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The Protein Transformation: A Critical Driver of the Net-Zero Economy

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This paper was written by MSCI ESG Research with input and contributions of data and research by Blue Horizon. MSCI ESG Research was compensated for this research. Please see the disclosures at the end of this document for more information.

Contents

Executive Summary

The global food system is one of the major drivers of climate change, biodiversity loss and depletion of freshwater resources.[1] A dietary shift toward more plant-based food, and notably traditional plant-based and alternative proteins, has been identified as a key step to significantly reduce these environmental impacts and align the food production system with a 1.5°C warming scenario and with the United Nations Sustainable Development Goals (SDGs).[2] This is true because animal-proteins production has a very large environmental footprint and contributes to about 14.5% of total global greenhouse gas (GHG) emissions.[3, 4]

In this paper, we parsed the ways in which different segments of the food value-chain have generated revenue from, or started to invest in, the traditional plant-based and alternative-proteins space.[5, 6] We drew on MSCI ESG Research's industry expertise to understand individual publicly listed companies' revenue exposure to and investment in this nascent market. We conducted a semantic keyword analysis using natural language processing (NLP) on news, websites, company reports and a green patents database to identify the emerging trends and drivers of the traditional plant-based and alternative-proteins market.[7] Finally, we combined the MSCI Climate Value-at-Risk (Climate VaR) analysis with Blue Horizon's proprietary research to measure climate change transition risks and potential alignment with a net-zero economy for the companies in our universe (n=485).

1 Springmann, M., Clark, M., Mason-D'Croz, D., Wiebe, K., Bodirsky, B.L., Lassaletta, L., De Vries, W., Vermeulen, S.J., Herrero, M., Carlson, K.M. and Jonell, M. 2018. "Options for keeping the food system within environmental limits." Nature, 562(7728), pp.519-525.

2 Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., Garnett, T., Tilman, D., DeClerck, F., Wood, A. and Jonell, M. 2019. "Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems." The Lancet, 393(10170), pp.447-492.

3 Blue Horizon. 2020. "Environmental impacts of animal and plant-based food." In the report, PwC analyzed the environmental impact of chicken, egg, pork, and beef and concluded a 5.5x, 3.4x, 3.2x, and 15x lower impact respectively of their plant-based alternatives.

4 Gerber, P.J., Steinfeld, H., Henderson, B., Mottet, A., Opio, C., Dijkman, J., Falcucci, A. and 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).

5 Examples: Protein-rich foods designed to mimic the taste and texture of meat, seafood, eggs, and dairy products.

6 Examples: Legumes, pulses, soy-based products, and nuts.

7 Universe: Constituents of the MSCI ACWI Investable Market Index (IMI) belonging to the following GICS sub-industries: agricultural products, packaged foods & meats, restaurants, food distributors, hypermarkets and supercenters, and, food retailers (n=485), as of July 15, 2021.

Key Findings

- **Corporate disclosure** on traditional plant-based and alternative proteins was **limited** and **non-standardized**. We observed **a lack of common definitions** for alternative and plant-based protein terms. We attempted in this report to distinguish the different approaches and terminologies related to non-animal-based proteins, and we identified a series of metrics to gauge companies' positioning in this space.
- Almost **46% of companies** (224 out of the 485-company universe) were **involved in the traditional plant-based and alternative-proteins space**. Yet among those involved, less than 10% generated more than 5% of their total sales from such products.
- Companies involved in the traditional plant-based and alternative-proteins space showed **a higher prevalence of science-based and comprehensive carbon reduction targets, carbon emissions disclosure and reduction efforts** across the full value-chain.
- We found on **average 95% lower value-chain climate transition risk** in companies generating more than 50% of their revenue share from the traditional plant-based and alternative proteins (n=6), compared with the whole 485-company universe. This was primarily due to lower upstream emissions of those six companies.
- In a hypothetical scenario in which if all 485 companies were to shift to generating revenue from selling mostly traditional plant-based and alternative proteins, we estimated their exposure to value-chain climate transition risks would be reduced. In our research universe, **we estimated a sum of USD 295 billion in potentially avoided market-cap loss in the 1.5°C climate scenario** (as of Nov. 30, 2021) resulting from decreased value-chain climate transition risks.

Key Implications

Based on our hypothetical scenario, a shift by the food industry shift toward alternative proteins could:

- Help food companies reduce their carbon intensity, meet their climate targets and potentially capture market opportunities;
- Help policymakers who are focused on reducing the carbon intensity of food production overall;
- Help provide options to investors looking to reduce climate risk in their portfolios.

Chapter 1: Protein Transformation and Climate Change

- Animal agriculture is recognized as a key contributor to global GHG emissions, and a growing number of consumers are beginning to shift their diets to plant-based substitutes that are increasingly available in the market. However, plant-based protein products as an alternative do not appear to be well-reflected in corporate disclosure and ESG reporting standards.
- We analyzed risks associated with animal agriculture and opportunities to provide quantitative and actionable insights for the protein transformation. Climate change transition risks and opportunities were evaluated from the perspectives of investors, companies and regulators working together toward a net-zero world (See Appendix 1).

What is this report about? Who is this for?

As the world population is estimated to reach 9.8 billion by 2050, it is unlikely the current global food system can feed that number of people.[8, 9] Possible solutions range from preventing food waste to vertical farming. This report combines Blue Horizon's proprietary alternative-protein research with MSCI ESG Research's models to examine some of the climate risks that the food companies in our universe (n=485) face as well as potential opportunities that traditional plant-based products and alternative proteins may offer.[10, 11] It also addresses ways in which these opportunities could affect companies' valuations.

This report caters to investors, companies and regulators:

- For investors, MSCI ESG Research's Climate Value-at-Risk (Climate VaR) model offers quantitative insights into how the protein transformation can be factored into company valuation.
- For corporates, this report provides insights on how to manage climate risk exposure by participating in traditional plant-based and alternative-proteins market growth.
- For regulators, this paper emphasizes that a protein transformation could foster a greener, more equitable and healthier global food system. This report suggests quantitative metrics to assess the food sector's contribution to the climate goals of SDGs (i.e., Goal 13 Climate Action: Take urgent action to combat climate change and its impacts) as well as achieving the net-zero targets.

8 UN. "World population projected to reach 9.8 billion in 2050, and 11.2 billion in 2100." June 21, 2017.

9 Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., Garnett, T., Tilman, D., DeClerck, F., Wood, A. and Jonell, M., 2019. "Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems." The Lancet, 393(10170), pp.447-492.

10 Blue Horizon proprietary research developed in conjunction with the Boston Consulting Group and PwC respectively - Boston Consulting Group (BCG) and Blue Horizon (BH). 2021. "Food for Thought: The Protein Transformation." The report set scenarios for the food market estimating that up to 22% of protein consumption can be based on alternative proteins by 2035. - Blue Horizon. 2020. "Environmental impacts of animal and plant-based food." In the report, PwC analyzed the environmental impact of chicken, egg, pork and beef and concluded a 5.5x, 3.4x, 3.2x, and 15x lower impact, respectively, of their plant-based alternatives.

11 Universe: Constituents of the MSCI ACWI Investable Market Index (IMI) belonging to the following GICS sub-industries: agricultural products, packaged foods & meats, restaurants, food distributors, hypermarkets and supercenters and food retailers (n=485), as of July 15, 2021.

Protein transformation can address climate change: Food for thought

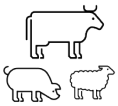
EXHIBIT 1: PROTEIN TRANSFORMATION AS A SOLUTION TO CLIMATE CHANGE?

