from Silicon Valley, where the cost of living was 96% above the U.S. average.[31]

Some outlets, such as fast-food chain Arby's, had declared fealty to real meat. In a statement to Fox News, Arby's said it was not "interested in working with Impossible Foods. The chances we will bring plant-based menu items to our restaurants, now or in the future, are absolutely impossible." A facetious Arby's ad showed chefs making what it termed "megetables"—vegetables made from meat—including a carrot-shaped "marrot." "Plant-based meats are the latest incarnation of making vegetables look like what Americans really want, which is great, tasty meat," said the chain's chief marketing officer.[32]

Brown affirmed that diet choices were personal and complicated. "I don't think I'm in any position to judge people," he said, adding that even though most environmentalists thought "the use of animals in food production is the most destructive technology on Earth . . . the overwhelming majority of them also eat meat."[33] There were also complicated choices in business. For example, Impossible had agreed to animal testing required by the U.S. Food and Drug Administration when it filed food safety documentation for soy leghemoglobin as an ingredient. That move had been condemned by People for the Ethical Treatment of Animals (PETA), a group Brown and his wife had previously supported.[34]

Brown also conceded that his own rhetoric could be inflammatory. For example, he had publicly described Impossible's strategy as "legal economic sabotage" of the beef industry. "I shouldn't have said that," he reflected. "You know, I do hate the animal agriculture industry, but not the people in it. Probably 20% of the staff at Impossible Foods today grew up on farms." Still, he unapologetically called for the end of the beef industry, which he claimed already faced "huge stress":

> They run on low margins, the farmers are old, jobs in slaughter and meat packing are among the lowest-paying and least safe in the country, and policies today are cutting off the flow of their labor. They are closer to the edge than many think. There is a whole ecosystem of subsidies and lobbying that enables the incumbents, and when consumers stop wanting and accepting beef, this will accelerate the industry's decline. Banks won't want to loan, and the government won't prop it up because consumers won't support it. So, we only need to capture a share of the market to achieve this fall.

The Story of Impossible Foods

Chapter 1: 2011-2015

After leaving his full-time role at Stanford in 2011, Brown raised $3 million from venture capital firm Khosla Ventures to fund the hiring of a small team of researchers. Their goal was to develop a plant-based product that could be prepared, cooked, and consumed just like ground beef—and, most importantly, be so similar to the real thing that beef lovers would not know the difference; switching would not require compromise. Unlike many plant-based products already on the market, the product would be specifically geared towards meat eaters, not vegans and vegetarians. It would compete with beef by appealing primarily to mouths and stomachs, not exclusively hearts and minds. "Educating and shaming and persuading is not how you get people to change diets," said Brown. "People who love meat are going to keep wanting it, so the way to eliminate the industry is to develop meat from plants that tastes better than meat from animals."

Before settling on a plant-based approach, Brown considered developing a product from culture-grown meat, which several labs around the world had been working on for years. However, he determined that the timeline for developing a commercial lab-grown meat product was too long, and the production costs too high—almost 12 times the cost of animal protein on a per-pound basis, according to a CB Insights analysis.[35]

Brown set out to unpack the experience of eating meat: What was it that meat lovers actually loved? The distinctive experience of eating a hamburger was a combination of sensory elements. There was the caramelized outside of the burger created through contact with heat, the inner juiciness, the meaty umami taste—but also a "can't quite put your finger on it" element that stirred beef lovers' cravings. Impossible's team zeroed in on heme, an iron-containing molecule carried in blood by hemoglobin and in muscle by myoglobin. It was also present in the root nodules of soy plants, carried by a protein called leghemoglobin. "A craving for meat is really a craving for heme and the iron and protein that it represents in the diet," Brown explained.[36]

Brown devised a way to harvest heme from the roots of soy plants, but extracting even tiny amounts was painstaking. After months of trying to improve the process, he gave up. It was a tough pivot. "But I told the team that if we don't make expensive mistakes, we're not trying hard enough to solve these hard problems," he recalled. After several more months, the team devised a new process for producing a heme protein at scale: inserting the soy leghemoglobin gene into yeast, growing the yeast via fermentation, and finally isolating the heme for use in production. Said David Lipman, chief science

officer: "We have patents on heme strains, and there will be other places to get patents in the future, but it's a challenge to get patents in food. However, we have trade secrets and know-how that are very valuable. Even if the ingredients and processes were all known, doing this at scale is very hard to replicate."

Over the next few years, the team tested thousands of ingredients and recipes. The goal was for every aspect of the cooking and eating experience—nutrition, aroma, appearance, flavor, texture, moisture, the sizzle sound when heated—to equal or surpass beef. After testing thousands of prototypes, they settled on a recipe containing proteins from wheat and potatoes to create a meaty flavor, starches for texture, coconut oil for fattiness and to sizzle when heated, and heme and other plant-based ingredients.[37] "The expectations were that the hard stuff, the science, was done—now came the 'easy' business stuff," joked Lee.

Fundraising By late 2015, Impossible had completed two more funding rounds, of about $70 million followed by $108 million. Investors included Khosla, which had increased its stake, Bill Gates, UBS, Google Ventures, Viking Global Investors, and Horizons Ventures. "For Impossible Foods, there's almost perfect alignment between business success and mission success," said Brown. "The way we erode the incumbent industry is by making a better product that consumers want more." His funding arrangements ensured that he would retain control. In his initial agreement with Khosla, for example, he identified some 40 meat producers and agricultural conglomerates to which Impossible could never be sold without his consent.[38] In mid-2015, Brown declined an acquisition bid from Google, telling the *New Yorker* that he rejected the offer "in less than five seconds, because we would have just been one of their suite of nifty projects."[39]

Chapter 2: 2016-2018

By 2016, Brown and the growing team of about 100 employees at Impossible's headquarters had made two key marketing decisions. First, they would use the "Impossible" brand for the product and try to leverage word-of-mouth and social media, rather than conventional paid advertising, to build a "consumer movement." "The only way for us to accelerate change is by building a consumer movement," said Konrad. "You do that by capturing the zeitgeist, by penetrating into people's news streams, social networks and daily conversations—not by conventional, top-down ads."

Second, they would launch into foodservice, specifically in hip, upscale outlets best known for their meat dishes. "To create a consumer food movement, we decided to hack foodservice," Lee explained. "Our pull strategy was to go for admired people in food, particularly in meat; the people millennials admire and PETA pickets. The conventional wisdom is to do retail because then you have more control, but the consumer approaches retail and foodservice very differently. In foodservice, the millennial wants what's new, they want an experience, and all of the options are visible on the menu. In retail, it's a routine: you look for what you are used to buying."

It was not an obvious strategy; most branded foods launched in the grocery channel. One issue in foodservice was that Impossible would depend on store workers to deliver the consumer experience. "We have to think about reducing inconsistency as much as we can," said Thakkar. "When we test the product, we have to ensure that the minimums and the maximums are set in a way that allows us to deliver the consumer experience we want in different settings as much as we can." He continued:

> The highly variable pieces are the cook and the cooking equipment. This is the same for any food, but if you get a bad ground-beef meatball at a restaurant, you'll most likely take issue with the restaurant rather than the beef, because you've had beef before and you know what it's supposed to taste like. Next time you'll just go eat animal-based beef

> elsewhere. But we are a new product and consumers don't have a baseline, so if they try it the first time and don't like it, they make an assessment of our product—not the cook or the equipment.

Launch In June 2016, the Impossible Burger debuted at the award-winning New York City restaurant Momofuku Nishi, whose celebrity chef-owner, David Chang, said he was "genuinely blown away" by the product.[40] Selling for $12.00, the Nishi Impossible Burger was topped with a pickle, tomato, cheese, and a sauce, and sandwiched in a bun. Reporters from outlets like tech-centered TechCrunch and British paper *The Guardian* visited Nishi to interview customers and try the curiosity themselves. Was it delicious? Revolting? Did it really bleed? A *New York Post* writer said it had "a slightly gristly texture, meh mouth feel and scarcely more bogus-beef quality than that of common veggie burgers made from grains and legumes."[41] Others raved, like this writer in *The Guardian*: "After the first bite, I felt like I had ended a more than six-year-long streak of not eating meat. The sear was thick and crunchy and I experienced that familiar, salty, fatty taste that I believed could only come from an animal."[42] Sheetal Shah, head of product and operations, emphasized the importance of trial: "The key is to get people to taste it, because once they do they are blown away."

More launches followed in trendsetting restaurants like Jardiniére in San Francisco and Crossroads in Los Angeles. These attracted more free publicity, and more demand. By early 2018, Impossible was supplying well over 1,000 U.S. restaurants and had moved beyond the upscale niche into burger-centric fast-casual chains, such as FatBurger, Umami Burger, and Hopdoddy. Daniel del Olmo, chief executive of Umami Burger, said in April 2018 that since launching the product, the group had increased traffic 38% and sales 18%.[43] Still, the Umami Impossible Burger (as it was termed) was priced at $13.00, unaffordable for many Americans. The Impossible team saw premium prices as an acceptable necessity to fund growth, though the goal was to eventually bring costs into line with commodity beef burgers.

The product was made at a small pilot facility until 2017, when Impossible opened a plant in Oakland, California, capable of producing 2.5 million pounds per month.[44] (By comparison, about five billion pounds of ground beef was sold at retail in the U.S. each year.)[45] The product was packed in frozen pre-formed patties or in five-pound frozen bricks and distributed by the same national, regional, and local foodservice suppliers and brokers used by the meat industry. (See **Exhibit 17** for a product photo.) Impossible instructed customers to keep the product cold until ready to use and to treat it like ground beef: form patties to make burgers, balls to make meatballs, crumbles for tacos or pizza toppings, etc.

Impossible did not have say over how customers priced or used its product, but it discouraged them from listing Impossible menu items in the vegetarian section of their menus. In many cases, Impossible provided customers with trainings, manuals, and market tests to work out different requirements for cooking the product within each customer's kitchen and menu. Many customers chose to insert "Impossible" into the names of dishes, from Impossible Bolognaise to Impossible Chili to Impossible Tartare.

White Castle In April 2018, Impossible launched the "Impossible Slider" at White Castle, a large U.S. fast-food chain, beginning in 140 stores in the greater New York City and Chicago regions. Available with or without cheese, the product sold for $1.99—about double the size and the price of White Castle's mainstay beef slider. The choice of White Castle was about mass-market penetration. White Castle was, as one article described it, an unabashed purveyor of cheap, munchie-sating burgers: "As the larger fast-food industry pays lip service to healthier offerings and builds cushier environs, White Castle remains a cultish, ultra-affordable, bare-bones outlier. There are no kale salads because,

heck, there are no salads."[46] Stated Dennis Woodside, president of Impossible Foods, "The person who thinks this 'elitist' stuff isn't for them will think differently if they can find it at places like White Castle."

