



Innovative Finance Inclusion

The alternative meat industry: fad or disruption?

Date: March 2022

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 Co-funded by the
Erasmus+ Programme
of the European Union



Project number 619453-EPP-1-2020-1-IL-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This publication [communication] reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein



Abstract

Consumption of plant-based meat has been booming over the past few years, accompanied by surging interest on the part of investors, traditional meat producers and the media. But is the alternative meat industry a true disruptive force in the meat industry, or is it just a fad? The case sets out to explore this question. Following an introduction of the issue at hand, it provides an overview of the reasons for the increase in popularity of meat substitutes. Next, the industry structure, competition and investments are examined. The case concludes with a discussion of the challenges facing the industry and potential policy issues.

Keywords

Alternative meat; Disruptive innovation; Market transition; Investments





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1 Introduction

“I do think that all rich countries should move to 100% synthetic beef”.

-- Bill Gates, February 14, 2021.¹

“The third-most impactful industry is the animal agriculture industry. And we have to find a better way to source protein for people.”

-- Prince Khaled bin Alwaleed of Saudi Arabia, February 11, 2020.²

The alternative meat industry has been all the rage over the past few years. But is this industry a true disruptive force in the meat industry, or is alternative meat just a blip in the history of meat? Should CEOs of large traditional meat companies be worried, devising strategies to fight back, or can they dismiss the threat? This is the question at hand.

The popularity of meat substitutes is part of a growing trend towards plant-based diets.³ Over the past few years, consumption of plant-based proteins has been booming and the onset of the Covid-19 pandemic gave plant-based products a boost, with young people leading the way. Boston Consulting Group estimates that by 2035 at least 11% of the global protein market will be alternative.⁴ A sign that animal-free diets are in vogue is the menu at one of New York City’s most prestigious restaurants. Eleven Park Madison, a Michelin 3-star restaurant, is offering, as of June 2021, a plant-based tasting menu at \$335 per person, and reservations are hard to come by.⁵

Consumer demand for plant-based meat, in particular, is surging. According to The Good Food Institute, global sales of plant-based meat grew 24% in 2020 to \$4.2 billion, up from \$3.4 billion in 2019. In the US, sales grew 45%, from \$962 million in 2019 to \$1.4 billion in 2020. Looking into the future, projections regarding market size and growth as well as market share are optimistic, to different degrees. Union Bank of Switzerland (UBS) projects a market size of \$85 billion in 2030 with an impressive compound annual growth rate (CAGR) of 28%, noting that this estimate might be conservative.⁶ Barclays forecasts a market size of \$140 billion in 2029 with a market share of 10%.⁷ A. T. Kearney holds a particularly bullish view. The company projects that by 2040, alternative meat will constitute 60% of the global meat market.^{8,9}



In spite of its rapid growth, the alternative meat market accounts currently for only about 1% of the total meat market. However, demographics are in favor of this sector. A US survey found that young people are the largest consumers of alternative meat and the most inclined to increase their consumption, with 54% of US consumers aged 24-39 self-identifying as meat reducers vs 47% of US consumers of all ages.¹⁰ A UK survey reveals similar trends - an increase in the number of people adopting a meat-free diet, with young people most likely to follow this lifestyle.¹¹ Exposure to plant-based meat is high: a Gallup poll found that 41% of Americans have tried plant-based meat, with an even higher exposure among upper-income, young adults and suburbanites.¹² This reflects the transition of alternative meat from a niche product to the mainstream.

The increase in demand for alternative meat has brought about a proliferation of outlets selling it, both retail and food service. Plant-based meat products can now be purchased in grocery stores and supermarkets such as Kroger, Whole Foods and Costco as well as in restaurants - primarily fast-food restaurants such as McDonald’s, Pizza Hut and Burger King. The variety of alternative meat products is increasing at a fast pace as well. Existing products include burgers, meatballs, sausages and chicken, and new products are rolled out frequently, though the holy grail of sizzling steak is yet to come.

Investment has skyrocketed as well, running the gamut from corporate behemoths to the public at large. Early backers, who recognized the industry’s market potential over a decade ago, include high-tech moguls and financiers such as Bill Gates of Microsoft and Sergey Brin of Google. Nowadays, venture capital funds and others investing in private alternative meat companies abound. Contributing to industry visibility and attracting media interest was the successful Initial Public Offering of Beyond Meat, a dedicated plant-based meat company and a market leader in the space, in May 2019, at a valuation of \$1.5 billion. This IPO was the entry point of the public to the space of alternative meat. So why is the alternative meat market expanding at such a high rate and spurring so much interest on the part of consumers, investors and the media? Will the novelty of alternative meat wear off or will the growth in consumption continue to the point where it poses a real threat to the traditional meat industry?



2 The meat industry

Meat is a staple food in Western diets and is fast becoming more and more popular in developing countries.¹³ Since the early 1970s, per capita meat consumption has almost tripled, with the increase stemming in large part from the growing middle class in South East Asia (particularly China and India).^{14,15} Looking ahead, a 2021 OECD-FAO report projects further growth in global consumption of meat proteins in the coming decade, driven largely by income and population growth.^{16,17,18}

At the same time, the 2021 OECD-FAO report anticipates some dietary shifts in consumption over the coming decade. In particular, per capita consumption of animal-based proteins in high-income countries is expected to level off. Moreover, the report projects a shift away from animal-based products and towards plant-based ones among young consumers in high-income countries. Consequently, vegetarian, vegan or “flexitarian” lifestyles are expected to be on the rise among these consumers.¹⁹

As noted earlier, consumption of alternative meat has already been on the rise. In what follows, the reasons for this trend, and how Covid-19 has impacted it, will be described and substantiated.

The reasons for the increase in demand for alternative meat over the past few years are threefold. First, an increasing understanding of the detrimental effects of meat production on the environment. Second, an enhanced awareness of the impact of meat consumption on human health. Third, a growing concern for animal welfare. The onset of the Covid-19 pandemic further fueled the demand, providing a body of evidence regarding the environmental hazards inflicted by the animal industry. These hazards range from greenhouse gas emissions to loss of biodiversity, with the latter likely to have been a major factor in the emergence of Covid-19.

What is this body of evidence? Let us examine it briefly, starting with the environmental impacts of the meat industry.