Global food system emissions was **18 Gt CO_2e** in 2015 i.e., **34%** of the global GHG emissions

Source: Crippa et al. 2021

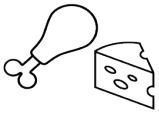
Even when all non-food system GHG emissions become net-zero, food system emissions alone can exceed 1.5°C limit between 2051 -2063

Source: Clark et al. 2020



14.5% of all global food system emissions comes from livestock-based agriculture

Source: FAO 2013



77% of global agricultural land (i.e., **40 million km^2**) is used in livestock production such as meat and dairy

Source: Blue Horizon and PwC 2020

A transition to alternative proteins can sequestrate **332 – 547 Gt CO_2** by **2050** i.e., approximately equal to past 9 – 16 years of CO_2 emissions

Source: Hayek et al. 2021

Plant-based products can reduce carbon emissions by **10 – 50 times** compared with most animal products

Source: Poore and Nemecek 2018

Sources: Crippa, M., Solazzo, E., Guizzardi, D., Monforti-Ferrario, F., Tubiello, F.N. and Leip, A., 2021. "Food systems are responsible for a third of global anthropogenic GHG emissions." Nature Food, 2(3), pp.198-209. Clark, M.A., Domingo, N.G., Colgan, K., Thakrar, S.K., Tilman, D., Lynch, J., Azevedo, I.L. and Hill, J.D., 2020. "Global food system emissions could preclude achieving the 1.5°C and 2°C climate change targets." Science, 370(6517), pp.705-708. Gerber, P.J., Steinfeld, H., Henderson, B., Mottet, A., Opio, C., Dijkman, J., Falcucci, A. and 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). Blue Horizon. 2020. "Environmental impacts of animal and plant-based food." Hayek, M.N., Harwatt, H., Ripple, W.J. and Mueller, N.D., 2021. "The carbon opportunity cost of animal-sourced food production on land." Nature Sustainability, 4(1), pp.21-24. Poore, J. and Nemecek, T., 2018. "Reducing food's environmental impacts through producers and consumers." Science, 360(6392), pp.987-992

The global demand for animal-based protein is expected to double by 2050 from a 2000 baseline.[12] This forecast growth is expected to have a detrimental impact on the environment: land, water, climate and biodiversity, as well as on human and animal health. Exhibit 1 shows that about a third of global GHG emissions are emitted by the food system: agriculture production and land use contribute to 71% of these emissions.[13] A further detailed contribution to global GHG emissions by sub-sectors within the food system is illustrated in Exhibit 2.

One possible way to reduce GHG emissions from the global food system is to shift consumers' diets from animal-based proteins to alternatively sourced proteins made of plants or cells, rather than animals. In a hypothetical scenario, if only 10% of the global animal market were to be replaced by alternative plant-based products, 176 million tCO2e would not be emitted, 38 million hectares of land would not be used and 8.6 billion cubic meters of global water consumption would be avoided.[14] In practice, this would mean more people could be fed, using the same current finite resources.[15] A combination of additional targeted mitigation measures, such as improvements in technology and management of the global food system, regenerative agriculture and reduction of food loss and waste also may help curb carbon emissions even further.[16, 17]

A shift in consumers' diets is already happening in developed countries like Germany, where two-thirds of the younger generation reportedly express concerns about today's meat industry.[18] A study published by ProVeg International showed that 37% of Europeans in their sample were flexitarian, vegetarian or vegan.[19] As the protein transformation goes mainstream, Blue Horizon research has projected that the alternative-protein market could multiply by a factor of seven by 2035, taking at least 11% of the overall protein market (up to 22% with technological changes and regulatory support).[20, 21] In practice, this means that by 2035, about one in every five dishes we eat is likely to be alternative-protein-based. In fact, our analysis of plant-based protein-related keywords mentioned in news articles already showed an increasing trend over the past two years (as of Aug. 31, 2021). Overall, technology, climate change and changing consumer preferences are likely to have a profound impact on the global agriculture and food industry.[22]

12 WRAP, 2015. "Food futures: From business as usual to business unusual."

13 Crippa, M., Solazzo, E., Guizzardi, D., Monforti-Ferrario, F., Tubiello, F.N. and Leip, A., 2021. "Food systems are responsible for a third of global anthropogenic GHG emissions." Nature Food, 2(3), pp.198-209. Note: GHGs includes CO2, CH4, N2O and fluorinated gases.

14 Blue Horizon. 2020. "Environmental impacts of animal and plant-based food."

15 Ibid.

16 Springmann, M., Clark, M., Mason-D'Croz, D., Wiebe, K., Bodirsky, B.L., Lassaletta, L., De Vries, W., Vermeulen, S.J., Herrero, M., Carlson, K.M. and Jonell, M. 2018. "Options for keeping the food system within environmental limits." Nature, 562 (7728), pp.519-525.

17 Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., Garnett, T., Tilman, D., DeClerck, F., Wood, A. and Jonell, M. 2019. "Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems." The Lancet, 393(10170), pp.447-492.

18 Heinrich Böll Stiftung, Friends of the Earth Europe, and Bund für Umwelt und Naturschutz, 2021. "The Meat Atlas 2021 – Facts and figures about the animals we eat."

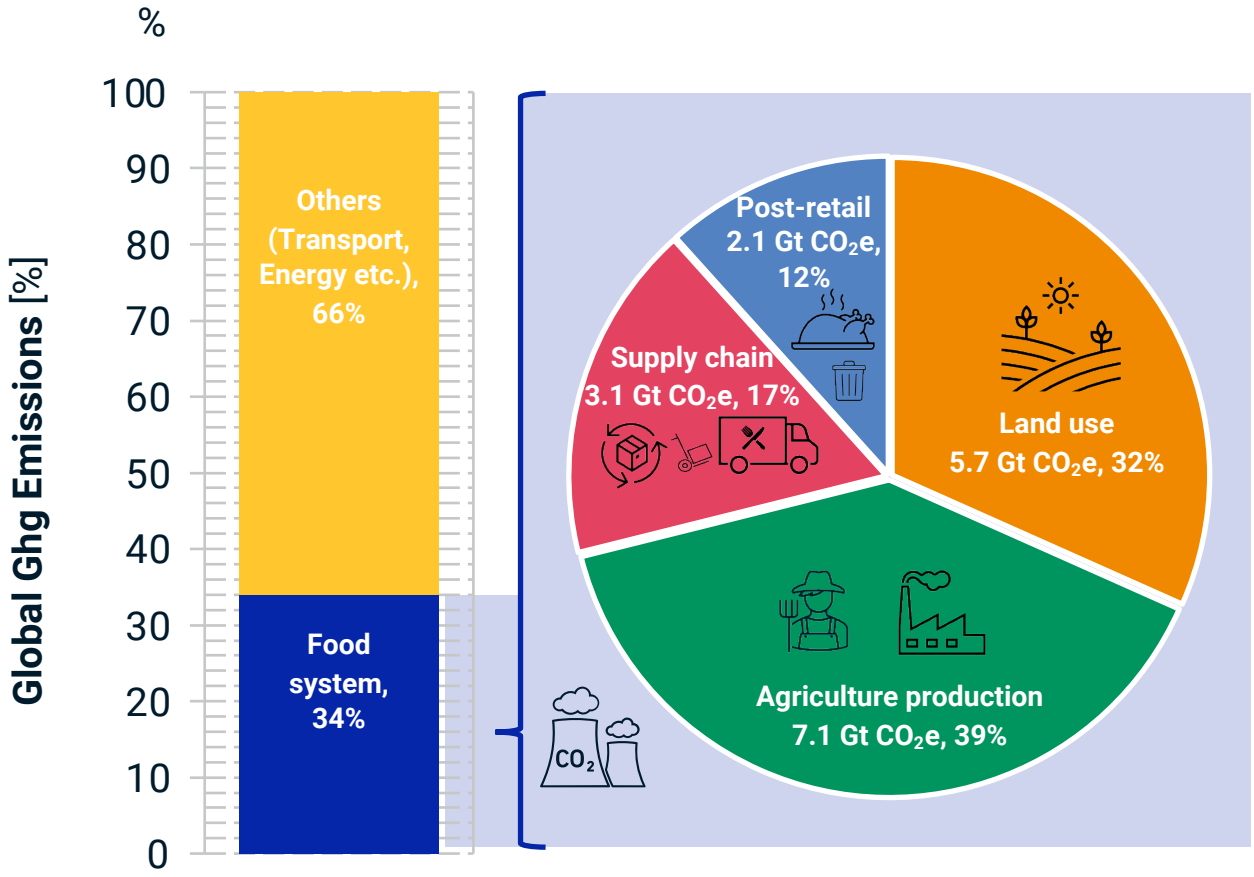
19 ProVeg International. 2021. "What consumers want: a survey on European consumer attitudes towards plant-based foods, with a focus on flexitarians." The Smart Protein Project funded by the European Union's Horizon 2020 Research and Innovation Programme.