One food writer heralded the Impossible Slider as "one of the country's best fast-food burgers, period."[47] Yet he did not find it similar to meat, but rather indistinct and condiment-dependent in the way that, in his view, mimicked the best of the inexpensive and crave-worthy fast-food burgers: "[T]he genius (or insidiousness) of the Impossible Food folks is not that they've created something that tastes like beef—they haven't—it's that they've taken discrete ingredients from the natural environment and transformed them to mimic the artificial awesomeness (or awfulness) of American processed food."[48]

Chapter 3: 2019

Throughout early 2019, Impossible continued expanding distribution into popular mass-market chains such as Cheesecake Factory, Qdoba, and Red Robin. Meanwhile, the company's team of over 100 researchers had been working to improve the flagship product. The lab at headquarters looked like a typical biotechnology workshop, except for the kitchens where scientists, focus groups, and invited chefs experimented with different prototypes and preparations. "As much as possible, we work to get quantitative measures of the aspects of the meat-eating experience and how the qualities change over time as the meat is cooked—for example, the way the burger starts to feel different on the back of a spatula as it cooks, and the differences in a burger cooked rare versus medium well," said Lipman, whose father ran a meat market in upstate New York. "When you chew food, volatile compounds are released that you perceive as taste but are actually smelled. We are looking for the ingredients that, when you produce them together, give that experience of the volatile compounds in a burger or a steak. It's all about improving the sensory experience. It's a few simple ingredients, but they all interact in a system. As we learn about how the system works, we're able to tweak the variables."

In January 2019, Impossible introduced its "first upgrade," the Impossible Burger 2.0. It was gluten free—dehydrated soy replaced wheat—and contained 30% less sodium and 40% less saturated fat (due to a reduction in coconut oil) than the original. A four-ounce patty had 240 calories, 14 grams of fat, 370 milligrams of sodium, and 19 grams of protein (refer to **Exhibit 2**). A four-ounce patty of 80% lean beef had about 280 calories, 22 grams of fat, 60 to 75 milligrams of sodium, and 19 grams of protein. "Our technology is only getting better," said Brown, "but livestock technology will never get better."

Impossible debuted the Impossible Burger 2.0 at the International Consumer Electronics Show (CES) in Las Vegas, an annual conference widely considered the most important platform for showcasing innovations and discovering trends; over 4,400 companies exhibited technologies in 2019. Impossible was the first company ever to showcase food at CES. "Rachel [Konrad] had the idea to go to the biggest consumer tech conference because no one brings food there," recalled Lee. "We broke the show." The Impossible Burger 2.0 won CES's highest honor, the "Best of the Best" award, and several others. Press outlets echoed the praise; tech website Gizmodo, for one, called the product "stupid delicious."[49] Impossible's Oakland plant quickly transitioned to the new recipe and shipped it out to customers. "We saw demand skyrocket at every location," said Lee.

Meanwhile, the company introduced the Impossible Burger into the foodservice channel in Singapore, followed by Hong Kong and Macau. These were identified as ideal markets for entering Asia—the company's next main focus—because of their multicultural demographics, innovation-friendly economies, and openness to pushing boundaries in technology and food.

Burger King In April 2019, Burger King, one of the largest U.S. fast-food chains, introduced the "Impossible Whopper" to the menu at 59 locations in greater St. Louis, Missouri. Burger King fashioned the product as a plant-based version of its flagship "Whopper" beef burger, promoting it with the

slogan "100% Whopper, 0% Beef." The Whopper retailed at about $4.19 and the Impossible Whopper at $5.59. (Prices varied by location.) An advertisement[a] accompanying the rollout showed Burger King customers who were self-proclaimed beef lovers reacting with disbelief when told that the burger they were eating was plant-based, not beef as they had believed. Burger King also offered a "50/50 Challenge" in which customers could buy the beef and plant-based Whoppers at a discount and conduct a side-by-side taste test.

For Impossible, partnering with Burger King was big: the chain epitomized mass-market appeal, with 7,200 stores nationwide selling products at affordable price points. Noted Woodside, "There is a Burger King within a short driving distance of practically everyone in the country, and for us it's so important to be able to reach everyone. Trial is everything. And the number one reason people try us is word of mouth." For Burger King, it was a way to modernize its image and attract new customers. The decades-old chain had been struggling to maintain growth and relevance with younger consumers in the competitive fast-food market. In quarter-one 2019, Burger King's same-store sales had increased 2.2%, down from 3.8% a year earlier.[50] Chris Finazzo, head of Burger King North America, explained that the Impossible Whopper could "give somebody who wants to eat a burger every day, but doesn't necessarily want to eat beef everyday, permission to come into the restaurants more frequently."[51]

The impact of the Impossible Whopper was almost instant. Compared to the average March 2019 foot traffic for all U.S. Burger King outlets, foot traffic in its St. Louis stores (the Impossible Whopper test market) increased 16.8% in April 2019; in non-St. Louis outlets, foot traffic decreased 1.8%.[52] Burger King announced plans for a nationwide rollout, to be completed by the end of 2019.

Shortage For Impossible, the heady moment ended when it became clear that increased demand from Burger King and other customers—Impossible was now in nearly 10,000 outlets—was going to far exceed production. Efforts to make up the shortfall by accelerating expansion of the Oakland plant, which already operated around-the-clock every day, backfired when operational problems forced intermittent shutdowns. Customers were warned as early as April about an upcoming shortage, though Impossible was unable to say with certainty when it could again fulfill orders. Some customers received no deliveries for weeks or longer. The recent publicity spike from the Burger King launch made the problem all the worse, with Burger King forced to respond to consumers who were upset that they could not find the Impossible Whopper.

The press attention that had helped catapult Impossible into relevance became a liability, as media across the country spotlighted the shortage. Some longtime customers, especially standalone and local restaurants that had taken an early bet on the product, were incensed. Stated the owner of one such outlet in San Francisco: "[The burgers] disappeared off our shelves and then showed up at Burger King across the street. . . . It felt like a betrayal. The success of Impossible Burger was borne on the backs of the restaurateurs who took it on and made a good product out of it."[53] "For our team, seeing customers angry at us was very, very challenging," Lee said. "We've had to convince customers who were burned that they can trust us again." The shortage was largely resolved by August.

"The reason we got into trouble is because we couldn't imagine we could do that well," said Woodside. "It was a rare moment when the consumer already wanted the product, and the product actually delivered." Brown agreed. "We didn't plan for our success," he reflected. "I blame this on a business culture of being conservative in modeling the demand curve so that you can outperform. We produced 25% above our projection, but it wasn't enough. The reality is that the future is fuzzy. The

[a] See: https://www.ispot.tv/ad/IJjn/burger-king-impossible-whopper-impossible-taste-test

idea that you can plan on a nice curve is an illusion. We have to have a plan where in the 99th percentile we can thrive and in the 1st percentile we can thrive, and we need to plan on being very successful."

The episode spurred changes at Impossible, including creating and filling new executive positions to bring more management and commercial expertise into the decision-making apparatus, to date dominated by scientists. New hires included Woodside, previously chief operating officer at Dropbox; Thakkar, former iPhone product manager at Apple; and Shah, previously COO of Verifone. (See the **Appendix** for executive bios.) In addition, to mitigate the risk of future shortages, Impossible invested in additional expansion of the Oakland plant, where the number of employees tripled from June to August, and entered a production agreement with OSI, one of the world's largest food co-manufacturers. "You can see the huge expertise in how well their whole system works," said Lipman about OSI. "They're incredible at quickly troubleshooting and keeping the line running." The OSI partnership would enable Impossible to quadruple production from September 2019 to January 2020; all of that additional product was already allocated to customers. The deal included the opportunity for Impossible to further increase capacity with OSI over multiple years and multiple continents.

Chapter 4: Countdown to 2035

By late August 2019, some 17,000 restaurants served Impossible's product, of which roughly half were mom-and-pop outlets and the rest part of restaurant groups. Within weeks, Impossible would launch Impossible Burger patties into the retail channel, starting in Gelson's stores in California. "The next challenge we're probably unprepared for—because how couldn't we be—is the amount of demand we'll see in retail," said Lee. The company was also piloting a plant-based sausage pizza topping with the Little Caesar's pizza restaurant chain. "We are in hyper-growth now, and we have to double in size and impact every year for the next 15 years to achieve our mission," said Brown. "The only way to achieve this on the timescale that we need is by having a successful business."

The Choices and Challenges of Scaling

Brown continued: "Our biggest problem now is boringly conventional: scaling. We know there is far more demand for our product than we can meet, but scaling is hard and it's expensive." Scaling would allow Impossible to reach more markets and lower its costs, explained Woodside: "Our input costs are slightly higher than beef, but our price premium is above that. With scale we'll get to a lower price point, to where price isn't the reason you're choosing us versus commodity beef."

Diversifying The R&D team was working on plant-based alternatives for pork, steak, fish, and dairy products. The goal was to offer replacements, at the same level of quality as the Impossible Burger, for all major animal proteins. "Our scientists could do any product," said Konrad. "We have to make choices. The Impossible Foods' philosophy is to go after the 'worst first' [in terms of contribution to biodiversity collapse and climate change], which probably means swine and fish." The pace of expansion had to account for the mission's urgency but also the need to uphold standards of quality and consumer experience. "There aren't many products out there that people say they love. I've heard people describe iPhone that way and their Tesla that way. This is one of those products," said Thakkar. "My belief has always been that if you build the best product in the world, consumers will crave it and repeatedly use it. What's important is that consumers love the product, and the way you develop trust with consumers is to continue to delight them. So while 2035 might seem around the corner, we are focused on building the best and not rushing."

Questions of pacing also applied to market expansion. The leadership team saw potential demand as nearly limitless, but deciding which markets to enter and how quickly was difficult. "A big challenge

is prioritization. There is so much we can do. Ultimately, we are driven by our mission," said Shah. "Every distribution channel has its own nuances and its own challenges. In retail, the most appropriate place for our product in the store is right next to ground beef from animals." The recent product shortage had left the team more nervous about their ability to allocate supply and predict demand. "The biggest risk to us is not being able to plan for the market," said Woodside.

"China and Europe are the biggest international markets that could fuel Impossible Foods' expansion, but smaller markets are likely to be accessible on a shorter timeline," said Konrad. "Also, China accounts for about 30% of the world's meat consumption in total. So Impossible Foods has focused on developing multiple Asian markets in the near term." Entering each market required extensive due diligence on culinary practices and consumer preferences, and in finding local distribution and restaurant partners. There was also the significant time and expense devoted to getting market-by-market product approval from regulators.

People Konrad called Impossible "the hottest startup in Silicon Valley." It was inundated with job applications from millennials who were excited by the brand and the mission. Compensation and benefits were on par with the area's top technology companies. Although Impossible was constantly onboarding staff—the count had risen to about 650, though no one was quite sure because it seemingly rose by the hour—hiring did not keep pace with need. Some teams were undersized and lacked the channel know-how typically found in branded food companies. About one-third of the company's business professionals (those in sales, marketing, finance, IT, legal, etc.) had food-industry experience; the remainder of those teams skewed heavily towards technology-sector experience. In R&D, many people came directly from academia. "People in the tech world tend to be very analytical and good at fast growth, which is great for us," said Woodside. "But I worry that the culture could drift too much toward tech and not enough toward food. Our company would look very different if we were in Chicago, for example, rather than in Silicon Valley. The best profile is someone who's been in CPG and tech, but that's very rare."

Job candidates were screened to ensure they shared the company's purpose, although it was difficult to be certain. "We get thousands of applications," said Konrad. "How do you find people who are really mission aligned, when everyone knows this on their resume for two years will get you into the best business school? How do you know what's in their hearts?" She added that a related challenge was in the channel: "For me, a big concern is how to extend the corporate ethos into our broader ecosystem, to the teenager in the fast-food restaurant who is explaining the product and why to eat it to patrons. We don't own the point of sale anywhere, so how do we get people we only tangentially touch to provide deep insight into our product and to be brand ambassadors?"