According to a report by the Food and Agriculture Organization (FAO) of the United Nations, the contribution of animal agriculture to global warming, air pollution, land and



water depletion and biodiversity loss is enormous.^{20,21,22} The report, appropriately titled “Livestock's Long Shadow”, singles out the animal industry as “one of the top two or three most significant contributors to the most serious environmental problems, at every scale from local to global.”²³

Starting with greenhouse gas emissions, the essence of livestock’s impact on climate change was succinctly captured by The Economist: “Treating cattle like coal would make a big dent in greenhouse-gas emissions”.²⁴ Livestock supply chains account for 14.5% of global greenhouse gas emissions originating from human activity.^{25,26,27} This compares with 14% of global anthropogenic emissions from the transportation sector as a whole.^{28,29}

What’s more, the role of livestock in methane emissions is especially significant. Livestock contributes about 37 percent of methane emissions originating from human activity.^{30,31} This is crucial, since methane is a potent greenhouse gas that has at least 80 times more warming power than carbon dioxide over a 20 year period.^{32,33} In the words of Senator Chuck Schumer, “Methane is like carbon dioxide on steroids”.³⁴ Although methane has received less attention than carbon dioxide so far, recent reports have been shining the spotlight on its impact on climate change. According to the 2021 Intergovernmental Panel on Climate Change (IPCC) report, at least a third (a half by some estimates) of global warming originates in methane.³⁵ The UN Emissions Gap Report 2021 concludes that since methane is relatively short-lived, slashing methane emissions would significantly contribute to reducing global warming in the near term.^{36,37} John Kerry, the US climate envoy, called cutting methane the “single fastest strategy that we have to keep a safer, 1.5-degree centigrade future within reach”, referring to the target of the 2015 Paris Agreement to limit global warming to 1.5 degrees centigrade compared to pre-industrial levels.³⁸ Indeed, at COP26, the 2021 United Nations climate change conference, more than 100 countries pledged to reduce methane emissions by 30% by 2030.

In light of the leading role of livestock in methane emissions, and in turn the impact of methane emissions on global warming, an obvious way towards achieving this goal would be to reduce animal-based proteins in our diet. Indeed, the UN Emissions Gap Report 2021 points out the potential for large cuts in methane emissions from the agriculture sector and notes that “substantial mitigation of livestock-related methane could be achieved through widespread changes in human dietary choices”.³⁹



The environmental hazards of meat production do not stop at greenhouse gas emissions. Animal agriculture is also responsible for excessive land and water use, leading to food insecurity and loss of biodiversity. The livestock industry accounts for about 70 percent of all agricultural land and for about 30% of global fresh water consumption.^{40,41} In addition, the animal industry is a leading source of water pollution and degradation. As a result, livestock actually detract more from total food supply than they provide, hence being a key driver of food insecurity.⁴² According to the 2018 Intergovernmental Panel on Climate Change (IPCC) report, a global food transition to less meat, let alone a complete switch to plant-based protein, could have a dramatic effect on land use and consequently play a role in delivering food security.⁴³

Beyond its impact on climate change, the animal industry plays a major role in biodiversity loss by being a key driver of deforestation and destruction of habitat.⁴⁴ Diversity loss is accelerating and its scale is enormous: the Global Living Planet Index of the World Wildlife Fund (WWF) shows an average of a 68% decrease in population sizes of mammals, birds, amphibians, reptiles and fish between 1970 and 2016.⁴⁵ The fact that 70% of previously forested land in the Amazon is now occupied by pastures attests to the contribution of animal agriculture to habitat destruction.^{46,47}

The damage to biodiversity brings about zoonotic diseases, that is, diseases transmitted by certain animals, such as bats, to humans. This happens because the damage to the natural habitat of these animals forces them to migrate. The US Centers for Disease Control and Prevention (CDC) estimates that 75% of new or emerging infectious diseases in people are zoonotic.^{48,49,50} According to multiple sources, among them a UN report titled “Preventing the next pandemic”, Covid-19 is one of these diseases.⁵¹ In the words of David Quammen, the well-known science and nature writer, at the onset of the Covid-19 pandemic: “We invade tropical forests and other wild landscapes, which harbor so many species of animals and plants — and within those creatures, so many unknown viruses. We cut the trees; we kill the animals or cage them and send them to markets. We disrupt ecosystems, and we shake viruses loose from their natural hosts. When that happens, they need a new host. Often, we are it.”^{52,53}

Zoonotic diseases are not the only health hazard caused by the meat industry. Excessive consumption of meat, especially red and processed meat, has been shown in numerous studies to increase the probability of certain diseases such as cancer,



cardiovascular disease and type-2 diabetes.^{54,55,56,57} Furthermore, meat often contains high quantities of antibiotics, contributing to antibiotics resistance.⁵⁸

Last but not least is the growing awareness of the suffering of animals and the ensuing desire to end this cruelty and pursue cruelty-free alternatives.⁵⁹ This has been a prevalent motivation in the community of early backers of the alternative meat industry. Sergey Brin of Google said “When you see how these cows are treated, it’s certainly something I’m not comfortable with.”⁶⁰ Jeremy Coller of Coller Capital, the private equity investor and philanthropist who established the FAIRR (Farm Animal Investment Risk and Return) initiative, said “People are human animals”.^{61,62,63}

Plant-based meat significantly improves, and in some cases eliminates, the environmental and health hazards associated with animal-based meat discussed above. The environmental benefits of a plant-based diet vs an animal-based diet, such as reduced emissions and reduced use of land and water, have been widely recognized.^{64,65,66,67,68} Just to illustrate, the amount of carbon dioxide (CO₂) emitted by beef per calorie is 31 times larger than the amount emitted by tofu.⁶⁹ In addition, studies comparing a regular beef burger to the plant-based burgers produced by the market leaders Beyond Meat and Impossible Foods yielded impressive results, showing that these plant-based burgers significantly reduce land and water use relative to regular burgers.^{70,71} Furthermore, elimination of animal agriculture alone, without any changes in other sources of anthropogenic activity, would freeze increases in global warming for 30 years.⁷²

As for health benefits, many studies document that a plant-based diet is associated with a lower risk of various diseases such as diabetes, high blood pressure and heart disease compared to a meat-based diet.^{73,74,75,76} Indeed, the Intergovernmental Panel on Climate Change (IPCC) reports of 2019 and 2022 highlight the positive impacts of plant-based foods on both the environment and human health.^{77,78,79}

Finally, alternative meat spares the life of millions of animals. The non-profit World Animal Protection (WAP) documented that in 2021, alternative meat spared nearly one million lives in the US alone.⁸⁰

Considering the above discussion, the increasing popularity of alternative meat with consumers, scientists, investors, and the media should not come as a surprise.



3 Industry structure and competition

Which population is the target market of alternative meat companies? If you thought it was the vegetarian and vegan population, think again. In fact, the target market is the enormous segment of flexitarians, meat eaters who reduce their consumption of animal-based meat and replace it with its alternative counterpart. The segment most likely to adopt a plant-based diet are young consumers. A One Poll survey found that 54% of respondents ages 24 to 39 identified themselves as flexitarians vs 47% of all Americans who describe themselves as such.⁸¹ Sixty-three percent of US consumers aged 24-39 believe that a plant-based diet fulfills their nutritional needs.⁸² Comparing meat consumption in 2019 and 2018, a Gallup poll found that 23% of Americans have cut back on eating meat, with the trend more pronounced in women, non-whites and urban consumers.⁸³ Another Gallup poll documented a high household exposure to plant-based meat with 41% of Americans having tried plant-based meat, and a higher exposure among upper-income, young adults, and suburbanites.⁸⁴