20 Alternative proteins are protein-rich foods derived from various sources that could be plant-based, micro-organism (MO)-based, or animal cell-based that are designed to mimic the taste and texture of meat, seafood, eggs and dairy products. See Chapter 2 for further details.

21 Boston Consulting Group (BCG) and Blue Horizon (BH). 2021. "Food for Thought: The Protein Transformation."

22 MSCI. 2020. "A food revolution? Climate, technology and the consumer in the re-shaping of the food industry value chain." Thematic Insight.

EXHIBIT 2: CONTRIBUTION OF SUB-SECTORS WITHIN THE FOOD SYSTEM TO GLOBAL GHG EMISSIONS (2015)



Source: Crippa, M., Solazzo, E., Guizzardi, D., Monforti-Ferrario, F., Tubiello, F.N. and Leip, A. 2021. "Food systems are responsible for a third of global anthropogenic GHG emissions." Nature Food, 2(3), pp.198-209

In this paper, emissions from the food system include post-retail (consumer cooking, waste), supply chain (retail, packaging, transport, food processing), land use (all global deforestation allocated as land use emissions due to agriculture) and agricultural production (including emissions from aquaculture and capture fisheries, and non-agricultural products such as wool, leather, rubber, textiles, and biofuels).[23]

23 Our World in Data. 2021. "How much of global greenhouse gas emissions come from food?" Data as of March 18, 2021.

Chapter 2: Protein Transformation — A Maturing Industry

Proteins — What are we talking about?

Over the course of our research, we found that the terms plant-based product, plant protein, non-animal protein and alternative protein tend to be used interchangeably. There are currently no standardized definitions to determine what falls under each of these terms. We attempt below to clarify this terminology and the scope of this report.

- **Plant-based products** encompass any type of food made from plant sources, vegetables, fruits, legumes, cereals and grains, with varying degrees of protein content.
- **Traditional plant-based protein products** are any food made from plant sources that are protein-rich. This includes legumes, pulses, tofu, soya, tempeh, seitan, nuts, seeds, certain grains and peas.
- **Alternative proteins** are protein-rich foods derived from various sources that could be plant-based, micro-organism (MO)-based or animal cell-based. They are designed to mimic the taste and texture of meat, seafood, eggs and dairy products.[24]

This report, as shown in Exhibit 3, looked at both traditional plant-based protein products and alternative-protein products specifically trying to mimic animal-based products.

Recent years have witnessed market growth in both traditional plant-based and alternative proteins as consumer preferences have shifted toward reduced meat consumption.[25] Blue Horizon research suggests this trend is driven at least in part by the call for climate actions (decarbonization, net-zero transitions, climate risk disclosures) and concerns over healthy diets (dietary trends, overconsumption of animal-based protein), as well as ethical issues tied to factory farming and environmental sustainability.[26]

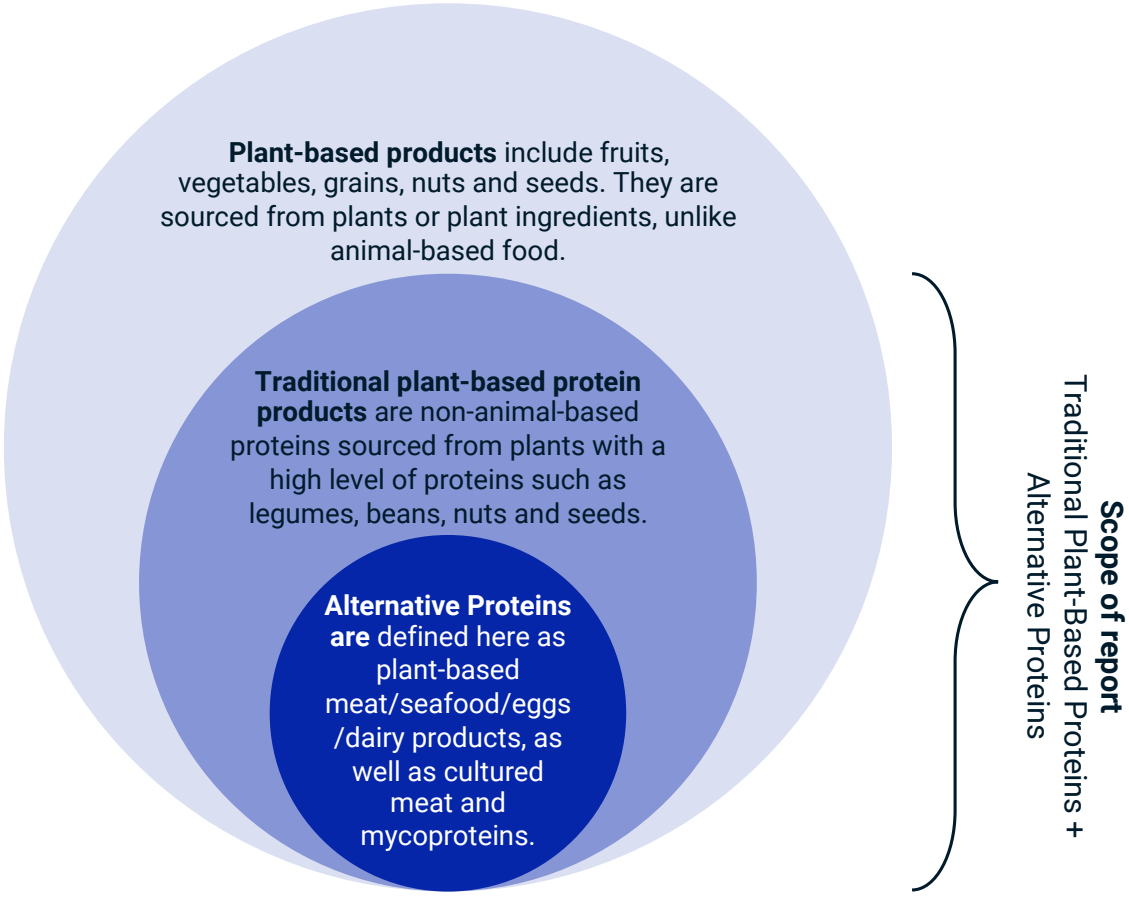
24 Good Food Institute (GFI). 2021. "Global Food System Transition is Necessary to Keep Warming Below 1.5°C."

25 Springmann, M., Clark, M., Mason-D'Croz, D., Wiebe, K., Bodirsky, B.L., Lassaletta, L., De Vries, W., Vermeulen, S.J., Herrero, M., Carlson, K.M. and Jonell, M. 2018. "Options for keeping the food system within environmental limits." Nature, 562(7728), pp.519-525.