Brown There was also the question of Brown's role. His passion and ability to persuade were powerful forces in the company, but he was not a trained manager and at times lacked the hard-nosed commercial instincts that were arguably necessary to grow the business. His analytical tendencies and penchant for questioning the status quo sometimes derailed conversations ("What is the point of pay scales, anyway?") and resulted in Impossible foregoing some standard business structures, such as a commission program for salespeople. "Pat sometimes envisions the world as it should be and not how it is," said Woodside. "He looks at mundane problems that have been solved—like how businesses are organized—and questions why and wants to rethink the whole thing. But some of these mundane things are the way they are for good reasons."

On the other hand, Brown's unconventional approach had a meaningful impact on Impossible's culture. For example, he spent one full day each week at the Oakland plant, where he was also instrumental in making sure workers, who were employed full-time after a temporary onboarding

period, received the same benefits package as he did. Moreover, Brown had the vision and intellectual heft to push Impossible towards its goal, which could mean taking risks that some businesses might not tolerate. "The 2035 mission is a guiding principle—not just the end-state but the timeline—to many strategic and managerial decisions. It certainly affects our risk tolerance," said Brown. "Pat has a way of extrapolating what you know now to an outcome in 10 years, and it seems implausible at first glance but when you plot it out, you realize it isn't," said Woodside. Added Konrad, "Pat is only here for the mission. If someone else could drive the change faster and better, he'd happily pack up and go home."

The (friendly?) competition A growing number of firms competed in the plant-based meat sector, including in burgers specifically, with Impossible and Beyond Meat typically described as rivals for market leadership (see **Exhibit 18**). Based in El Segundo, California, Beyond Meat was founded in 2009 and launched its "Beyond Burger" in 2016 in the U.S. retail market; at Whole Foods, it was the first plant-based burger sold in the meat case.[54] Its product line, since extended to other items such as sausages, proved highly popular with consumers who were delighted by its similarity to meat. Over time, Beyond Meat's distribution expanded to some 22,000 grocery stores, restaurants, and institutional outlets like sports stadiums in the U.S. and other markets.[55] Beyond Meat's marketing approach included paid celebrity brand ambassadors. (Impossible also had celebrity endorsers, though they were unpaid and "self-appointed," noted Brown.) In 2018, the brand had 9.9 billion earned media impressions (i.e., readership or viewership of media items mentioning Beyond Meat, which were not funded by the company).[56] In quarter-two 2019, Beyond Meat's revenue increased 287%, to $67.3 million, with a net loss of $9.4 million.[57] The company had not yet turned a profit.

Beyond Meat's initial public offering in early May 2019 was one of the most successful in U.S. history. On the first trading day, shares closed "163% higher than where they were initially priced just ten days earlier," said a commenter in *Forbes*. "Most stocks don't rise that much in five years. Forget about one day. But the party was just getting started."[58] By the end of July, its shares were trading at $234, giving the company a valuation of over $13 billion. (Refer to **Exhibit 16**.)

Some Impossible executives described Beyond Meat as more ally than competitor. The success of both was good for the climate; in fact, the two were co-recipients of the 2019 United Nations Champions of the Earth award, which the United Nations called its "highest accolade for the environment."[59] Lee, for one, was not overly concerned with out-competing Beyond Meat. "Each food retail behemoth is a tiny fraction of global meat consumption. So who really cares if they are going to offer Impossible or Beyond? We think bigger than that." He added: "We're not in a zero-sum game. For example, *Barron's* wrote an article comparing the rivalry of Coke and Pepsi to us and Beyond Meat, but it was not correct. Our addressable market is the meat eater, and it's big enough for everyone. Consumers don't have a Coke or Pepsi at breakfast, lunch, dinner, and snack, but they often have meat at every meal."

Woodside saw it differently. "Every big QSR [quick-serve restaurant] that we lose, there are millions of people whose first experience with the plant-based burger will be informed by the competition, not us." He worried about complacency. "How strong is our brand and how differentiated is our product, *really*, and how long can they remain so? These are legitimate questions. There's a mindset of not worrying about competition, but is it really true we shouldn't be that concerned? I think it is naïve to think we're only competing against the beef industry. In tech, where I'm from, it tends to be organized by 60-20-10 market share, 60% being Google, 20% Yahoo, and 10% whoever else. The 60% drives the market. Maybe it's not always so in food, but you certainly have category leaders and followers."

Criticism For all its adoring fans and viral social media buzz, Impossible also had ardent critics, including some vegan advocates who complained that Impossible's products were often sold at restaurants in non-vegan preparations. Impossible was also criticized for using genetically modified

soy protein and heme. (Brown supported certain uses of genetic modification in the food system and was transparent about Impossible's use of such ingredients.) Some health advocates also criticized Impossible's product as processed and unhealthy. "Our detractors get super focused on picking examples of how we're not perfect, but it's not like we're competing with broccoli," said Konrad.

Impossible was also targeted by critics like Richard Berman, a former tobacco lobbyist and founder of several groups that promoted corporate interests.[60] In August 2019, his organization, The Center for Consumer Freedom, ran full-page ads in the *Wall Street Journal* and *New York Post* titled "Fake Meat, Real Chemicals" that compared the ingredients in meat products to plant-based substitutes.[61] Berman had also authored several opinion pieces framing the plant-based sector as duplicitous. Stated his January 2018 *Washington Times* piece: "Fake meat companies happily allow their customers to assume these benevolent-sounding ingredients are no more than healthy veggies ground down to their constituent proteins. In truth, vegetable proteins are highly processed, stripped of nutrients, and far removed from the 'natural' food they're made out to be."[62]

Konrad reacted: "Nothing about the animal agriculture situation today is natural. Pumped with antibiotics, diseased and lame, shot with a stun gun in factories—it's unsustainable and on the wrong side of history. We've created a civilization that allows us to disassociate from the animals we eat." She likened "big beef's resistance to change" to the tobacco industry's attempts to inject uncertainty and confusion about whether smoking contributed to emphysema, cancer, and heart disease. She also compared the "inevitable" switch to plant-based meat to the switch one century ago from animal-based to mechanized transportation—from horse and buggy to automobile. "Big beef says beef is this iconic American thing," she continued. "People also once thought that about horses for transportation. But it took some innovative crazy people offering a way better technology—the internal combustion engine—and then everything changed."

Not all meat defenders were as fiery as Berman, though many still dismissed the 2035 timeframe, and the idea of eliminating beef at all, as unrealistic.[63] Others objected to using "meat" or "beef" to describe non-animal products; as of mid-2019, more than half of U.S. states had passed or introduced bills to regulate use of the terms.[64] Still others took offense at what they felt was a disregard for their traditions, livelihoods, and contributions to society implied in calls to eliminate animal agriculture.

"You could replace the protein content of all animals eaten today, matched for quality, with less than 1% of the earth's land area growing soybeans," said Brown. "Farmland prices would plummet, which is a problem, but there are ways to incentivize the repurposing of their land. Agricultural states should be the biggest advocates of a carbon market, because that would make former farmland very valuable for carbon capture. Also, in California for example, farmers and ranchers pay virtually nothing for water. If you changed the laws so that they could sell their water rights to downstream users, like municipalities, they would earn more money selling water than making cows."

Becoming "Big Beef-Alternative"

To truly compete with "big beef," Impossible would have to become a huge player—which meant deciding on a model to fund and execute a rapid scale up. In May 2019, it had executed its largest funding round to date, raising $300 million from institutional investors as well as celebrity entertainers and athletes, such as Jay-Z, Katy Perry, and Serena Williams. By August 2019, the company had raised $750 million in total, a combination of equity investment and convertible bonds. The latter had been sold in 2018 to investors such as Temasek, which invested on behalf of Singapore's sovereign wealth fund, and Sailing Capital, a Shanghai- and Hong Kong-based private equity firm.

To date, there had been no shortage of investor interest; employees spoke of "piles of money" available to the company. Still, even for investors who believed deeply in Brown and shared Impossible's values, the notion of doubling in size every year, as Brown wanted, was hard to stomach. "I would like to theoretically grow capacity by 20 times!" said Brown. "Investors know the consumer demand is there, but building production facilities is always a bet that you're going to keep growing, and that's a hard ask. For us, the funding questions are more about control. How do we take on more funding while retaining as much control as we need?"

The prospect of an IPO was often discussed, though not imminently planned. After Beyond Meat's public offering, sales of Impossible shares in the secondary market had valued the company as high as $5 billion. "I've never seen anything like it," said a partner at a San Francisco bank. "Investors from Turkey through the U.K. are calling us at all hours. They're trying to find a way to get in the stock."[65]

How quickly should Impossible seek to grow, and with what funding model? Should the company stay focused on beef? Did Impossible have the right strategy for achieving commercial and mission success—and was there a point at which the two objectives would no longer be mutually reinforcing?

Exhibit 1 Impossible Burger 2.0 (launched in 2019) Photo

Source: Company documents.

Exhibit 2 Impossible Burger 2.0 (launched in 2019) Nutrition Facts

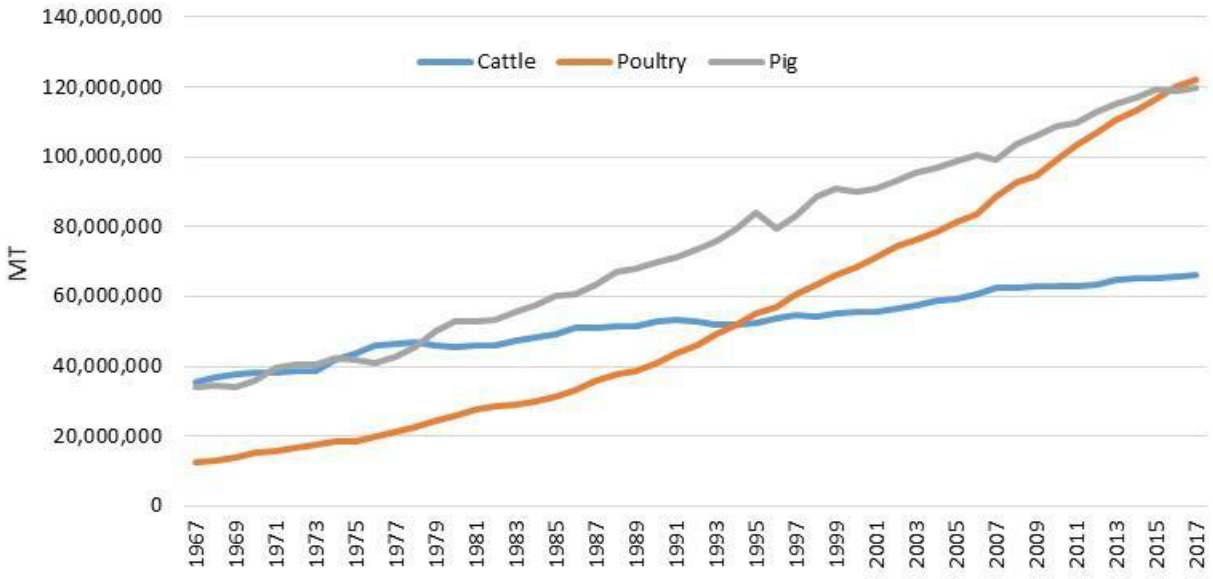
Serving size	4 oz (113g)
Amount per serving	
Calories	**240**
	% Daily Value*
Total Fat 14g	**18%**
Saturated Fat 8g	**40%**
Trans Fat 0g	
Cholesterol 0mg	**0%**
Sodium 370mg	**16%**
Total Carbohydrate 9g	**3%**
Dietary Fiber 3g	**11%**
Total Sugars <1g	
Includes <1g Added Sugars	**1%**
Protein 19g	**31%**