Hence, one could argue that the alternative meat industry poses a significant challenge to the animal-based meat industry. Indeed, the CNBC Disruptor 50 list contains alternative meat companies.⁸⁵ It should not come as a surprise, then, that traditional meat companies began moving into the plant-based meat space, much like the entrance of legacy car manufacturers such as General Motors to the electric vehicles market following the disruption introduced by the electric car manufacturer Tesla. In effect, these companies, among them Brazilian JBS, the world's largest meat company, Tyson Foods, Cargill, Smithfield and Hormel, are attempting to hedge against a decrease in their meat business by grabbing a share of the growing alternative meat market. David MacLennan, CEO of Cargill, said plainly on June 4, 2021: "Our analysis is that in ... three to four years plant-based will be perhaps 10% of the market. We're a large beef producer and that is a big part of our portfolio. So there's some cannibalization that will occur".⁸⁶

How do traditional meat companies establish their presence in this increasingly crowded field? Methods include developing their own brands, buying shares in alternative meat companies and forming collaborations. Cargill, for example, launched its own plant-based meat brand PlantEver for consumers in China and invested in alternative meat companies such as Memphis Meats (now Upside Foods). It went a step further and got involved in the emerging field of alternative seafood, as did Tyson Foods and JBS.⁸⁷ This massive entry of conventional meat companies into the field of meat substitutes may be



interpreted as a positive signal that alternative meat is making its way from being a niche product to the mainstream.

Not surprisingly, traditional meat companies such as Tyson Foods and Smithfield clearly state their intention to continue to sell conventional meat products and emphasize that they see alternative meat products as a business opportunity.^{88,89} This stands in stark contrast to the mission statements of the dedicated alternative meat companies such as the market leaders Beyond Meat and Impossible Foods which emphasize their commitment to environment and health.

Indeed, in an interview conducted on October 2020 Patrick Brown, the CEO of Impossible Foods and former Stanford University biochemistry professor, said of his main competitor: “Beyond Meat is not our competition, the incumbent animal industry is.”⁹⁰ He also stated that his mission was to eradicate the animal industry by 2035.^{91,92} Ethan Brown, CEO of Beyond Meat and former clean energy executive (no relation to Patrick Brown), said, referring to the big meat producers: “I don’t want to collaborate with them. I want to be them”.⁹³

4 The different types of alternative meat at a glance

The term “alternative meat” actually refers to several different products, most commonly plant-based meat and cultivated meat (also known as lab-grown meat or cultured meat).⁹⁴ The goal of these products is identical: create an alternative to animal-based meat that tastes and looks like the real thing with the aim of replacing it, for the sake of mitigating the environmental, health and animal welfare hazards associated with real meat. However, the similarity between the different products ends there. Differences between these products abound, among them ingredients, processes, costs, and regulation.

Plant based meat is made of ingredients such as peas, chickpeas, beans and soy. Products made from these ingredients have been around for centuries.^{95,96} The difference between these products and the current-day plant-based meat products is that the new products are meant to mimic real meat in terms of taste, texture, and looks and to be marketed to meat eaters, whereas their predecessors were meant mostly for vegans and vegetarians. The transformation to a new generation of substitute meat products was enabled by the development of new formulations and novel ways of using ingredients. The new meat-like products first came to the market in 2013.



Cultivated meat is based on a completely different concept. It involves taking a small number of cells from living animals and growing them in a bioreactor in a lab. Thus, it is real meat, without the slaughter of animals. Cultivated meat is currently produced and sold on a very small scale for a variety of reasons, not the least of which is regulation. While, for the most part, plant-based meat products require little regulation, cultivated meat is subject to heavy regulation.⁹⁷ The only country that has granted approval to sell lab-grown meat so far is Singapore, with the approval granted in November 2020 specifically to a chicken product by the US company Eat Just. Regulatory approval is in process in the US, Europe, Canada, Israel and more.

5 Investments throughout the years

Alternative meat has been attracting investments from the get-go. Financiers and tech moguls, existing meat companies, celebrities, the public – they all want to grab a piece of this fast-growing market. In 2020, investment in alternative proteins reached a record high of \$3.1 billion, three times more than the amount raised in the previous year and 4.5 times more than in 2018, according to the Good Food Institute. Of this amount, roughly half went to alternative meat companies.⁹⁸ In 2021, a new record high of \$5 billion was set, exceeding previous year’s record high by 60%.⁹⁹

Early backers of the industry were motivated in large part by ideology. The list of early investors includes high tech moguls and financiers such as Bill Gates of Microsoft, Sergey Brin of Google, Peter Thiel of PayPal, Richard Branson of Virgin and the billionaire entrepreneur Mark Cuban, as well as entrepreneurs and philanthropists such as Jeremy Coller. Gates, a long-time proponent of sustainability as a whole, set a concrete goal for meat consumption: “I do think that all rich countries should move to 100% synthetic beef”.¹⁰⁰

Many of these investors have bought shares in more than one company in the alternative meat space. Bill Gates invested in both Beyond Meat and Impossible Foods as well as in a handful of smaller companies. Recently, he invested, together with Jeff Bezos of Amazon, in Nature’s Fynd, a company using fungus as the key ingredient in its products.¹⁰¹ Peter Thiel invested in a few alternative meat companies as well, among them Wild Earth, a company developing alternative meat for pets.

Another notable investor in the field is the former vice president of the US and long-time environmental activist Al Gore, whose work on climate change earned him the Nobel Prize in 2007. Gore has been a strong proponent of plant-based diets, a lifestyle he has



adopted personally, for the sake of the environment. Recently he invested in the emerging company Natura’s Fynd along with Gates and Bezos.

Conventional meat companies have been investing in alternative meat companies as well. Tyson Foods invested in Beyond Meat as early as 2016 and sold its stake in the company in 2019, soon after announcing it would launch its own meat substitute and a week prior to beyond Meat’s IPO.¹⁰² It also invested in Memphis Meats (along with Richard Branson). Other conventional meat companies investing in alternative meat companies include Cargill and JBS.

Very few alternative meat companies are traded on public markets. The most notable is Beyond Meat that filed a high-profile initial public offering (IPO) in 2019 valuing the company at \$1.5 billion.¹⁰³ Beyond Meat is practically the only way for the public at large to gain exposure to this sector. Its big rival, Impossible Foods, is not publicly traded as of yet, but it has raised capital in a few successful rounds. In 2020 alone, it raised \$700 million from investors such as Bill Gates and the Qatar Investment Authority. As of October 2021, it is reportedly (though not confirmed by the firm) in talks to raise about \$500 million at a valuation of \$7 billion. Its founder and CEO, Pat Brown, acknowledged that going public at some point in the future is inevitable.¹⁰⁴

What better indication is there for the trendiness of a sector than investment by celebrities? Many celebrities have been fond of alternative meat companies, among them Leonardo DiCaprio, Jay-Z, Serena Williams and Ashton Kutcher. DiCaprio, a long-time environmental activist, invested in Beyond meat as early as 2017.¹⁰⁵ Since then he has backed other companies such as the Dutch Mosa Meat. Impossible Foods is especially popular among celebrity investors: Jay Z, Serena Williams, Trevor Noah and Katy Perry all participated in its March 2020 financing round.