26 Boston Consulting Group (BCG) and Blue Horizon (BH). 2021. "Food for Thought: The Protein Transformation."

According to Blue Horizon and Boston Consulting Group, the taste, texture and the price of alternative proteins all are predicted to reach parity with those of animal proteins in the 2020s and early 2030s, with the refinement and scaling-up of existing technologies as key steps, which may make them more appealing to consumers aspiring to reduce meat consumption but skeptical of today's offerings.[27] Also according to the report, protein transformation relies on highly differentiated technology, creating opportunities for innovation and investments. Investors and companies that embrace this emerging food-tech trend stand to benefit from a USD 290 billion market making positive ESG contributions.[28] Regulators can ease the protein transformation toward a healthy and green food system by enabling innovation while protecting farmers' livelihoods, with shifts in subsidies and clear processes for novel food approvals. Furthermore, companies could start experiencing investor pushback if they don't join the conversation about animal agriculture and transforming the way food is produced, using, for example, more efficient and environmentally friendly food production systems such as plant-, microorganism-, and cell-based technologies.[29]

EXHIBIT 3: DEFINING TERMS AND CONCEPTS AROUND PROTEIN TRANSFORMATION AND PLANT-BASED DIETS



Source: MSCI ESG Research, as of Nov. 1, 2021

27 Ibid.

28 Boston Consulting Group (BCG) and Blue Horizon (BH). 2021. "Food for Thought: The Protein Transformation."

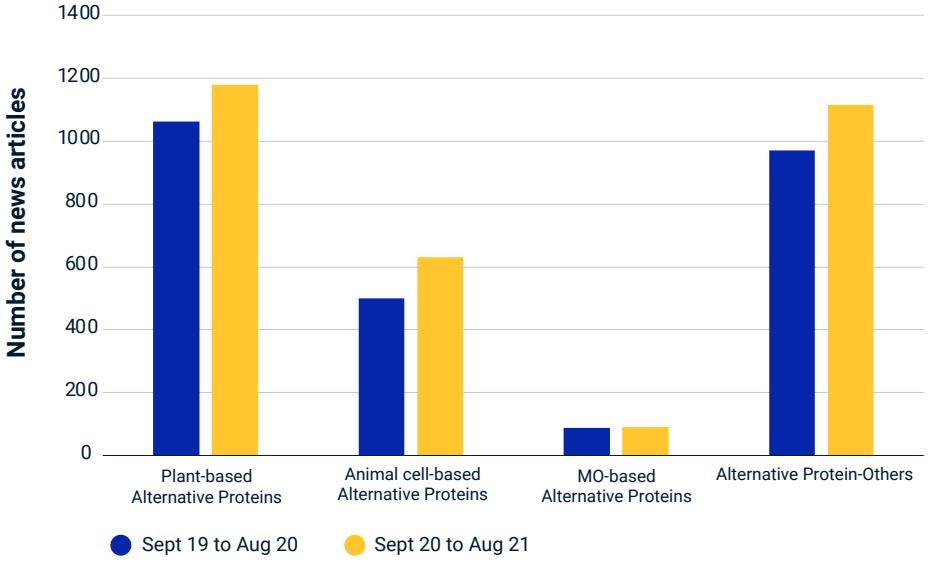
29 Levitt, Tom. 2021. "Factory Farming Divestment: What You Need to Know." The Guardian. March 3, 2016.

Emerging trends and drivers

We used natural language processing (NLP) to further understand the emerging trends, patterns and drivers of the traditional plant-based and alternative-proteins landscape. The focus was put specifically on alternative proteins. Using NLP algorithms, we performed keyword analysis on online news, websites, company reports (n=485) and patent databases. Through this process, we collected several data points, such as word count and average keywords hit in online news, websites and company documents. These keywords were classified based on different types of alternative protein such as plant-based, MO-based, animal cell-based and others (including more commonly used terms for alternative proteins).

To evaluate the **trend of alternative-based proteins in consumer media**, we analyzed global news articles pertaining to the publicly listed companies within our study universe for the period from September 2019 to August 2021.[30] The analysis (Exhibit 4) shows that terms related to plant-based alternative proteins were the most mentioned and were steadily rising year-on-year.

EXHIBIT 4: TREND OF ALTERNATIVE-PROTEIN CATEGORY-RELATED KEYWORDS MENTION AND KEYWORD FREQUENCY WITHIN EACH CATEGORY



Source: MSCI ESG Research. News articles from 271 sources in English were retrieved from the LexisNexis database. Companies (n=102) matched with our study universe (n=485), as of Aug. 31, 2021

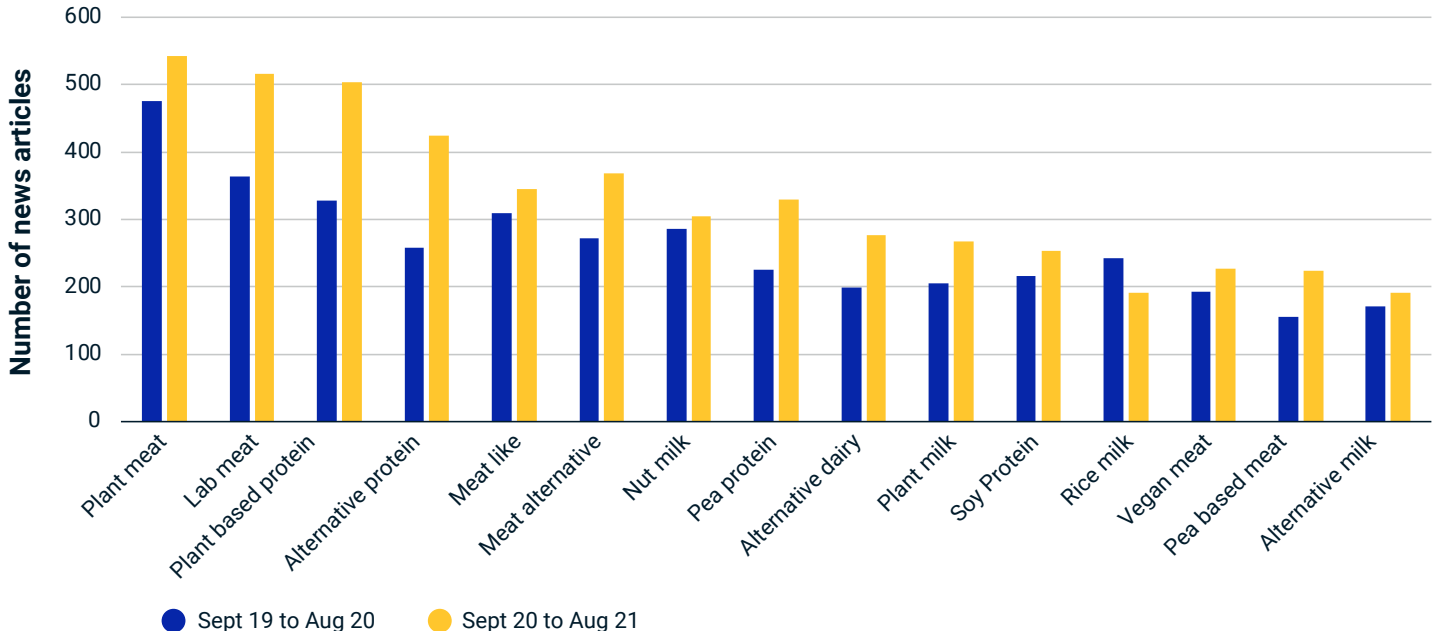
30 Universe: Constituents of the MSCI ACWI Investable Market Index (IMI) belonging to the following GICS sub-industries: agricultural products, packaged foods & meats, restaurants, food distributors, hypermarkets and supercenters and food retailers (n=485), as of July 15, 2021.

1 A more detailed analysis of **specific keywords within individual alternative-protein categories** showed that plant meat, lab-based meat and plant-based protein were the top three alternative proteins mentioned in company news (Exhibit 5). Common terms such as "alternative protein" and "alternative dairy" were cited more frequently to capture broader alternative-proteins trends and developments.

2 We also wanted to determine which companies are mentioning alternative proteins in **all public sources of information about them, irrespective of the company's current revenue involvement**. To achieve this, we cast a wider net for sources, including company documents and websites in addition to news articles (Exhibit 6). We found that about 70% of companies within the packaged foods & meats and hypermarkets & supercenters GICS® sub-industries had at least one use of alternative-protein-related terms.[31] Additionally, plant-based alternative proteins were consistently the top category of these mentions, with, on average, around half the companies in these sub-industries having more than one mention of plant-based-related keywords across all documents.

3 A **country-level breakdown** showed that companies based in the U.K., U.S., Canada and Australia led in number of mentions of alternative-proteins-related keywords across different industries and languages (Exhibit 7).