Vitamin D 0mcg	0%
Calcium 170mg	15%
Iron 4.2mg	25%
Potassium 610mg	15%
Thiamin 28.2mg	2350%
Riboflavin 0.4mg	30%
Niacin 5.3mg	35%
Vitamin B_6 0.4mg	25%
Folate 115mcg DFE	30%
Vitamin B_{12} 3mcg	130%
Phosphorus 180mg	15%
Zinc 5.5mg	50%

*The % Daily Value tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

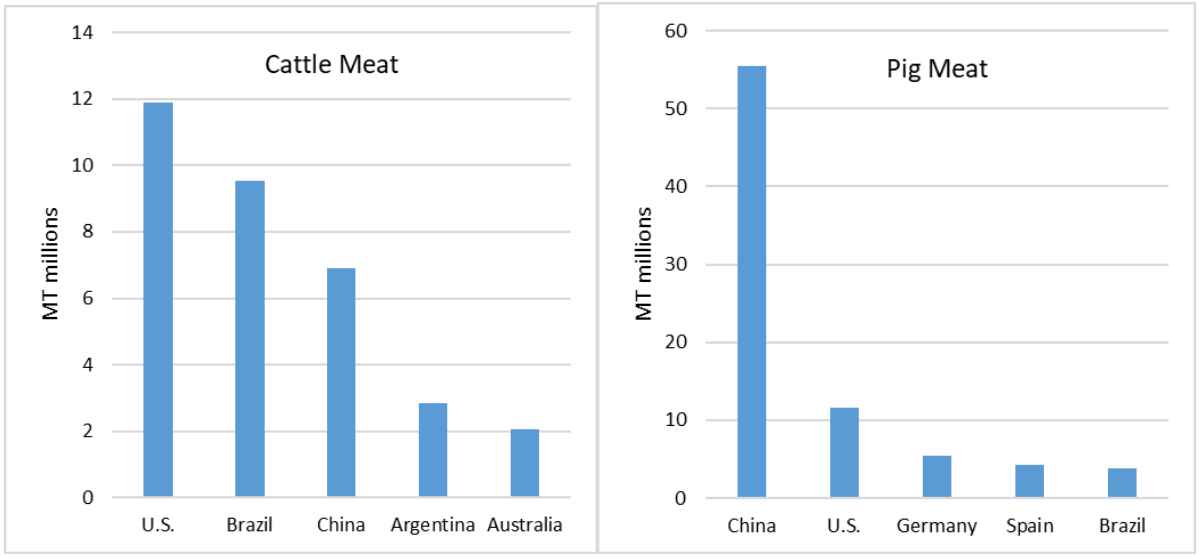
Source: Company documents.

Exhibit 3 World Production (MT) of Cattle, Poultry, and Pigs, 1967-2017



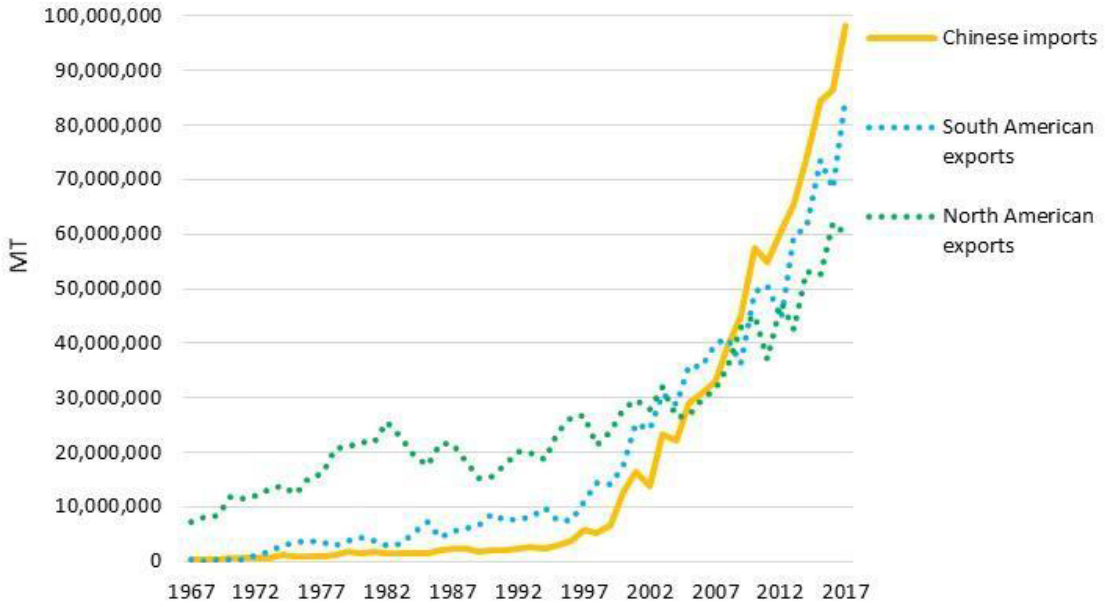
Source: Compiled via FAO Stat, Compare Data (Production, Livestock Primary, World Total, Quantity), http://www.fao.org/faostat/en/#compare, accessed November 2019.

Exhibit 4 Top Five Countries in Production of Meat from Cattle and Pigs (MT millions), 2017



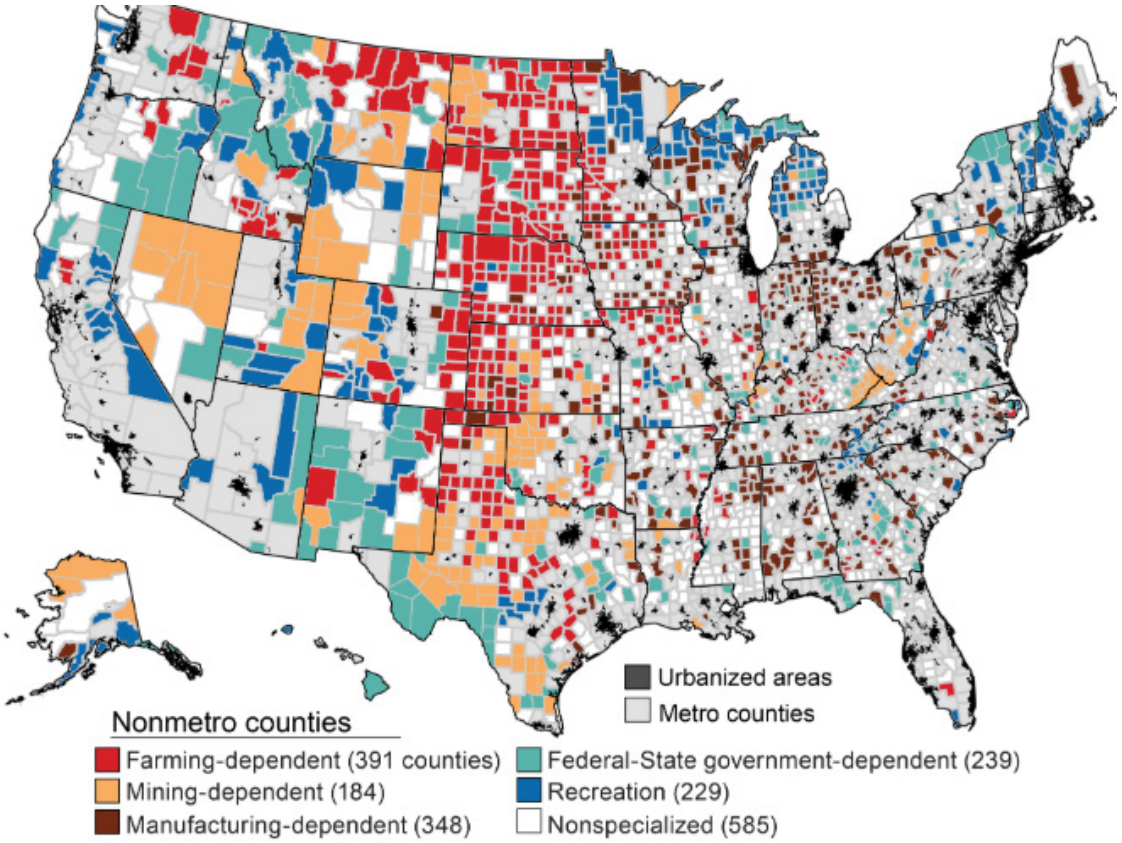
Source: Compiled from UN FAOSTAT, (Data, Livestock Primary, Production), http://www.fao.org/faostat/en/#data/QL, accessed September 2019.

Exhibit 5 Total South and North American Soybean Exports and Chinese Soybean Imports (MT), 1967-2017



Source: Compiled via FAO Stat, Compare Data (Trade, Crop and Livestock Products, South America (total) and Northern America (total), Export Quantity, Soybeans; and Trade, Crop and Livestock Products, China, Import Quantity, Soybeans), http://www.fao.org/faostat/en/#compare, accessed November 2019.

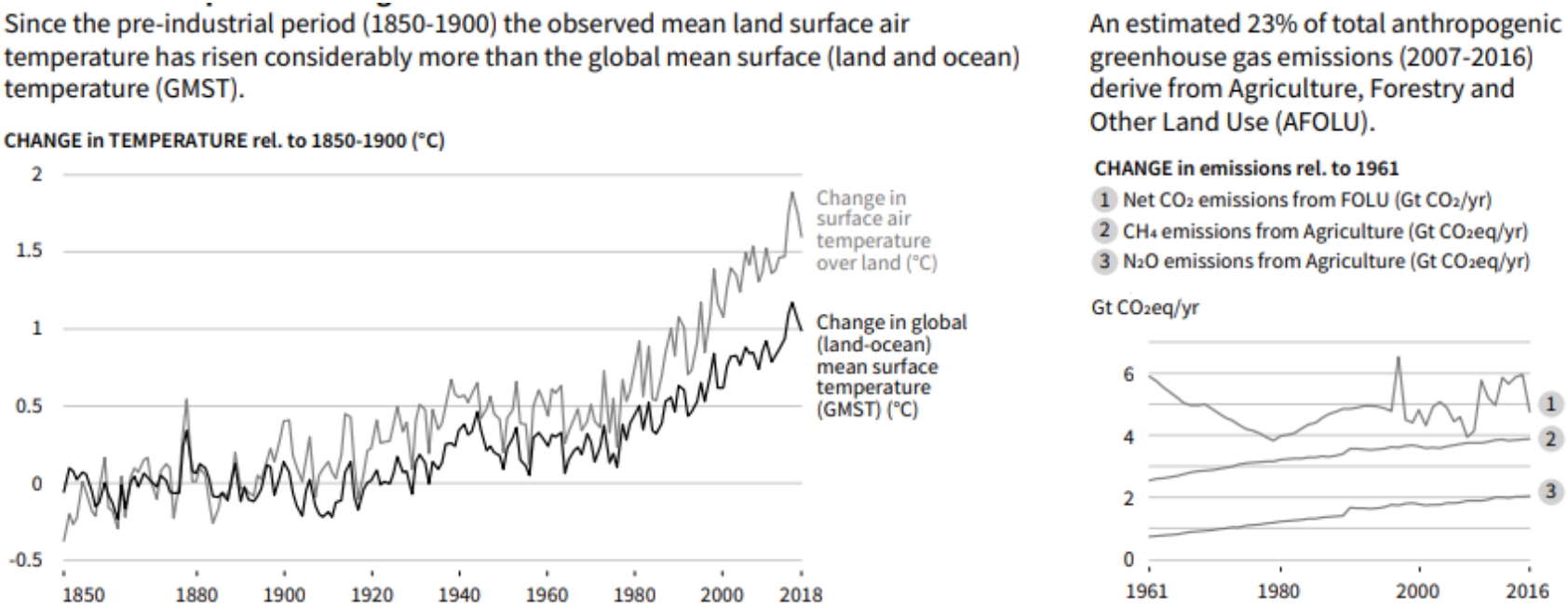
Exhibit 6 Dependence on Farming and Other Industries by U.S. Counties



Source: "Rural economies depend on different industries," USDA ERS, updated June 2019, https://www.ers.usda.gov/data-products/chart-gallery/gallery/chart-detail/?chartId=58290, accessed September 2019.