6 Challenges facing the alternative meat industry and policy issues

Perhaps the biggest challenge facing the alternative meat industry is to deliver the sensory experience of meat in terms of taste, texture and looks to the flexitarian consumer. Though significant progress has been made since the days of the veggie burger, there is still a way to go. Views on the similarity of existing plant-based products to the “real thing” diverge greatly. The experts at Food & Wine tried four different plant-based burgers and found two



out of the four, the ones by Beyond Meat and Impossible Foods, good meat replacements in terms of taste.¹⁰⁶ Not everyone shares their view, however.

Then there is the issue of perception: how are the products perceived by consumers and what will it take to convince consumers to try the products? A One Poll survey conducted in the US found that 47% of people polled were hesitant to taste plant-based meat because they did not think it would taste like real meat, and a similar percentage hesitated to try it because of texture.¹⁰⁷

The other big obstacle is price. Currently alternative meat products cost more than their real meat counterparts, mostly due to higher costs of production and ingredients. As production is scaled up costs are expected to go down, and the goal is to bring plant-based meat to price parity with animal-based meat. Beyond Meat, the publicly traded market leader, announced that it would make at least one of its products cost-competitive with its meat counterpart by 2024. Dennis Woodside, President of Impossible Foods, said on the issue of pricing: “We will be able to price at the same level or lower than the cow. Our entire production process starts with plants — we turn it into meat without using the cow as the middleman...Our ingredients require a small fraction of water, small fraction of the land and energy than it takes to raise a cow.”¹⁰⁸

Scaling up production is also necessary to meet rising demand. As the popularity of plant-based products has soared, fast food behemoths such as McDonald’s and Burger King have introduced these products into their menus. If current physical production capacity of plant-based product suppliers cannot meet the increased demand, supply shortages would happen and hinder the growth momentum of the industry.¹⁰⁹ Beyond Meat experienced such shortages in 2017 and 2018 as demand for its products surged, while Impossible Foods had its own share of shortages in 2019.^{110,111}

Related to price is the contentious issue of government subsidies granted to the animal agriculture industry. A 2021 UN report found that nearly 90% of global subsidies given to farmers each year, a majority of which are granted to animal agriculture, are harmful, asserting that they cause damage to human health, fuel the climate crisis, destroy nature, and drive inequality.^{112,113} Consequently, the report calls for phasing out of this distortive and harmful support and for repurposing subsidies for good uses, such as supporting healthy food. The 2022 Intergovernmental Panel on Climate Change (IPCC) report makes a similar recommendation.¹¹⁴ The idea of subsidies being distortive is not new, and in the context of



the environment it is best demonstrated in the statement of the United Nations Development Programme (UNDP) pertaining to fossil fuels – “Moving away from subsidies is a critical step to show the true cost of using fossil fuels, to both society and the environment”.¹¹⁵ This argument is perfectly applicable to meat subsidies.

Furthermore, some commentators have suggested levying taxes on meat, similar to those levied on cigarettes and sugary drinks because of their negative impact on health.^{116,117,118} Because of this impact, taxes on cigarettes and sugary drinks are sometimes referred to as “sin taxes”.^{119,120}

Taxes on meat should not be viewed as fines but rather as a mechanism to internalize the environmental and health externalities associated with meat, that is, to incorporate the true costs of negative health and environmental consequences into meat’s price. The European Union is considering applying the Polluters Pay Principle to agriculture, with the backing of the Agricultural Commissionaire.^{121,122}

In some countries, such as Germany, Sweden and Denmark, these suggestions have come up in parliamentary and regulatory discussions.^{123,124,125} There have also been calls for public investment in alternative protein, specifically in alternative meat.^{126,127} Tax incentives for alternative meat producers, such as those included in the social safe net and climate bill recently approved by the US House of Representatives for producers of clean energy, are another potential avenue of public support. As in the case of most subsidies and taxes, political issues are involved.^{128,129}

Will these obstacles be overcome? The answer depends on who you ask. Richard Branson of Virgin Group said: “I believe that in 30 years or so we will no longer need to kill any animals and that all meat will either be clean or plant-based, taste the same and also be much healthier for everyone.”¹³⁰



7 Case Questions

1. Global meat consumption is going up. In light of this fact, is it fair to say that the alternative meat industry is a true disruptive force in the meat industry? Is Richard Branson right - will the world ever stop eating meat altogether?
2. Should the industry focus its efforts solely on young consumers? How can it gain additional crowds (including in the developing world)?
3. Should governments stop subsidizing animal agriculture? Should they impose taxes on meat? Should governments take an active role in reducing real meat consumption in other ways?
4. If you answered “yes” to the previous question, what should be done in the transition period? Take into account the people employed in the industry.
5. Alternative meat products are labeled “meat”. What are the implications for meat eaters and for vegetarians? As a meat eater, would you be upset that alternative meat can be labeled “meat”? As a vegetarian or vegan, what would you answer the question “by calling these products ‘meat’ aren’t we reinforcing the notion of meat as the ultimate ‘center of the plate’ food”?



References

- ¹ Temple, J., "Bill Gates: Rich nations should shift entirely to synthetic beef," MIT Technology Review, February 14, 2021.
- ² Turak, N., "The son of Saudi Arabia's Warren Buffett sees a big future for Beyond Meat and plant-based foods," CNBC, February 11, 2020.
- ³ Kerle, A., "Plant-based proteins: building a sustainable future," The Economist Intelligence unit, April 13, 2021.
- ⁴ Morach, B., Witte, B., Walker, D., von Koeller, E., Grosse-Holz, F., Rogg, J., Brigl, M., Dehnert, N., Obloj, P., Koktenturk, S. and Schulze, U., "Food for thought: the protein transformation," Boston Consulting Group, March 24, 2021.
- ⁵ <https://www.elevenmadisonpark.com/>.
- ⁶ Khan, Y., "UBS predicts plant-based meat sales could grow by more than 25% a year to \$85 billion by 2030," Business Insider, July 19th, 2019.
- ⁷ "Carving up the alternative meat market," Barclays website, August 19, 2019, <https://www.cib.barclays/our-insights/carving-up-the-alternative-meat-market.html>.
- ⁸ See Gerhardt C., Warschun, M., Donnan, D. and Zienssen, F., "When consumers go vegan, how much meat will be left on the table for agribusiness?" A. T. Kearney website, <https://www.de.kearney.com/consumer-retail/article/?/a/when-consumers-go-vegan-how-much-meat-will-be-left-on-the-table-for-agribusiness->.
- ⁹ Gerhardt, C., Suhlmann, G., Ziemßen, F., Donnan, D., Warschun, M. and Ku"hnle, H.J., "How Will Cultured Meat and Meat Alternatives Disrupt the Agricultural and Food Industry?" Industrial Biotechnology, Volume 16 NO. 5 October 2020: 262-270.
- ¹⁰ "Survey by Sprouts looks into new year eating habits, reveals young Americans are likely to shift away from meat," Sprouts Farmers Market, January 18, 2021.
- ¹¹ Johnson, G. R., "UK diet trends 2021," The Finder, February 12, 2021.
- ¹² McCarthy, J. and Decoster, S., "Four in 10 Americans have eaten plant-based meats," Gallup, January 28, 2020. <https://news.gallup.com/poll/282989/four-americans-eaten-plant-based-meats.aspx>.
- ¹³ The term "meat" refers to all types of meat, including beef, pork, poultry, lamb, etc., but does not refer to fish. The term "livestock" refers to all types of meat as defined above with the exception of poultry. The impacts discussed in this chapter are most pronounced for livestock.
- ¹⁴ FAO. 2017. The future of food and agriculture – Trends and challenges. Rome.
- ¹⁵ OECD-FAO (2017), OECD-FAO Agricultural Outlook 2017-2026, OECD Publishing, Paris, https://doi.org/10.1787/agr_outlook-2017-en.
- ¹⁶ OECD/FAO (2021), OECD-FAO Agricultural Outlook 2021-2030, OECD Publishing, Paris, <https://doi.org/10.1787/19428846-en>. In particular, Chapter 6, "Meat", in OECD/FAO (2021), OECD-FAO Agricultural Outlook 2021-2030, OECD Publishing, Paris, <https://doi.org/10.1787/19428846-en>.