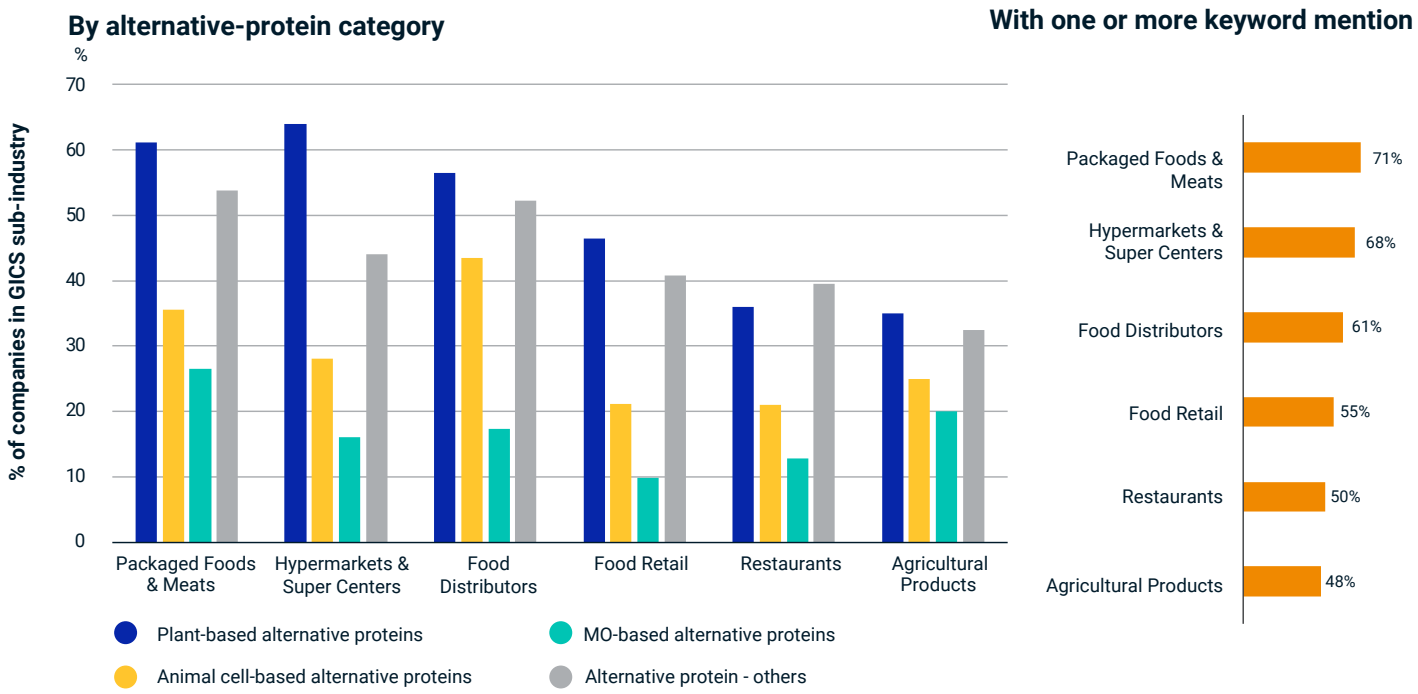
EXHIBIT 5: TOP 15 ALTERNATIVE-PROTEIN-RELATED KEYWORD MENTIONS IN NEWS ARTICLES



Source: MSCI ESG Research. News articles from 271 sources in English were retrieved from the LexisNexis database. Companies (n=102) matched with our study universe (n=485), as of Aug. 31, 2021

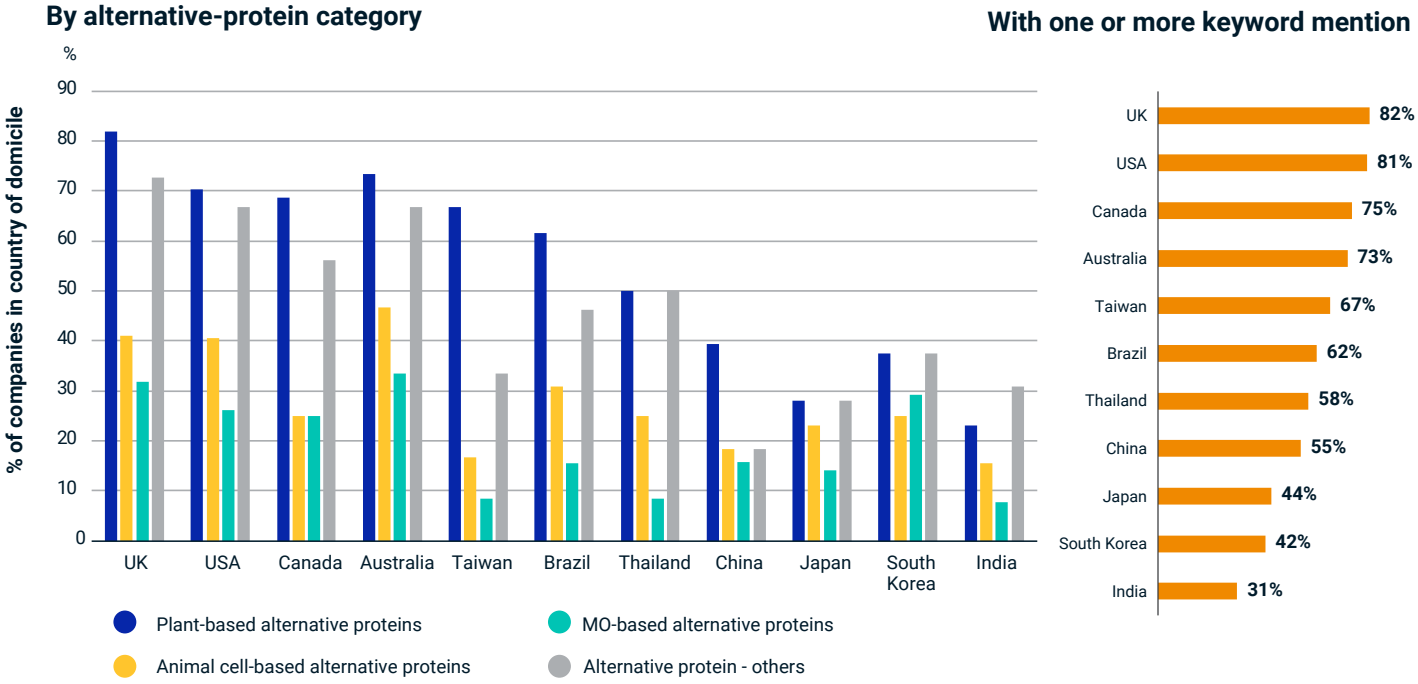
31 GICS is a global industry classi ication standard jointly developed by MSCI and S&P Global Market Intelligence.

EXHIBIT 6: PERCENTAGE OF COMPANIES IN GICS SUB-INDUSTRY BY ALTERNATIVE-PROTEINS-CATEGORY-RELATED KEYWORD MENTIONS ACROSS ALL SOURCES



Sources: MSCI ESG Research, News articles (September 2019 to August 2021), company documents (annual reports, 10-Ks, CSR reports, investor presentations), corporate websites (as of August 2021) for companies in the study universe (n=485), Languages: English, Japanese, Chinese-Simplified, Thai, Portuguese, Korean, as of Aug. 31, 2021

EXHIBIT 7: PERCENTAGE OF COMPANIES IN DOMICILE COUNTRY BY ALTERNATIVE-PROTEINS-CATEGORY-RELATED KEYWORD MENTIONS ACROSS ALL SOURCES