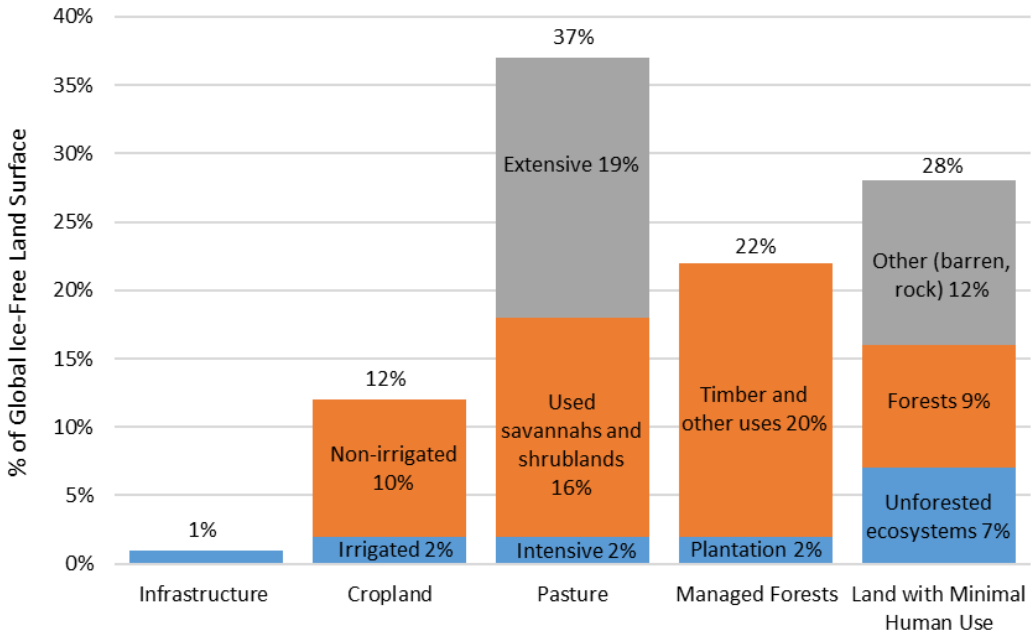
Note: Analysis conducted using 2010-2012 average county earnings and jobs from the U.S. Department of Commerce.

Exhibit 7 Temperature Change, 1850-2018 (left) and GHG Emissions from Agriculture, Forestry, and Other Land Use, 1961-2016 (right)



Source: Intergovernmental Panel on Climate Change, "Climate Change and Land, Summary for Policymakers," August 7, 2019, p. 4, Figure SPM.1., Panels A (left) and B (right), IPCC website, https://www.ipcc.ch/site/assets/uploads/2019/08/Edited-SPM_Approved_Microsite_FINAL.pdf, accessed October 2019.

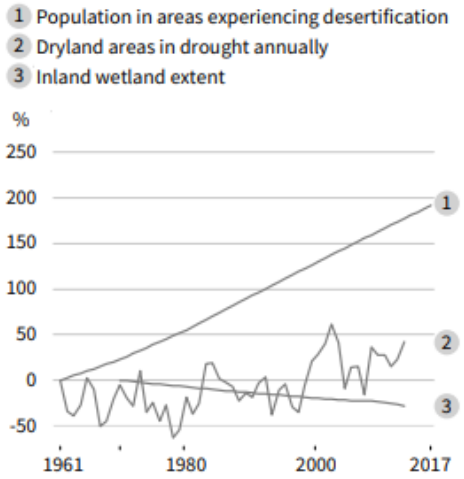
Exhibit 8 Global Land Use by Type (% of global ice-free land surface), 2015



Source: Adapted from Intergovernmental Panel on Climate Change, "Climate Change and Land, Summary for Policymakers," August 7, 2019, p. 4, Figure SPM.1, Panel C, IPCC website, https://www.ipcc.ch/site/assets/uploads/2019/08/Edited-SPM_Approved_Microsite_FINAL.pdf, accessed October 2019.

Note: Intensive pasture is defined as having a livestock density greater than 100 animals/km².

Exhibit 9 Selected Impacts from Land Use Intensification and Climate Change (% change relative to 1961 and 1970)



Source: Intergovernmental Panel on Climate Change, "Climate Change and Land, Summary for Policymakers," August 7, 2019, p. 4, Figure SPM.1, Panel F, IPCC website, https://www.ipcc.ch/site/assets/uploads/2019/08/Edited-SPM_Approved_Microsite_FINAL.pdf, accessed October 2019.

Exhibit 10 Eat-*Lancet* Commission Targets for "Planetary Health Diet," for Intake of 2,500 kcal/day

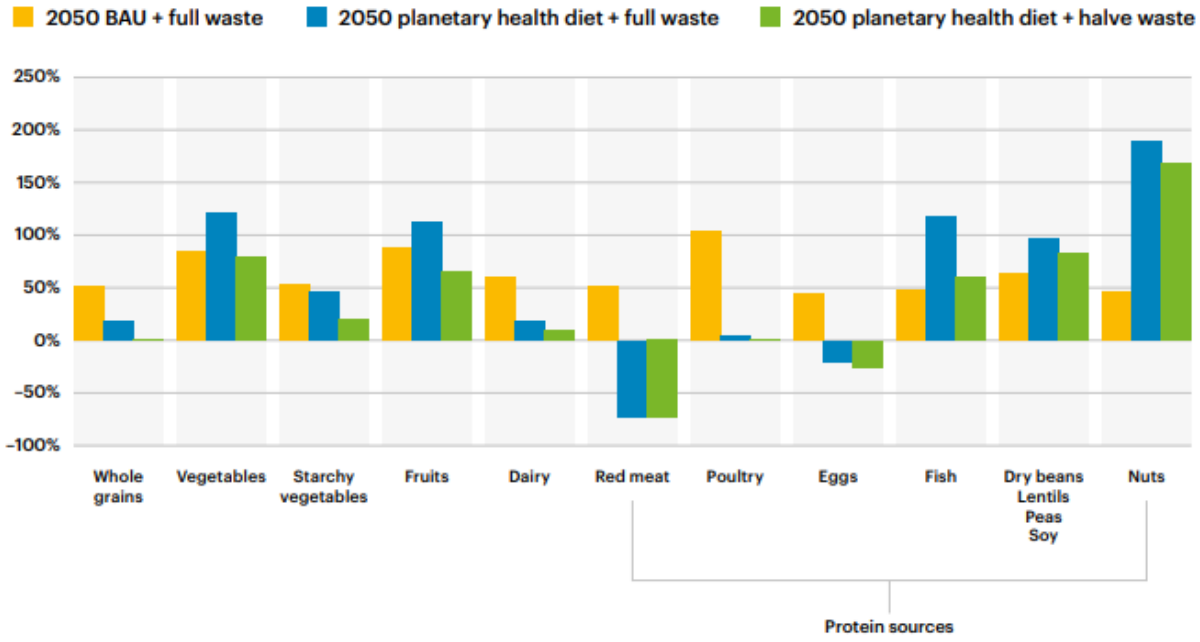
	Macronutrient intake grams per day (possible range)	Caloric intake kcal per day
Whole grains		
Rice, wheat, corn and other	232	811
Tubers or starchy vegetables		
Potatoes and cassava	50 (0–100)	39
Vegetables		
All vegetables	300 (200–600)	78
Fruits		
All fruits	200 (100–300)	126
Dairy foods		
Whole milk or equivalents	250 (0–500)	153
Protein sources		
Beef, lamb and pork	14 (0–28)	30
Chicken and other poultry	29 (0–58)	62
Eggs	13 (0–25)	19
Fish	28 (0–100)	40
Legumes	75 (0–100)	284
Nuts	50 (0–75)	291
Added fats		
Unsaturated oils	40 (20–80)	354
Saturated oils	11.8 (0-11.8)	96
Added sugars		
All sugars	31 (0–31)	120

Source: "Food Planet Health: Health Diets from Sustainable Food Systems—Summary Report of the EAT-*Lancet* Commission," 2019, p. 10, Eat-Forum website, https://eatforum.org/content/uploads/2019/07/EAT-Lancet_Commission_Summary_Report.pdf, accessed October 2019. This graphic was prepared by EAT and is included in an adapted summary of the Commission Food in The Anthropocene: the EAT-*Lancet* Commission on Healthy Diets From Sustainable Food Systems. The entire Commission can be found online at eatforum.org/eat-lancet-commission.

Note: The reported noted that the diet "does not imply that the global population should eat exactly the same food, nor does it prescribe an exact diet" but rather it "outlines empirical food groups and ranges of food intakes, which combined in a diet, would optimize human health. Local interpretation and adaptation of the universally-applicable planetary health diet is necessary and should reflect the culture, geography and demography of the population and individuals."