- ¹⁷ United Nations, Department of Economic and Social Affairs, Population Division (2015). Population 2030: Demographic challenges and opportunities for sustainable development planning (ST/ESA/SER.A/389).
- ¹⁸ The United Nations projects a population of 8.6 billion in 2030, compared to 7.9 in 2021.
- ¹⁹ OECD/FAO (2021), OECD-FAO Agricultural Outlook 2021-2030, OECD Publishing, Paris, <https://doi.org/10.1787/19428846-en>. In particular, Chapter 6, “Meat”, in OECD/FAO (2021), OECD-FAO Agricultural Outlook 2021-2030, OECD Publishing, Paris, <https://doi.org/10.1787/19428846-en>.
- ²⁰ Steinfeld, H., Gerber, P., Wassenaar, T., Castel, V., Rosales, M. & de Haan, C. 2006. Livestock's Long Shadow: Environmental Issues and Options. Rome: Food and Agriculture Organization of the United Nations.
- ²¹ Gerber, P.J., Steinfeld, H., Henderson, B., Mottet, A., Opio, C., Dijkman, J., Falcucci, A. & Tempio, G. 2013. Tackling climate change through livestock – A global assessment of emissions and mitigation opportunities. Food and Agriculture Organization of the United Nations (FAO), Rome.
- ²² For European data see Leip A, Billen G, Garnier J, Grizzetti B, Lassaletta L, Reis S, Simpson D, Sutton MA, de Vries W, Weiss F, Westhoek H. Impacts of European livestock production: nitrogen, sulphur, phosphorus and greenhouse gas emissions, land-use, water eutrophication and biodiversity. Environmental Research Letters 10 (11) (2015).
- ²³ Wynes S, Nicholas, KA. The climate mitigation gap: education and government recommendations miss the most effective individual actions. Environmental Research Letters 12 (7) (2017).
- ²⁴ "Treating cattle like coal would make a big dent in greenhouse-gas emissions." The Economist, October 2, 2021.
- ²⁵ Cattle are responsible for about two-thirds of that total, largely due to their methane emissions. About 44 percent of livestock emissions are in the form of methane. See IPCC, 2018: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press.
- ²⁶ “Key Facts and Figures”, FAO website, <http://www.fao.org/news/story/en/item/197623/icode/>.
- ²⁷ More generally, a third of global greenhouse gas emissions comes from the food system. See Crippa M, Solazzo E, Guizzardi D, Monforti-Ferrario F, Tubiello FN, Leip, A. Food systems are responsible for a third of global anthropogenic GHG emissions. Nature Food 2, pp. 198-209 (2021). Moreover, the amount of greenhouse gas emissions originating in animal agriculture is increasing. To illustrate, greenhouse gases released by New Zealand’s cows on New Zealand dairy farms just hit an all-time high. See McClure, T., “Emissions from cows on New Zealand dairy farms reach record levels,” The Guardian, August 5, 2021. On the accelerating increase in emissions, see World Meteorological Organization (WMO) greenhouse gas bulletin, No. 17, October 25, 2021.
- ²⁸ Reference: Global emissions by economic sector, United States Environmental Protection Agency, <https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data>.



- ²⁹ For the impact of the global food system see Clark MA, Domingo NGG, Colgan K, Thakrar SK, Tilman D, Lynch J, Azevedo IL, Hill JD. Global food system emissions could preclude achieving the 1.5° and 2°C climate change targets. *Science*. 2020 Nov 6;370(6517):705-708. doi: 10.1126/science.aba7357. PMID: 33154139.
- ³⁰ Livestock contribute about 9 percent of total carbon dioxide emissions, 37 percent of methane and 65 percent of nitrous oxide. See Steinfeld, H., Gerber, P., Wassenaar, T., Castel, V., Rosales, M. & de Haan, C. 2006. *Livestock's Long Shadow: Environmental Issues and Options*. Rome: Food and Agriculture Organization of the United Nations.
- ³¹ For Europe, see Leip A, Billen G, Garnier J, Grizzetti B, Lassaletta, L, Reis S, Simpson D, Sutton MA, de Vries W, Weiss F, Westhoek H. Impacts of European livestock production: nitrogen, sulphur, phosphorus and greenhouse gas emissions, land-use, water eutrophication and biodiversity, *Environmental Research Letters* 10 (2015).
- ³² UN Environmental Programme. Methane emissions are driving climate change. Here's how to reduce them. August 20, 2021. <https://www.unep.org/news-and-stories/story/methane-emissions-are-driving-climate-change-heres-how-reduce-them#:~:text=Rather%20than%20allowing%20the%20continuous,water%2C%20making%20it%20more%20economical>.
- ³³ UN Economic Committee for Europe (UNECE), Sustainable Developments Goals. Supporting climate action on the road to COP26. <https://unece.org/unece-and-sdgs/supporting-climate-action-road-cop-26>.
- ³⁴ Tabushi, H., "Halting the vast release of methane is critical for climate, U.N. says," *New York Times*, April 24, 2021. For the full speech see "Majority leader Schumer floor remarks supporting the Biden administration plan to cut greenhouse gas emissions in half and laying out Senate actions to combat climate change," April 22, 2021, <https://www.democrats.senate.gov/news/press-releases/majority-leader-schumer-floor-remarks-supporting-the-biden-administration-plan-to-cut-greenhouse-gas-emissions-in-half-and-laying-out-senate-actions-to-combat-climate-change>.
- ³⁵ IPCC, 2021: Summary for Policymakers. In: *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [Masson-Delmotte, V., P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu and B. Zhou (eds.)]. Cambridge University Press. In Press.
- ³⁶ The half-life of Methane is 9.1 years vs 120 for carbon dioxide.
- ³⁷ United Nations Environment Programme (2021). *Emissions Gap Report 2021: The Heat Is On – A World of Climate Promises Not Yet Delivered*. Nairobi.
- ³⁸ Friedman, L., "More than 30 countries join US pledge to slash methane emissions," *New York Times*, October 11, 2021.
- ³⁹ Ocko IB, Sun T, Shindell D, Oppenheimer M, Hristov AN, Pacala SW, Mauzerall DL, Xu Y, Hamburg, SP. Acting rapidly to deploy readily available methane mitigation measures by sector can immediately slow global warming. *Environmental Research Letters* 16 (2021).