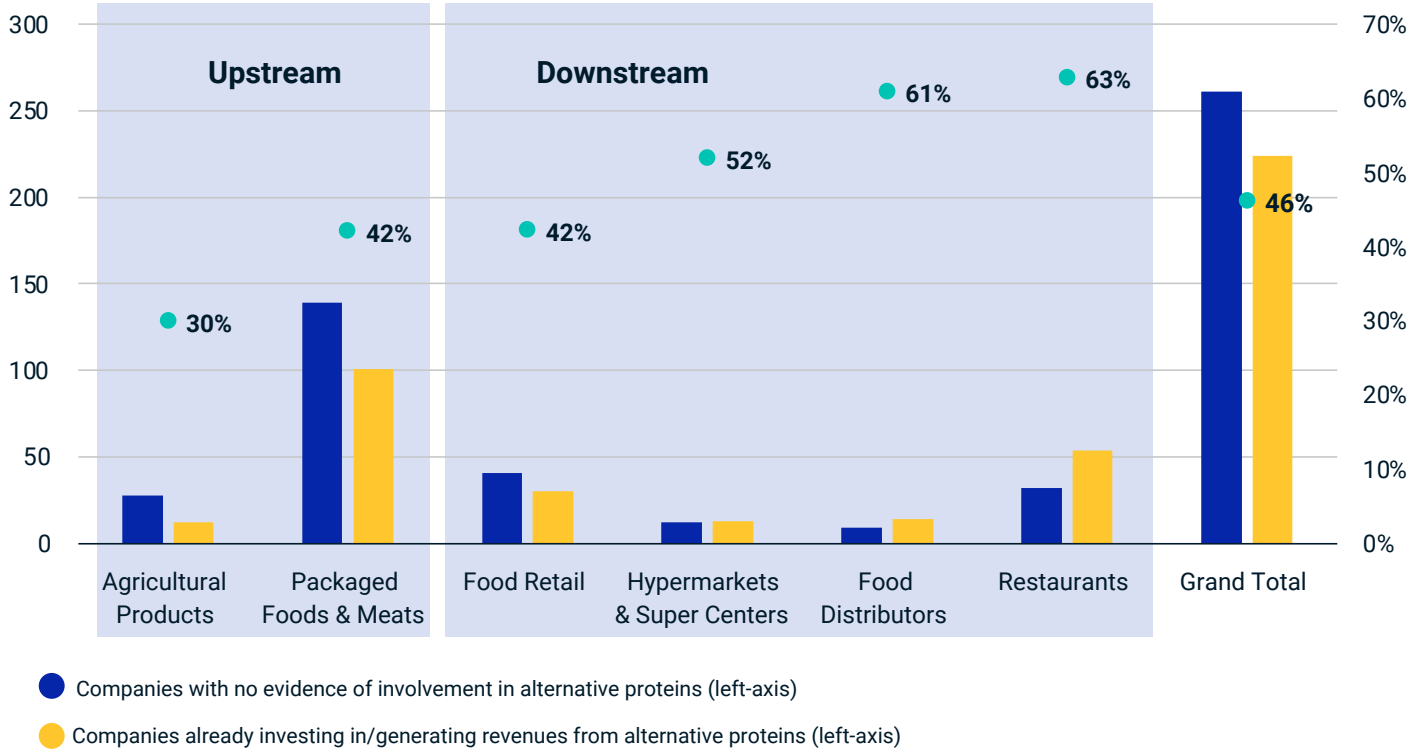
Source: MSCI ESG Research, news articles (Sept 2019 to August 2021), company documents (annual reports, 10-Ks, CSR reports, investor presentations), corporate websites (as of August 2021) for companies in the study universe (n=485), Languages: English, Japanese, Chinese-Simplified, Thai, Portuguese, Korean, as of Aug. 31, 2021

Current state of the market

Review of involvement throughout the food value-chain and across regions

Alongside the NLP analysis, we conducted an analyst-driven review of publicly available information to confirm and evaluate the level of companies' involvement (Appendix 2: Methodology). Forty-six percent of the publicly listed companies analyzed across the food value-chain (224 out of 485) were constituents of the MSCI ACWI Investable Market Index (IMI) and already were invested in or generated revenue from traditional plant-based and alternative proteins (as of July 15, 2021).[32, 33] This trend was accentuated when moving down the value-chain — closer to the end-users, or customers — with a majority (>54%) of retailers, distributors and restaurants involved (Exhibit 8).

EXHIBIT 8: INVOLVEMENT IN TRADITIONAL PLANT-BASED AND ALTERNATIVE PROTEINS



Source: MSCI ESG Research, July 15, 2021

Universe: Constituents of the MSCI ACWI IMI belonging to the following GICS sub-industries: agricultural products, packaged foods & meats, food retail, food distributors, hypermarkets & super centers, restaurants, as of July 15, 2021

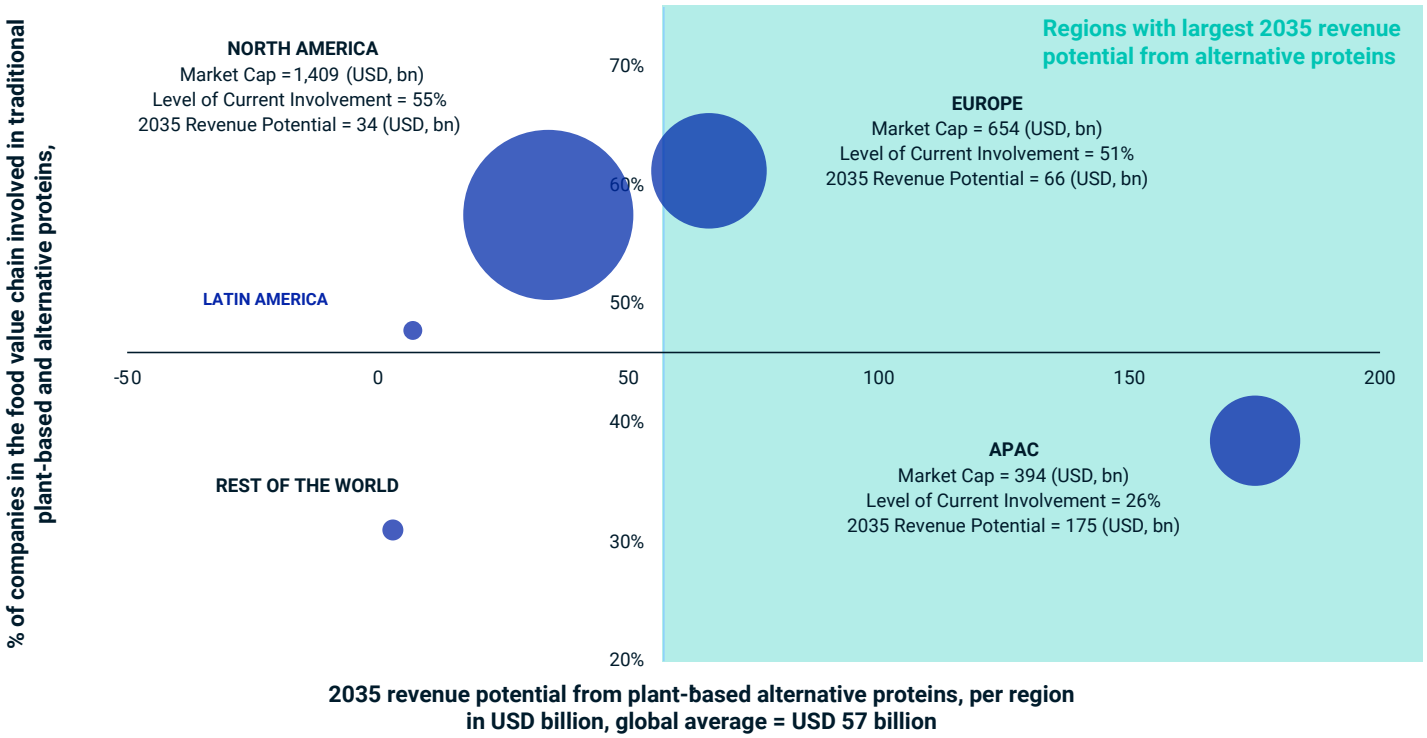
32 We define companies belonging to the food value chain as those classified in the following GICS sub-industries: agricultural products, packaged foods & meats, food retail, hypermarkets & supercenters, restaurants, food distributors.

33 The MSCI ACWI Investable Market Index (IMI) captures large, mid-, and small-cap stocks across 23 Developed Markets (DM) and 27 Emerging Markets (EM) countries, covering approximately 99% of the global equity investment opportunity set.

Most companies' involvement came from plant-based proteins, while cultured meat and mycoproteins appeared to be nascent fields (<5% of results). In addition, the revenue exposure to traditional plant-based and alternative proteins at the company level remained marginal: Less than 10% of companies where we identified involvement in traditional plant-based and alternative proteins provided evidence that they derive more than 5% of total sales from such products.