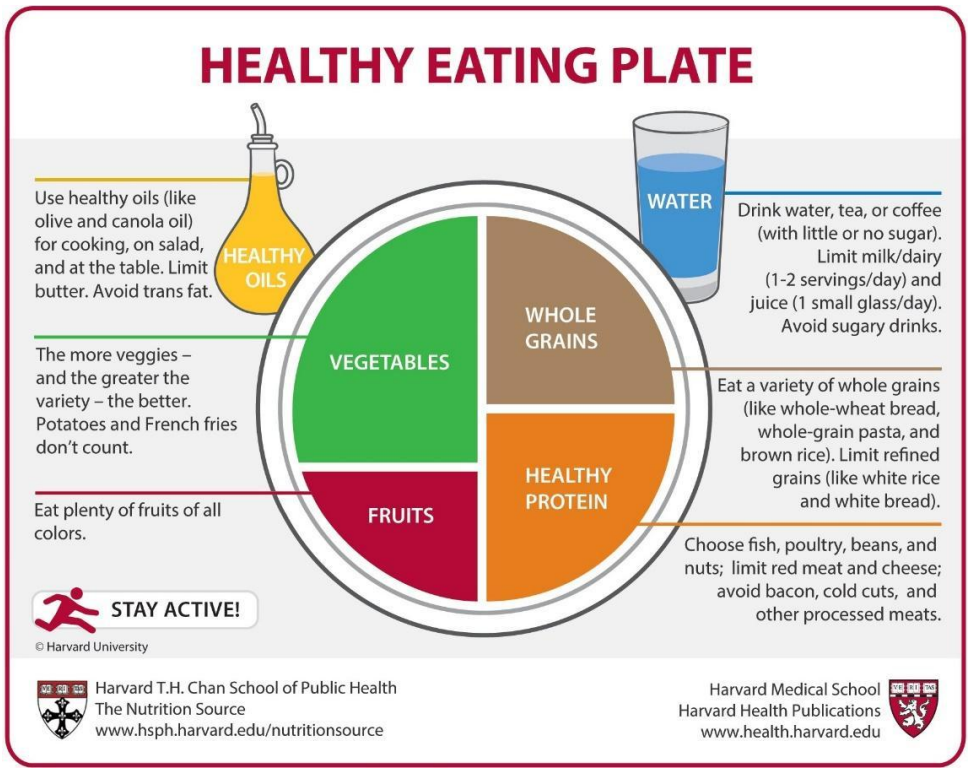
Exhibit 11 EAT-*Lancet* Projections of Change in Food Production in 2050, from 2010 Baseline

BAU = Business as Usual (no change in consumption patterns); Waste = Food waste and loss, with full waste referring to 2010 levels.



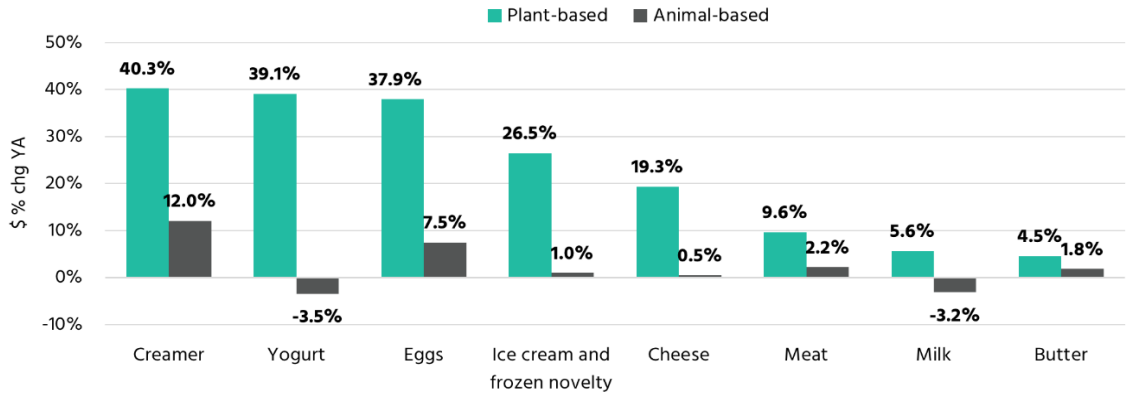
Source: "Food Planet Health: Health Diets from Sustainable Food Systems—Summary Report of the EAT-*Lancet* Commission," 2019, p. 21, Eat-Forum website, https://eatforum.org/content/uploads/2019/07/EAT-Lancet_Commission_Summary_Report.pdf, accessed October 2019. This graphic was prepared by EAT and is included in an adapted summary of the Commission Food in The Anthropocene: the EAT-*Lancet* Commission on Healthy Diets From Sustainable Food Systems. The entire Commission can be found online at eatforum.org/eat-lancet-commission.

Exhibit 12 "Healthy Eating Plate" Dietary Guidance



Source: "Healthy Eating Plate," Harvard T.H. Chan School of Public Health, https://www.hsph.harvard.edu/nutritionsource/healthy-eating-plate/, accessed November 2019. Copyright © 2011, Harvard University. For more information about The Healthy Eating Plate, please see The Nutrition Source, Department of Nutrition, Harvard T.H. Chan School of Public Health, www.thenutritionsource.org, and Harvard Health Publications, www.health.harvard.edu.

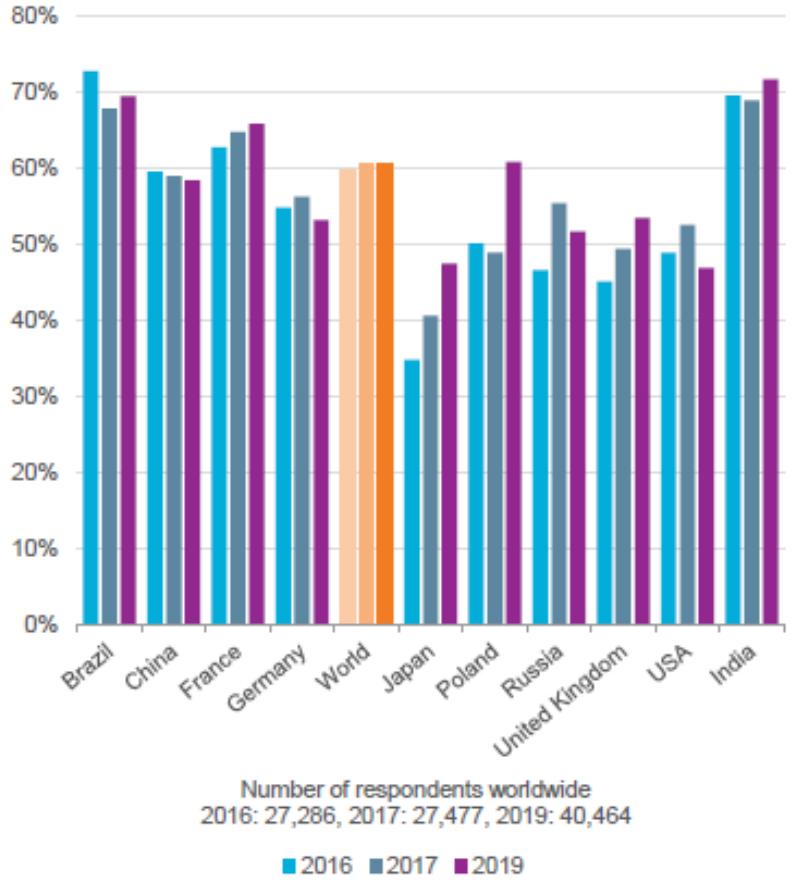
Exhibit 13 U.S. Retail Dollar Sales Growth (% change), Animal-Based and Plant-Based Products, April 2018-April 2019



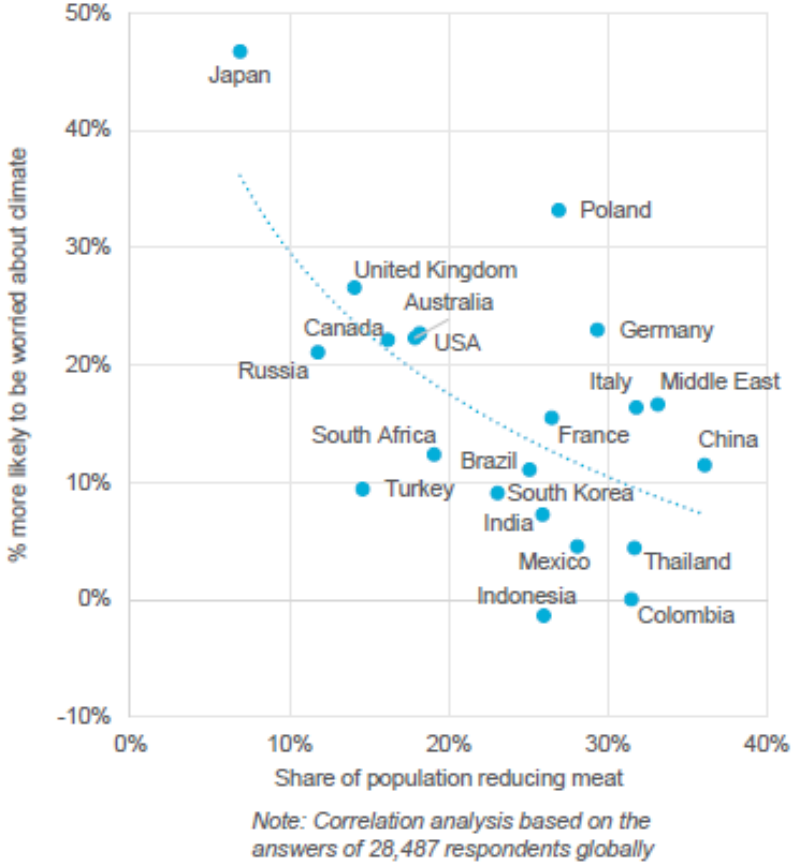
Source: "Plant-Based Market Overview," Good Food Institute, citing SPINSscan Natural and Specialty Gourmet (proprietary), SPINSscan Conventional Multi Outlet (powered by IRI), 52 weeks ending April 21, 2019, Good Food Institute website, https://www.gfi.org/marketresearch?utm_source=blog&utm_medium=website&utm_campaign=marketresearch, accessed November 2019.

Exhibit 14 Survey on Climate Change Worry and Meat Reduction, 2017-2019

Affirmative Responses to "I Am Worried About Climate Change"



Correlation of Climate Change Worry and Meat Reduction



Source: "Driving Forces Behind Plant-Based Diets: Climate Concern and Meat Reduction," Passport, June 2019, pp. 6, 11, Euromonitor International database, accessed July 2019.

Exhibit 15 Large Packaged Food and Meat Companies with Plant-Based Brands and Investments

Tyson Foods (U.S.): Invested in Beyond Meat in 2016 but exited before the IPO, and invested in lab-based meat firms Memphis Meats (U.S.) and Future Meat Technologies (Israel).

JBS (Brazil): Launched a plant-based burger in 2019 under its Seara brand, also used for meats.

Marfrig (Brazil): Entering plant-based category in joint venture with ADM, with ADM supplying raw material for products to be made and sold by Marfrig.

Cargill (U.S.): Invested in Memphis Meats in 2018 and lab-meat grower Aleph Farms (Israel) in 2019.

Smithfield Foods (U.S.; Chinese parent): Launched meatless Pure Farmland brand in 2019.

Maple Leaf Foods (Canada): Acquired plant-based protein maker Lightlife Foods (U.S.) and agreed to buy grain-based beat and vegan dairy products maker Field Roast Grain Meat Co. (U.S.) in 2018.

OSI Group (U.S.): Entered production deal with Impossible Foods in 2019.

Nestlé (Switzerland): Owned vegetarian brand Garden Gourmet, which sold an "Incredible Burger." Acquired plant-based food maker Sweet Earth (U.S.) in 2017 and launched its Awesome Burger in 2019.

Bell Food Group (Switzerland): Invested in cultured-beef startup Mosa Meat (Netherlands) in 2018.

Hilton Food Group (U.K.): Bought 50% of vegetarian supplier Dalco Food (Netherlands) in 2018.