- ⁴⁰ Steinfeld, H., Gerber, P., Wassenaar, T., Castel, V., Rosales, M. & de Haan, C. 2006. Livestock's Long Shadow: Environmental Issues and Options. Rome: Food and Agriculture Organization of the United Nations. .
- ⁴¹ Gerbens-Leenes PW, Mekonnen MM, Hoekstra AY, The water footprint of poultry, pork and beef: A comparative study in different countries and production systems. Water Resources and Industry, Volume 1-2 (2013).
- ⁴² Steinfeld, H., Gerber, P., Wassenaar, T., Castel, V., Rosales, M. & de Haan, C. 2006. Livestock's Long Shadow: Environmental Issues and Options. Rome: Food and Agriculture Organization of the United Nations.
- ⁴³ IPCC, 2018: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press.
- ⁴⁴ According to the 2019 report by Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, current negative trends in biodiversity and ecosystems will undermine progress towards 80% of UN Sustainable Development Goals. See IPBES (2019): Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. S. Díaz, J. Settele, E. S. Brondízio E.S., H. T. Ngo, M. Guèze, J. Agard, A. Arneth, P. Balvanera, K. A. Brauman, S. H. M. Butchart, K. M. A. Chan, L. A. Garibaldi, K. Ichii, J. Liu, S. M. Subramanian, G. F. Midgley, P. Miloslavich, Z. Molnár, D. Obura, A. Pfaff, S. Polasky, A. Purvis, J. Razzaque, B. Reyers, R. Roy Chowdhury, Y. J. Shin, I. J. Visseren-Hamakers, K. J. Willis, and C. N. Zayas (eds.). IPBES secretariat, Bonn, Germany.
- ⁴⁵ WWF (2020) Living Planet Report 2020 - Bending the curve of biodiversity loss. Almond, R.E.A., Grooten M. and Petersen, T. (Eds). WWF, Gland, Switzerland.
- ⁴⁶ FAO. 2017. The future of food and agriculture – Trends and challenges. Rome.
- ⁴⁷ According to the report “Beef, banks and the Brazilian Amazon” by Global Witness, “In just one Amazon state over three years, beef giants JBS, Marfrig and Minerva bought cattle from a combined 379 ranches containing 20,000 football fields’ worth of illegal deforestation.”
- ⁴⁸ For information on zoonotic diseases, see Centers for Disease Control and Prevention (CDC): <https://www.cdc.gov/onehealth/basics/zoonotic-diseases.html>.
- ⁴⁹ World Organisation for Animal Health (OIE), <https://www.oie.int/en/one-world-one-health/>.
- ⁵⁰ United Nations Environment Programme and International Livestock Research Institute (2020). Preventing the next pandemic: Zoonotic diseases and how to break the chain of transmission. Nairobi, Kenya.
- ⁵¹ United Nations Environment Programme and International Livestock Research Institute (2020). Preventing the Next Pandemic: Zoonotic diseases and how to break the chain of transmission. Nairobi, Kenya.



- ⁵² Quammen, D., "We made the coronavirus epidemic," New York Times, January 28, 2020.
- ⁵³ Carrington, D., "Deadly diseases from wildlife thrive when nature is destroyed, study finds," Guardian, August 5, 2020; Vidal, J., "'Tip of the iceberg': is our destruction of nature responsible for Covid-19?" Guardian, March 18, 2020 and Quammen, D., "Spillover: animal infections and the next human pandemic," New York: W.W. Norton & Co, 2012.
- ⁵⁴ FAO. 2017. The future of food and agriculture – Trends and challenges. Rome.
- ⁵⁵ On cancer see, e.g., Bouvard V, Loomis D, Guyton KZ, Grosse Y, Ghissassi FE, Benbrahim-Tallaa L, Guha N, Mattock H, Straif K; International Agency for Research on Cancer Monograph Working Group. Carcinogenicity of consumption of red and processed meat. *Lancet Oncology*. 2015 Dec;16(16):1599-600. doi: 10.1016/S1470-2045(15)00444-1. Epub 2015 Oct 29. PMID: 26514947. See also Battaglia Richi E, Baumer B, Conrad B, Darioli R, Schmid A, Keller U. Health Risks Associated with Meat Consumption: A Review of Epidemiological Studies. *International Journal for Vitamin and Nutrition Research*. 2015;85(1-2):70-8. doi: 10.1024/0300-9831/a000224. PMID: 26780279.
- ⁵⁶ On cardiovascular disease see, e.g., Crimarco A, Springfield S, Petlura C, Streaty T, Cunanan K, Lee J, Fielding-Singh P, Carter MM, Topf MA, Wastyk HC, Sonnenburg ED, Sonnenburg JL, Gardner CD. A randomized crossover trial on the effect of plant-based compared with animal-based meat on trimethylamine-N-oxide and cardiovascular disease risk factors in generally healthy adults: Study With Appetizing Plantfood-Meat Eating Alternative Trial (SWAP-MEAT). *American Journal of Clinical Nutrition*. 2020 Nov 11;112(5):1188-1199. doi: 10.1093/ajcn/nqaa203. PMID: 32780794; PMCID: PMC7657338.
- ⁵⁷ On diabetes see, e.g., Feskens EJM, Sluik D, van Woudenberg GJ. Meat consumption, diabetes, and its complications. *Current Diabetes Reports* 2013;13: 298–306. PMID:23354681. See also Wolk A. Potential health hazards of eating red meat. *Journal of Internal Medicine*. 2017 Feb;281(2):106-122. doi: 10.1111/joim.12543. Epub 2016 Sep 6. PMID: 27597529.
- ⁵⁸ Wallinga, D. and Kar, A., "New Data: Animal vs. Human Antibiotic Use Remains Lopsided," Natural Resources Defense Council expert blog, June 15, 2020. <https://www.nrdc.org/experts/david-wallinga-md/most-human-antibiotics-still-going-us-meat-production>.
- ⁵⁹ Number of animals slaughtered. <https://faanalytics.org/global-animal-slaughter-statistics-and-charts-2020-update/>
- ⁶⁰ "Google's Sergey Brin funded test-tube burger for animal welfare reasons," One Green Planet, August 5, 2013.
- ⁶¹ Rose-Smith, I., "Private Equity Veteran Jeremy Collier Champions Farm Animal Welfare," Institutional Investor, January 14, 2016.
- ⁶² Ezra Klein of the New York Times wrote: "If we could produce the meat we want without the suffering we now inflict, it would be one of the great achievements of our age." See Klein, E., "Let's Launch a Moonshot for Meatless Meat," New York Times, April 24, 2021.
- ⁶³ Surprising evidence for the growing awareness to animal suffering in the business world, though not directly related to alternative meat, is the recent activism of the billionaire investor and corporate raider Carl Icahn. Icahn, famous for putting pressure on firms in order to achieve financial goals, launched a proxy fight against McDonald's in connection to its treatment of pigs. See, e.g., Han, Y.,