European and North American companies appeared best prepared to tap into the growing demand from traditional plant-based and alternative proteins, with most already involved in this area (Exhibit 9). In contrast, Asia Pacific (APAC) companies lagged, even though the Boston Consulting Group and Blue Horizon estimated they could benefit the most by 2035 in terms of revenue potential from alternative proteins.[34]

EXHIBIT 9: CURRENT INVOLVEMENT IN TRADITIONAL PLANT-BASED AND ALTERNATIVE PROTEINS VS. SALES PROJECTION BY 2035



Bubble size represents total market capitalization of companies. Universe: constituents of the MSCI ACWI IMI belonging to the following GICS sub-industries; agricultural products, packaged foods & meats, food retail, food distributors, hypermarkets & super centers, restaurants, as of July 15, 2021.

Sources: U.S. Department of Agriculture, Euromonitor, Boston Consulting Group, MSCI ESG Research, July 15, 2021

34 Boston Consulting Group (BCG) and Blue Horizon (BH). 2021. "Food for Thought: The Protein Transformation."

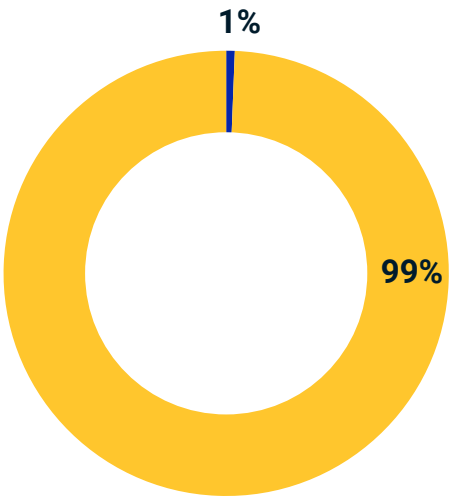
Starving for more data: Frugal disclosure from corporates

Our evaluation of food companies' publicly available data on traditional plant-based and alternative proteins showed an overall lack of quantitative and harmonized metrics on the topic (Exhibit 10). Less than 10% of the companies where we identified involvement in traditional plant-based and alternative proteins provided their exact percentage of revenue derived from such products. This opacity limits a comparative assessment or evaluation of companies' progress in this category over time.

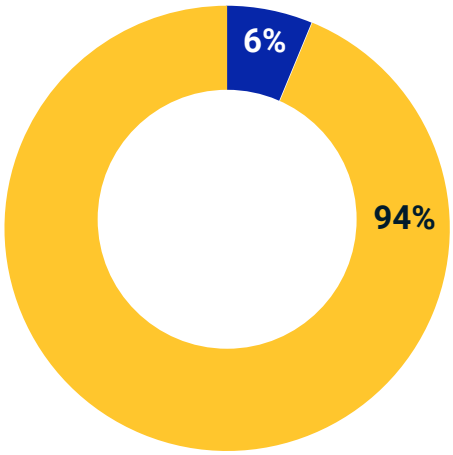
There was also a lack of clarity about the definition of what constitutes alternative and plant-based proteins. For example, the terms alternative, plant-based proteins and plant-based products were sometimes used interchangeably in corporate narratives, despite their differing meanings (Exhibit 3).

EXHIBIT 10: LEVEL OF DISCLOSURE AMONG CORPORATES IN THE FOOD VALUE-CHAIN

% of companies with a quantitative and timebound target to increase revenue/production from traditional plant-based and alternative proteins



% of companies involved in alt proteins, disclosing exact revenue from traditional plant-based and alternative proteins



Universe: Constituents of the MSCI ACWI IMI belonging to the following GICS sub-industries; agricultural products, packaged foods & meats, food retail, food distributors, hypermarkets & super centers, restaurants, for which we identified some involvement in alternative proteins (revenue, R&D, investments), as of July 15, 2021

Source: MSCI ESG Research, July 15, 2021

The scarcity of data may be the result of the emerging nature of this topic, although some leading examples were encountered (Exhibit 11).

EXHIBIT 11: EXAMPLES OF LEADING CORPORATE DISCLOSURE PRACTICES

TYPE OF DISCLOSURE	COMPANY EXAMPLES
Financial relevance	**Maple Leaf** has a specific operating segment dedicated to plant proteins and accordingly discloses annual and quarterly revenue, gross profit, selling, general and administrative (SG&A) expenses and adjusted operating earnings derived from such products. **Ingredion** disclosed that it invested USD 250 million to enhance its plant-based protein capabilities through acquisition, dedicated facilities and partnerships in FY 2020.
Forward-looking	**Danone** aims to triple its sales from plant-based products (which in its case mostly refers to dairy alternatives using plant-based proteins) to EUR 5 billion, over the period of 2020-2025. Other companies such as **Compass** and **Maple Leaf** also set quantitative and timebound targets to increase their traditional plant-based and alternative protein offerings.
Impact relevance	**Compass** identified the goal of expanding its plant-based proteins products to 40% of its food offering by 2030 (with an interim target of 25% by 2025) as a key enabler to deliver a 65% reduction in GHG emissions across the value-chain by 2030 and to reach net-zero by 2030.

Note: Examples were picked based on the most advanced corporate disclosures we identified; they do not constitute an exhaustive list of all companies engaged in such practices.

Source: MSCI ESG Research, Sept. 28, 2021

It should be noted that traditional plant-based and alternative-proteins-related metrics are not yet part of the most common ESG reporting standards, such as those from the Sustainability Accounting Standards Board (SASB) or the Global Reporting Initiative (GRI).

Generally, corporate disclosure on healthy and eco-friendly food has been sparse and lags other ESG themes in terms of harmonized reporting. As a matter of comparison, still less than 5% of food producer (agricultural products and packaged foods & meats) constituents of the MSCI ACWI IMI (as of July 15, 2021) were disclosing revenue derived from organic products or any quantitative target to increase this share of revenue going forward.

Similarly, only a handful of these food producers have disclosed their portion of total sales derived from products aligned with health and nutritional criteria defined by independent (i.e. non-industry) bodies.

Given the current dearth of consistent data, investors wishing to engage with companies and/or regulators on the matter of disclosure may find the following engagement points a useful starting point (Exhibit 12).

EXHIBIT 12: HOW TO FRAME THE DIALOGUE TO ENHANCE MEANINGFUL DISCLOSURE

TYPE OF DISCLOSURE	EXAMPLES OF QUESTIONS TO FRAME DIALOGUE WITH COMPANIES
Financial relevance	• Has the company discussed and identified the demand opportunities (e.g., CAGR, competition, market incentives) for traditional plant-based and alternative proteins in its respective regional markets and based on its targeted customer base? • Has the company disclosed its total sales, total amount of investment, R&D and CAPEX, if any, dedicated to traditional plant-based and alternative proteins?
Transparency	• Has the company clarified what it means by alternative proteins and with which type of alternative proteins it is involved (e.g., plant-based proteins, mycoproteins, cultured meat) as well as which type of plant-based proteins (e.g., soy or pea proteins) it is involved with? • Confirm the company does not use interchangeably plant-based products (fruits and vegetables), traditional plant-based and alternative proteins and clearly differentiates between those terms when disclosing revenue or quantitative targets. • Does the company provide historical and year-on-year performance data on alternative proteins to show trends and progress over time?
Forward-looking	• Does the company disclose a quantitative and timebound target to increase its involvement in traditional plant-based and alternative proteins (e.g., by revenue, by production volume, by investment or by R&D)? • Does the company disclose how much the expansion of traditional plant-based and alternative proteins in the company's product portfolio will contribute to the path to net-zero emissions?
Impact relevance	• Has the company discussed and disclosed the environmental footprint of its plant-based proteins products vs. other type of food products/animal proteins it produces? • Has the company discussed and disclosed the nutritional facts of its plant-based proteins products and how they are aligned vs. health criteria from independent nutritional guidelines/bodies? • Has the company discussed the affordability of its traditional plant-based and alternative-proteins products and how this contributes to addressing food security issues?