Izico Food Group (Netherlands): Produces own range of vegetarian and vegan products and acquired vegetarian products maker Goodlife Foods (U.K.) in 2017.

PHW-Gruppe (Germany): Entered partnership with lab-based meat startup SuperMeat (Israel) in 2018.

Nortura (Norway): Launched vegetarian meat substitute brand, MEATish, in 2018.

Wiesenhof (Germany): Launched vegan sausages and mortadella in 2015, adding to its existing vegetarian products under its Paul's Veggie brand.

Finnebrogue Artisan (Northern Ireland): Opened plant to make vegetarian products in 2019.

The Black Farmer (U.K.): Launched incubator in 2018; included vegan products maker Plant Jason.

Heck Food (U.K.): Launched plant-based sausage line in 2018.

ABP Food Group (Ireland): Launched plant-based meat brand, Equals, in 2019.

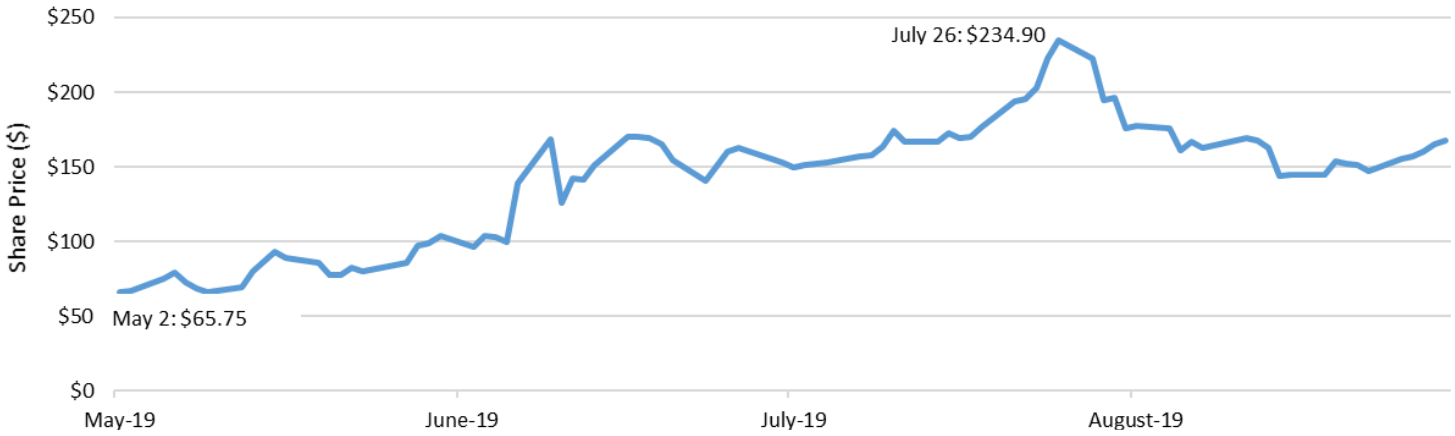
Danish Crown (Denmark): Planned to introduce plant-based burger substitutes in by end 2019.

Hormel Foods (U.S.): Launched plant-based meat-alternative brand, Happy Little Plants, in 2019.

Kerry Group (Ireland): Launched Richmond-brand meat-free sausages in 2019.

Source: Compiled from Andy Coyne, "Eyeing alternatives—meat companies with stakes in meat-free," Just-Food website, October 15, 2019, https://www.just-food.com/analysis/eyeing-alternatives-meat-companies-with-stakes-in-meat-free_id139678.aspx; and David Yaffe-Bellany, "The New Makers of Plant-Based Meat? Big Meat Companies," *The New York Times* online, October 14, 2019, https://www.nytimes.com/2019/10/14/business/the-new-makers-of-plant-based-meat-big-meat-companies.html, both accessed November 2019.

Exhibit 16a Beyond Meat Share Price, May 2, 2019-August 31, 2019



Source: Compiled from Capital IQ, accessed November 2019.

Exhibit 16b Beyond Meat Revenue ($ thousands) and Growth (%), Segment and Channel, Q2 and H1, 2019

	Three Months Ended		Change		Six Months Ended		Change	
(in thousands)	June 29, 2019	June 30, 2018	Amount	%	June 29, 2019	June 30, 2018	Amount	%
Net revenues:								
Gross Fresh Platform	$ 67,722	$ 15,119	$ 52,603	347.9%	$ 106,528	$ 24,715	$ 81,813	331.0%
Gross Frozen Platform	5,639	4,506	1,133	25.1%	10,151	9,254	897	9.7%
Less: Discounts	(6,110)	(2,258)	(3,852)	170.6%	(9,222)	(3,826)	(5,396)	141.0%
Net revenues	$ 67,251	$ 17,367	$ 49,884	287.2%	$ 107,457	$ 30,143	$ 77,314	256.5%

	Three Months Ended		Change		Six Months Ended		Change	
(in thousands)	June 29, 2019	June 30, 2018	Amount	%	June 29, 2019	June 30, 2018	Amount	%
Net revenues:								
Retail	$ 34,120	$ 11,684	$ 22,436	192.0%	$ 53,699	$ 20,972	$ 32,727	156.1%
Restaurant and Foodservice	33,131	5,683	27,448	483.0%	53,758	9,171	44,587	486.2%
Net revenues	$ 67,251	$ 17,367	$ 49,884	287.2%	$ 107,457	$ 30,143	$ 77,314	256.5%

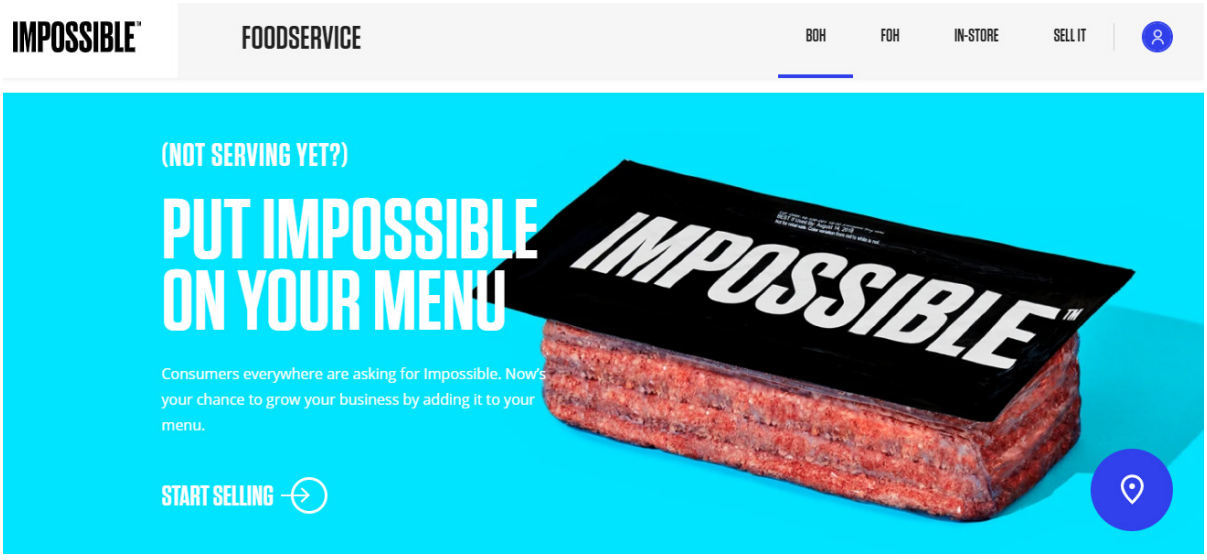
Source: "Beyond Meat Reports Second Quarter 2019 Financial Results," Beyond Meat press release (El Segundo, California, July 29, 2019), https://investors.beyondmeat.com/news-releases/news-release-details/beyond-meatr-reports-second-quarter-2019-financial-results, accessed November 2019.

Exhibit 16c Beyond Meat Financial Snapshot ($ thousands except per share data), 2016-2018 (year-end Dec. 31)

(in thousands, except per share data)	2016	2017	2018
Statements of Operations Data:			
Net revenues	$ 16,182	$ 32,581	$ 87,934
Cost of goods sold	22,494	34,772	70,360
Gross (loss) profit	(6,312)	(2,191)	17,574
Restructuring expenses	—	3,509	1,515
Total operating expenses	18,454	26,374	45,563
Loss from operations	(24,766)	(28,565)	(27,989)
Total other expense	(380)	(1,814)	(1,896)
Loss before income taxes	(25,146)	(30,379)	(29,885)
Income tax expense	3	5	1
Net loss	(25,149)	(30,384)	(29,886)
Net loss per share attributable to common stock:			
Basic and diluted[1]	$ (5.51)	$ (5.57)	$ (4.75)
Pro forma net loss per share attributable to common stock:			
Basic and diluted[1]			$ (0.64)

Source: Beyond Meat, Inc., Form S-1, filed with the U.S. Security and Exchange Commission April 22, 2019, p. 13, https://www.sec.gov/Archives/edgar/data/1655210/000162828019004543/beyondmeats-1a5.htm#s57546DB62BAA824E7F8F8678F87B70AB, accessed November 2019.

Exhibit 17 Screenshot of Impossible Foods Webpage for Foodservice Customers



Source: Company documents.

Exhibit 18 Comparison of Selected Plant-Based Burger Products Available in the U.S., 2019

Product	Maker	Price	Ingredients
Impossible Burger (retail) – anticipated for September launch	Impossible Foods (Redwood City, California)	$8.99 for a 12-ounce package	Water, soy protein concentrate, coconut oil, sunflower oil, natural flavors, 2 percent or less of: potato protein, methylcellulose, yeast extract, cultured dextrose, food starch-modified, soy leghemoglobin, salt, soy protein isolate, mixed tocopherols (vitamin E), zinc gluconate, thiamine hydrochloride (vitamin B1), sodium ascorbate (vitamin C), niacin, pyridoxine hydrochloride (vitamin B6), riboflavin (vitamin B2), vitamin B12.
Beyond Burger	Beyond Meat (El Segundo, California)	$5.99 for two four-ounce patties	Water, pea protein isolate, expeller-pressed canola oil, refined coconut oil, rice protein, natural flavors, cocoa butter, mung bean protein, methylcellulose, potato starch, apple extract, salt, potassium chloride, vinegar, lemon juice concentrate, sunflower lecithin, pomegranate fruit powder, beet juice extract (for color).
Lightlife Burger	Lightlife/ Greenleaf Foods (Toronto, Canada)	$5.99 for two four-ounce patties	Water, pea protein, expeller-pressed canola oil, modified cornstarch, modified cellulose, yeast extract, virgin coconut oil, sea salt, natural flavor, beet powder (for color), ascorbic acid (to promote color retention), onion extract, onion powder, garlic powder.
Field Burger	Field Roast (Seattle, Washington)	~$6 for four 3.25-ounce patties	Vital wheat gluten, filtered water, organic expeller-pressed palm fruit oil, barley, garlic, expeller-pressed safflower oil, onions, tomato paste, celery, carrots, naturally flavored yeast extract, onion powder, mushrooms, barley malt, sea salt, spices, carrageenan (Irish moss sea vegetable extract), celery seed, balsamic vinegar, black pepper, shiitake mushrooms, porcini mushroom powder, yellow pea flour.
Sweet Earth Fresh Veggie Burger	Sweet Earth Foods (Moss Landing, California)	~$4.25 for two four-ounce patties	Garbanzo beans, mushroom, vital wheat gluten, green peas, kale, water, bulgur wheat, barley, bell peppers, carrot, quinoa, extra-virgin olive oil, red onion, celery, flax seed, cilantro, garlic, nutritional yeast, granulated garlic, sea salt, ginger, granulated onion, lime juice concentrate, cumin, canola oil, oregano.