- “McDonald's goes on the defense against activist investor Carl Icahn in escalating battle over pork production,” Business Insider, February 21, 2022.
- ⁶⁴ See Poore J, Nemecek T. Reducing food’s environmental impacts through producers and consumers. *Science*, Volume 360, Issue 6392, pp. 987-992, 2018.
- ⁶⁵ Xu X, Sharma P, Shu S et al. Global greenhouse gas emissions from animal-based foods are twice those of plant-based foods. *Nature Food* 2, 724–732 (2021).
- ⁶⁶ Clark MA, Domingo NGG, Colgan K, Thakrar SK, Tilman D, Lynch J, Azevedo IL, Hill JD. Global food system emissions could preclude achieving the 1.5° and 2°C climate change targets. *Science*, 2020 Nov 6;370(6517):705-708. doi: 10.1126/science.aba7357. PMID: 33154139
- ⁶⁷ “Plant-Based Meat for a growing world,” The Good Food Institute, 2019.
- ⁶⁸ IPCC, 2019: Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems [P.R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.-O. Pörtner, D. C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi, J. Malley, (eds.)]. In press.
- ⁶⁹ “Treating cattle like coal would make a big dent in greenhouse-gas emissions.” *The Economist*, October 2, 2021.
- ⁷⁰ For Beyond Meat, see Heller, MC and Keoleian, GA, “Beyond Meat's Beyond Burger Life Cycle Assessment: A detailed comparison between a plant-based and an animal-based protein source.” CSS Report, University of Michigan: Ann Arbor 1-38, 2018. For Impossible Foods, see Dettling J, Tu Q, Faist M, DeDuce A, Mandelbaum SA, “Comparative life cycle assessment of plant-based foods and meat foods” [Internet]. Quantis USA and MorningStar Farms. Available: https://www.morningstarfarms.com/content/dam/morningstarfarms/pdf/MSFPlantBasedLCARreport_2016-04-10_Final.pdf.
- ⁷¹ For some differences between the burgers of Beyond Meat and Impossible Foods see, e.g., “Cows are no longer essential for meat and milk,” *The Economist*, September 28, 2021.
- ⁷² Eisen MB, Brown PO (2022). Rapid global phaseout of animal agriculture has the potential to stabilize greenhouse gas levels for 30 years and offset 68 percent of CO₂ emissions this century. *PLOS Climate* 1(2): e0000010. <https://doi.org/10.1371/journal.pclm.0000010>.
- ⁷³ Melina V, Craig W, Levin S. Position of the Academy of Nutrition and Dietetics: Vegetarian Diets. *Journal of the Academy of Nutrition and Dietetics*. 2016 Dec;116(12):1970-1980. doi: 10.1016/j.jand.2016.09.025. PMID: 27886704.
- ⁷⁴ Satija A, Hu FB. Plant-based diets and cardiovascular health. *Trends in Cardiovascular Medicine*. 2018 Oct;28(7):437-441. doi: 10.1016/j.tcm.2018.02.004. Epub 2018 Feb 13. PMID: 29496410; PMCID: PMC6089671.
- ⁷⁵ Battaglia R, Baumer B, Conrad B, Darioli R, Schmid A, Keller U. Health risks associated with meat consumption: A review of epidemiological studies. *International Journal of Vitamin and Nutrition Research* Volume 85(1-2):70-8, 2015. PMID: 26780279 doi: [10.1024/0300-9831/a000224](https://doi.org/10.1024/0300-9831/a000224).
- ⁷⁶ Tello, M., “Eat more plants, fewer animals,” *Harvard Health Blog*, November 29, 2018.



- ⁷⁷ IPCC, 2019: Summary for Policymakers. In: Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems [P.R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.- O. Pörtner, D. C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi, J. Malley, (eds.)]. In Press.
- ⁷⁸ "IPCC report highlights critical role of sustainable proteins in adapting to climate change," The Good Food Institute, February 28, 2022.
- ⁷⁹ The EAT-Lancet diet was developed with both human health and the environment in mind. For a discussion see Vaidyanathan, G., "What humanity should eat to stay healthy and save the planet," Nature magazine, March 17, 2022, in Scientific American.
- ⁸⁰ Bazzi, M., "Plant-based offerings in the food industry are sparing the lives of nearly a million animals per year," World Animal Protection, January 6, 2022. <https://www.worldanimalprotection.us/blogs/plant-based-offerings-food-industry-are-sparing-lives-nearly-million-animals-year>.
- ⁸¹ "Survey by Sprouts looks into new year eating habits, reveals young Americans are likely to shift away from meat," Sprouts Farmers Market, January 18, 2021.
- ⁸² "Survey by Sprouts looks into new year eating habits, reveals young Americans are likely to shift away from meat," Sprouts Farmers Market, January 18, 2021.
- ⁸³ McCarthy, J. and Decoster, S., "Nearly one in four in US have cut back on eating meat," Gallup, January 27, 2020.
- ⁸⁴ McCarthy, J. and Decoster, S., "Four in 10 Americans have eaten plant-based meats," Gallup, January 28, 2020.
- ⁸⁵ CNBC Disruptor 50, <https://www.cnbc.com/2021/05/25/these-are-the-2021-cnbc-disruptor-50-companies.html>. Note that the list consists only of private companies.
- ⁸⁶ "Plant-based protein to cannibalize meat demand, Cargill CEO says," Reuters, June 4, 2021.
- ⁸⁷ Cargill announced that it is committed to transforming its agricultural supply chains to be free of deforestation by 2030. However, the Guardian sharply criticized the company for its practices. See Wright, G., Olenick, L. and Westervelt, A., "The dirty dozen: meet America's top climate villains," The Guardian, October 27, 2021.
- ⁸⁸ Yaffe-Bellany, D., "The New Makers of Plant-Based Meat? Big Meat Companies," New York Times, October 14, 2019. The article also raises the concern that meat companies would "swallow" the stand-alone plant-based meat companies, in much the same way that big oil companies bought clean energy start-ups and closed them down.
- ⁸⁹ Sorvino, C., "The World's Largest Meat Seller Embraces Plant-Based Proteins as Pandemic Demand Surges," Forbes, June 18, 2020.
- ⁹⁰ "Impossible Foods CEO: 'Beyond Meat is not our competition', the incumbent animal industry is," Yahoo finance, October 21, 2020.
- ⁹¹ Greenfield, P., "'Let's get rid of friggin' cows' says creator of plant-based 'bleeding burger'," The Guardian, January 8, 2021.