Source: Compiled from Julia Moskin, "How Do The New Plant-Based Burgers Stack Up? We Taste-Tested Them," *The New York Times* online, October 22, 2019, https://www.nytimes.com/2019/10/22/dining/veggie-burger-taste-test.html?action=click&module=Top%20Stories&pgtype=Homepage, accessed October 2019.

Appendix: Impossible Foods Leadership Team, August 2019

Patrick Brown: Pat is CEO and founder of Impossible Foods. After receiving his BA, M.D., and Ph.D (in Biochemistry) at the University of Chicago, Pat completed a residency in pediatrics at Chicago's Children's Memorial Hospital. As a fellow with Mike Bishop and Harold Varmus, he defined the mechanism by which HIV and other retroviruses incorporate their genes into the genomes of the cells they infect. At Stanford, Pat and colleagues developed DNA microarrays—a new technology that made it possible to monitor the activity of all the genes in a genome—along with the first methods for analyzing, visualizing, and interpreting global gene expression programs. He pioneered the use of gene expression patterns to classify cancers and improve prediction of their clinical course.

He has also been a leader in making scientific and medical research results freely available to scientists, physicians, and the public. With Harold Varmus, then Director of the National Institutes of Health, and Berkeley professor Michael Eisen, he founded the Public Library of Science, a nonprofit scientific publisher that has transformed the publishing industry by making scientific and medical research results freely available to the public. He is a member of the National Academy of Sciences and the Institute of Medicine and recipient of the American Cancer Society Medal of Honor. He is also the co-founder of Lyrical Foods, Inc., maker of Kite Hill artisanal nut-milk-based cheeses and yogurts.

Dan Greene: Dan is an accomplished business leader with a special talent for growing and scaling organizations quickly and helping his teams quickly achieve fantastic business results. Over the course of his professional career, he has held a variety of operational revenue-driving roles from early startups to established Fortune 500 companies. Prior to joining Impossible, Dan served as Chief Revenue Officer for a conversational artificial intelligence startup, and served as an executive consultant with other early-stage software companies. Prior to that, Dan spent 11 years overseeing large teams and revenue-generating business units at Google and Twitter.

Before Google, Dan graduated from The United States Naval Academy and served over ten years as a Navy fighter pilot and director of operations for multiple aviation units. He left active duty in 2004 and earned his MBA at the University of California Los Angeles while starting his civilian career in the commercial aviation business.

Nick Halla: Nick joined Impossible Foods as its first employee and has helped build the company from the ground up. Nick has held numerous senior executive roles at Impossible Foods and currently serves as Senior Vice President for International. He oversees the company's growing presence around the world, including overseas business development and operations.

Before joining Impossible, Nick was an expert in food commercialization at General Mills, where he developed and launched several new product lines and designed large-scale food manufacturing systems. He also has experience in agriculture, having grown up on a family dairy farm, and commercializing new technologies such as solar, energy storage, and biofuels. Nick holds a B.S. in Chemical Engineering from the University of Minnesota, an MBA from the Stanford Graduate School of Business, and an M.S. in Environment and Resources from the Stanford School of Earth Sciences.

Sue Klapholz: Sue, M.D., Ph.D, is VP of Nutrition and Health at Impossible Foods. She is also on the board of directors of Impossible's sister company, Lyrical Foods. Sue holds five patents and brings a wealth of experience from her diverse career as a scientist, doctor, teacher, editor, and writer. Before joining Impossible Foods in 2013, Sue was a senior scientist at Cell Genesys, where she established a large DNA cloning lab and led the team that cloned the megabase-sized human immunoglobulin genes in yeast, among other projects. Sue also taught a professional course in cloning and analysis of large

DNA molecules at Cold Spring Harbor Laboratory, NY, and was a lecturer on genetics and evolution at The University of Chicago.

Sue was a resident physician in the Department of Psychiatry at The University of California, San Francisco. She was also a postdoctoral fellow in the Department of Biochemistry at Stanford University, where she worked on cloning a gene responsible for manic-depression, and a postdoctoral fellow in the Department of Biology at The University of Chicago, focusing on the genetic control of recombination and chromosome segregation during meiosis in yeast. Sue has an M.D. from The University of Illinois College of Medicine and a Ph.D. in genetics from The University of Chicago.

Rachel Konrad: Rachel joined Impossible Foods in August 2016 and is responsible for communication strategy; messaging, reputation, and content development; and product, corporate, and executive communications. Rachel has extensive communications and marketing expertise in startup and multinational environments, both in the United States and internationally. From 2011-2016, Rachel was the global head of communication and marketing for the Renault-Nissan Alliance, one of the world's largest automakers and the leader in zero-emission mobility. She was in charge of all aspects of communication, reputation management, sponsorships, and events, reporting directly to CEO Carlos Ghosn and based in Paris.

From 2010-2011, Rachel led communications for Tesla Motors Europe, where she was based in the U.K. and responsible for raising awareness and increasing sales in more than two dozen countries. Before moving to Europe, Rachel was in charge of communications for Tesla Motors from 2008-2009, where she was the sole PR person during the startup's most transformative period, reporting directly to CEO Elon Musk. From 1994 to 2008, Rachel covered business and technology for the Associated Press, CNET, and other news organizations. Rachel was a 2002 Pew Fellow for International Journalism and has a bachelor's degree in history and journalism from Northwestern University.

David Lee: David is the CFO of Impossible Foods. He led the business functions as COO from 2015-2019, helping transform Impossible from pre-revenue to hyper-growth, with global sales, commercial manufacturing, and supply chain capability. He has successfully raised over $650 million debt and equity to fund commercialization.

Previously as CFO of Zynga, David was responsible for leading Zynga's finance and corporate development teams. Prior to Zynga, David led corporate finance and strategy for Best Buy during its turnaround in 2013. He previously led the $2 billion topline set of brands at Del Monte Foods as SVP of Consumer Products, consummating in the take-private transaction of Del Monte Foods to KKR for $5.5 billion, resulting in over 40% return to shareholders. His prior experience includes leading PG&E's turnaround during the California Energy Crisis, strategy consulting at McKinsey, venture capital investing, and advertising at the Leo Burnett Company. David received his MBA from the University of Chicago and a BA from Harvard College.

David Lipman: David is the Chief Science Officer at Impossible Foods, which he joined in May 2017. Previously, he was the Director of the National Center for Biotechnology Information (NCBI), a division of the National Library of Medicine within the National Institutes of Health (NIH). He was appointed as NCBI's first director in 1989, shortly after Congress created the center in 1988, and has overseen its growth (employing over 700 leading scientists) into one of the most heavily used resources in the world for the search and retrieval of biomedical information, with over 4 million users each day. Dr. Lipman obtained a B.A. in Biology from Brown University in 1976 and an M.D. from the State University of New York at Buffalo in 1980.

After medical training, David joined the Mathematical Research Branch of the National Institute of Diabetes, Digestive, and Kidney Diseases (NIDDK) at NIH as a Research Fellow, studying molecular evolution and developing computational tools for sequence comparison. David is one of the developers of the original BLAST (Basic Local Alignment Search Tool) algorithm for rapidly identifying biological sequences that are similar to a queried sequence, and is the recipient of numerous awards. He is an elected member of the National Academy of Sciences, the Institute of Medicine, and the American Academy of Arts and Sciences.

Sheetal Shah: Sheetal joined Impossible Foods in May 2019 as Senior Vice President, Product and Operations. Sheetal oversees several mission-critical business units, including product, operations, manufacturing, supply chain and logistics. Before joining Impossible, Sheetal was Chief Operations Officer at Verifone, where he oversaw global operations including supply chain, customer care, quality, and program management for customers in more than 150 countries.

Prior to Verifone, Sheetal served in numerous leadership roles at Motorola Mobility, a $10 billion mobile device company acquired by Google. Among other positions, Sheetal served as Chief Procurement Officer, responsible for end-to-end global supplier management including all commercial and operational aspects including supplier new technology readiness. Sheetal's career began at Motorola as a software engineer, where he designed and shipped automatic speech recognition and voice annotation technology for Motorola handsets. He holds multiple patents and has Bachelor's and Master's degrees in electrical engineering from the University of Florida.

Ravi Thakkar: Ravi is Vice President of Product Management at Impossible Foods, where he leads a growing team of product managers. Ravi joined Impossible Foods from Apple, where he served as iPhone Product Manager in the Worldwide Product Marketing division. Before Apple, Ravi held several product leadership roles at Motorola Mobility, a mobile devices company acquired by Google.

Ravi has a track record of launching successful products at global scale. He has an MBA from Northwestern University's Kellogg School of Management and a Bachelor of Science in Computer Engineering from the University of Illinois at Urbana-Champaign. His experience spans product management, engineering, marketing, sales, operations, and other functions.

Dana Wagner: Dana is the Chief Legal Officer at Impossible Foods. He oversees the company's legal, regulatory, and governmental affairs. From 2011 through 2016, Dana served as the General Counsel of Square Inc., where he built and led the legal, government relations, compliance, and security teams. While at Square, he played a central role in the company's design and launch of innovative financial products, its expansion into international markets, and its initial public offering. Before that, he led antitrust, competition, and consumer protection matters at Google from 2007 to 2011, and he held various positions in the U.S. Department of Justice from 2000 through 2007.

Dana has taught and lectured at Harvard Law School, Stanford Law School, Berkeley Law, Northwestern University, U.C. Hastings College of the Law, and many other institutions on the topics of law, business, and technology. He received his undergraduate degrees in Economics and Comparative Literature from the University of California-Berkeley and his J.D. from Yale Law School.

Dennis Woodside: Dennis joined Impossible Foods in March 2019 in the newly-created position of President. In this role, Dennis oversees Impossible Foods' operations, manufacturing, supply chain, sales, marketing, and HR functions. Previously Chief Operating Officer of Dropbox, Dennis is a tech industry veteran and has more than 25 years of experience at both startups and major multinationals. At Dropbox, Dennis helped founder Drew Houston build a robust, scalable technology company with millions of customers globally. Dennis helped increase Dropbox's global revenue to nearly $1.4 billion,

and he was part of the company's IPO in early 2018. Prior to Dropbox, Dennis was the Chief Executive Officer of Motorola Mobility after its acquisition by Google. During his tenure there, Dennis restructured the business and refined the product strategy, then sold the mobile device business to Lenovo and the cable infrastructure business to Arris.

Before Motorola Mobility, Dennis held various leadership roles at Google from 2003-2012. During his tenure he built the first business operations team, oversaw sales operations in Europe, the Middle East and Africa, and led sales in North and South America, responsible for over $10 billion in revenue. Underlying every role was the challenge of scaling a fast-growing business with an expanding product set and a consumer pool of literally billions of people. Dennis received his Juris Doctorate at Stanford Law School and his BA from Cornell University.

Source: Adapted from company documents.

Endnotes

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