- ⁹² Reiley, L., “Why the CEO of Impossible Foods thinks he can eliminate all animal-based meat in 15 years,” The Washington Post, July 16, 2021. Among other things, Mr. Brown said in this interview “put it on your calendar, because Impossible Foods is going to do it.”
- ⁹³ Yaffe-Bellany, D., “The New Makers of Plant-Based Meat? Big Meat Companies,” New York Times, October 14, 2019.
- ⁹⁴ Another process used in the production of alternative meat is fermentation, a process similar to the one used in the production of bread and beer. It is sometimes used in the production of plant-based meat, for example in the case of Impossible Foods, to create a hybrid product, but it can also be used by itself. The term “hybrid product” may also refer to a blend of plant-based meat and cultivated meat. See, for example, Firth, N., "Your first lab-grown burger is coming soon—and it'll be 'blended'," MIT Technology Review, December 18, 2020. Another type of hybrid meat is real meat blended with plants such as the one brought to the market by Tyson Foods in 2019.
- ⁹⁵ Smith, A., “The History of the Veggie Burger,” Smithsonian Magazine, March 19, 2014.
- ⁹⁶ Hunt, E., “From tofu lamb chops to vegan steak bakes: the 1,000-year history of fake meat,” The Guardian, January 12, 2020.
- ⁹⁷ The exception for plant-based meat products is the regulation required for ingredients defined as “novel food”. Impossible Foods needed a regulatory approval to use an ingredient known as “heme” that causes the burger to bleed like a real meat burger, and is considered “novel food”.
- ⁹⁸ Notable beneficiaries include Impossible Foods that got about one fourth of total investments.
- ⁹⁹ Of the \$11.1 billion invested in alternative proteins since 2010, 73% percent was raised since the onset of the pandemic in 2020, according to the Good Food Institute.
- ¹⁰⁰ Temple, J., “Bill Gates: Rich nations should shift entirely to synthetic beef,” MIT Technology Review, February 14, 2021.
- ¹⁰¹ Woods, B., “Bezos, Gates back fake meat and dairy made from fungus as next big alt-protein,” CNBC, July 3, 2021.
- ¹⁰² El-Bawab, N., “Tyson Foods sold its stake in alternative protein company Beyond Meat,” CNBC, April 24, 2019.
- ¹⁰³ The other public alternative meat companies are relatively small.
- ¹⁰⁴ Sorvino, C., “Impossible Foods’ CEO Says Going Public Is ‘Inevitable.’ So Why Have Most Of 2021’s Food Listings Spoiled?” Forbes, November 4, 2021.
- ¹⁰⁵ Garfield, L., “Leonardo DiCaprio just invested in the Bill Gates-backed veggie burger that 'bleeds' like beef — here's how it tastes,” Business Insider, October 17, 2017.
- ¹⁰⁶ Hallinan, B., “Plant-Based Burger Taste Test: We Tried Four Vegan ‘Meat’ Brands Ahead of Grilling Season,” Food & Wine, May 13, 2019.
- ¹⁰⁷ “Survey by Sprouts looks into new year eating habits, reveals young Americans are likely to shift away from meat,” Sprouts Farmers Market, January 18, 2021.
- ¹⁰⁸ Cohen, M., “Impossible Foods, Beyond Meat battle to achieve price parity with real meat,” CNBC, August 25, 2021.



- ¹⁰⁹ For more on this issue see “Can Alternative Proteins Scale?” Breakthrough Institute, January 30, 2020.
- ¹¹⁰ Lucas, A., “Beyond Meat says it can supply any fast-food chain as rival Impossible Foods struggles with shortage,” CNBC, June 6, 2019.
- ¹¹¹ Taylor, K., “A looming problem has plagued Beyond Meat for years. Here’s how the CEO says it plans to deal with demand as its rival Impossible Foods faces shortages,” Business Insider, May 3, 2019.
- ¹¹² FAO, UNDP and UNEP. 2021. A multi-billion-dollar opportunity – Repurposing agricultural support to transform food systems. Rome, FAO.
- ¹¹³ Carrington, D., “Nearly all global farm subsidies harm people and planet –UN,” The Guardian, September 14, 2021.
- ¹¹⁴ “IPCC report highlights critical role of sustainable proteins in adapting to climate change,” The Good Food Institute, February 28, 2022.
- ¹¹⁵ See UNDP web page: <https://feature.undp.org/breaking-up-with-fossil-fuels/>.
- ¹¹⁶ Ivanova, I., “Is it time to put a tax on meat?” CBS News, November 20, 2018.
- ¹¹⁷ Samuel, S., “We put a ‘sin tax’ on cigarettes and alcohol. Why not meat?” Vox, August 11, 2019.
- ¹¹⁸ For a study on the optimal tax levels on red and processed meat based on the marginal health costs associated with their consumption see Springmann M, Mason-D’Croz D, Robinson S, Wiebe K, Godfray HCJ, Rayner M, Scarborough P. Health-motivated taxes on red and processed meat: A modelling study on optimal tax levels and associated health impacts. PLoS One. 2018 Nov 6;13(11):e0204139. doi: 10.1371/journal.pone.0204139. PMID: 30399152; PMCID: PMC6219766.
- ¹¹⁹ Parker, G. and Abboud, L., “Boris Johnson vows review of ‘sin taxes,’” Financial Times, July 3, 2019.
- ¹²⁰ Allen, L., “Rejection of sugar tax is based on faulty logic about the poor,” The Conversation, University of Oxford, <https://www.ox.ac.uk/research/rejection-sugar-tax-based-faulty-logic-about-poor-0>.
- ¹²¹ Foote, N., “Agri Commissioner backs call for polluter pays principle in farming,” Euractive, July 7, 2021, <https://www.euractiv.com/section/agriculture-food/news/agri-commissioner-backs-call-for-polluter-pays-principle-in-farming/>.
- ¹²² The Polluter Pays Principle: Inconsistent application across EU environmental policies and actions. Special Report, European Court of Auditors, December 2021.
- ¹²³ Charlton, E., “This is why Denmark, Sweden and Germany are considering a meat tax,” World Economic Forum, August 28, 2019.
- ¹²⁴ “The livestock levy: progress report,” FAIRR, a Collier initiative, June 2020.
- ¹²⁵ The issue was especially hotly debated in Germany. See, e.g., “Germany: ‘meat tax’ is on the table to protect the climate,” Deutsche Welle (DE), August 7, 2019 and “Climate change: German MPs want higher meat tax,” BBC News, August 8, 2019.
- ¹²⁶ Smith, A., Shah, S. and Blaustein-Rejto, D., “The case for public investment in alternative proteins,” Breakthrough Institute, March 30, 2021.



- ¹²⁷ Klein, E., “Let’s Launch a Moonshot for Meatless Meat,” New York Times, April 24, 2021.
- ¹²⁸ Shapiro, P., “The Elephant-Sized Subsidy in the Race,” National Review, February 17, 2016.
- ¹²⁹ See also Vaidyanathan, G., “What humanity should eat to stay healthy and save the planet,” Nature magazine, March 17, 2022, in Scientific American, regarding the meat industry pressure in response to the attempt of United States Department of Agriculture (USDA) to revise its dietary guidelines so that they take into account the environment.
- ¹³⁰ Singh, S.D., “‘No longer kill animals’: Bill Gates, Richard Branson back ‘clean meat’ start-up,” The Sydney Morning Herald, August 24, 2017.





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