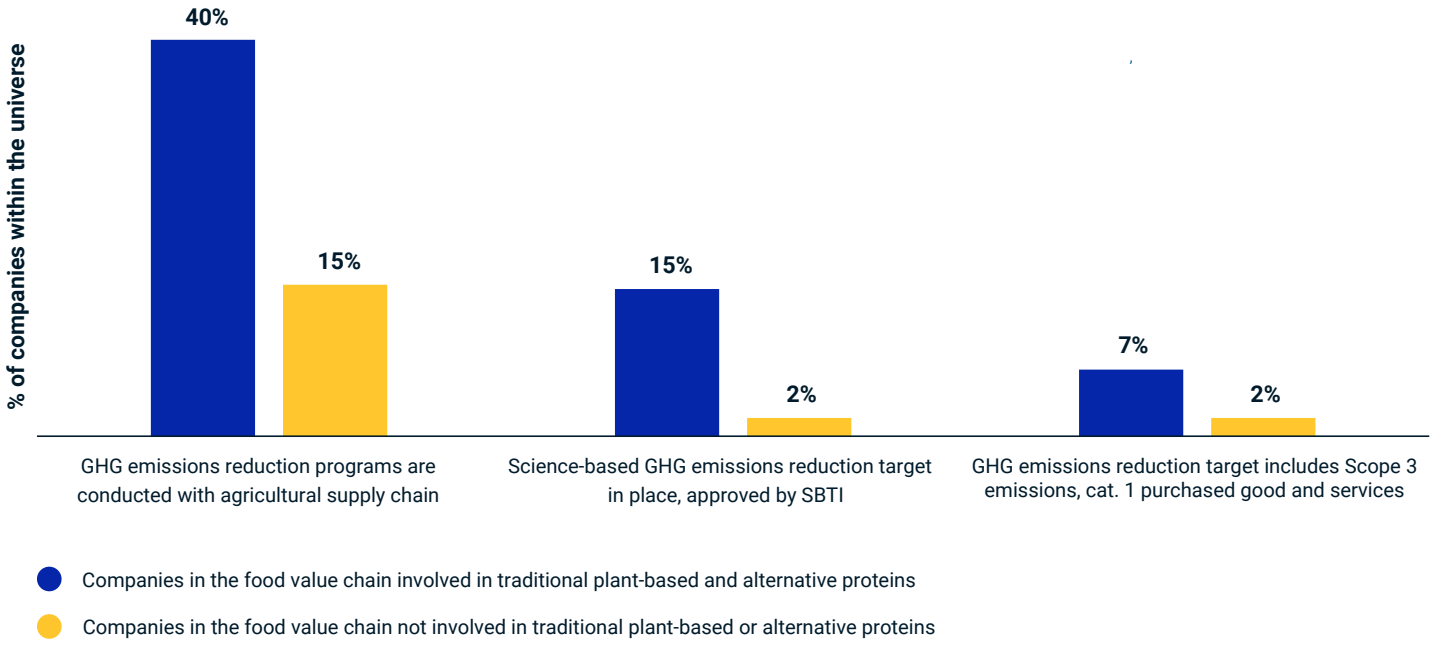
Source: MSCI ESG Research, Sept. 28, 2021

Protein transformation and comprehensiveness of climate response

As discussed, the food production system would require a structural transformation geared toward more plant-based diets (and a reduction of livestock production and consumption) to reach net-zero, but that alone isn't enough. The system's reaching net-zero also would require additional carbon mitigation practices such as regenerative and sustainable crop cultivation.[35] The EU Taxonomy reiterates the need, even for plant-based agriculture, to implement carbon mitigation practices. It notably requires non-perennial crop agriculture to follow a trajectory of 20% reduction in GHG emissions by 2030, 30% by 2040 and 40% by 2050.[36] Mitigation practices that are mentioned by the EU Taxonomy include low-input farming, the reduced use of pesticides and fertilizers, promotion of agroforestry, no land conversion from high-carbon stocks, low- and no-tillage practices and zero-deforestation.

Our research indicated that food companies already involved in the traditional plant-based and alternative proteins space were also the ones showing stronger climate mitigation responses (Exhibit 13).[37]

EXHIBIT 13: COMPARATIVE ANALYSIS OF CLIMATE STRATEGY WITHIN THE FOOD VALUE-CHAIN



Sources: MSCI ESG Research, as of Sept. 28, 2021. Universe: Constituents of the MSCI ACWI IMI belonging to the following GICS sub-industries; agricultural products, packaged foods & meats, food retail, food distributors, hypermarkets & supercenters, restaurants, as of July 15, 2021. GHG emission reduction programs conducted with agricultural supply chain were only assessed for 313 companies belonging to the packaged foods & meats, food retail, food distributors and hypermarkets & supercenters, per MSCI ESG ratings coverage and identification of most financially relevant ESG key issues

35 Smith P., M. Bustamante, H. Ahammad, H. Clark, H. Dong, E.A. Elsiddig, H. Haberl, R. Harper, J. House, M. Jafari, O. Masera, C. Mbow, N.H. Ravindranath, C.W. Rice, C. Robledo Abad, A. Romanovskaya, F. Sperling, and F. Tubiello. 2014. "Agriculture, Forestry and Other Land Use (AFOLU)." In: Climate Change 2014. "Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change" [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, U.K. and New York, NY.

36 EU Technical Expert Group on Sustainable Finance. 2020. "Taxonomy Report: Technical Annex."

37 Companies we identified as either generating some revenue, allocating R&D or investing in alternative-proteins projects, as of July 15, 2021 (n=224) within the food value chain universe defined earlier in the report (n=485).

Chapter 3: Assessment of Risks, Impacts and Opportunities

224

COMPANIES

involved in traditional plant-based and alternative proteins

Implementation of models from the Net-Zero Solution Toolbox

MSCI ESG Research has developed a variety of metrics as a part of its Net-Zero Solution Toolbox to measure a company's carbon footprint and exposure to climate-related risks. These metrics range from the Scope 3 Emissions Estimation model to sophisticated risk metrics like the Climate Value-at-Risk (Climate VaR) and temperature alignment metrics like the Implied Temperature Rise.

For the purpose of this report, we refined the Scope 3 emissions with the associated upstream and downstream carbon emissions of the 485-company universe defined previously (also, see Appendix 2: Methodology). This was achieved by explicitly integrating revenue shares from traditional plant-based and alternative-protein products of the 224 companies identified in Chapter 2. Accounting for traditional plant-based and alternative proteins' revenue resulted in a more precise emission estimation, specifically regarding Scope 3 emissions. The Scope 3 carbon footprint is a crucial input in our model for understanding climate risk and alignment to global climate goals like keeping global warming under 1.5°C.

Only six of the 485 companies derived more than 50% of their revenue from traditional plant-based and alternative proteins (Exhibit 14). These companies can be considered a proxy to illustrate how the protein transformation could drive the food industry to a net-zero economy.[38, 39]

Not surprisingly, these six companies consist mainly of upstream companies, as they tend to be more organized around food system inputs (e.g., pulses, soy, nuts) and hence classify and disclose their revenue accordingly.[40] **Beyond Meat Inc.** was the only company we found in our 485-company universe that generated 100% of its revenue from alternative proteins.

38 These identified companies generated more than 50% of their revenue (as of July 15, 2021) from the sales of traditional plant-based and alternative foods, which were found during the market analysis as explained in Chapter 2.

39 Although the protein transformation is mostly driven by increase in demand for like-for-like alternatives in terms of taste, texture and price to meat, dairy, seafood and eggs, we used largest percentage of revenue share generated from traditional plant-based and alternative proteins (50% above threshold) as a proxy for our sample set of six companies.

40 We ensured that the disclosed or estimated revenue from traditional plant-based and alternative proteins was all related to human consumption. Please refer to Appendix 2 – Methodology, "Analyst-driven evaluation of companies' involvement in traditional plant-based and alternative proteins."

EXHIBIT 14: COMPANIES WITH THE LARGEST SHARE OF REVENUE FROM TRADITIONAL PLANT-BASED AND ALTERNATIVE PROTEINS

Ranked by revenue	Company name (GICS sub-industry)	% of revenue from traditional plant-based and alternative proteins (disclosed or estimated)	Primary protein type/ product
1	**Beyond Meat Inc.** (Packaged food & meat)	100%	Plant-based meat
2	**Select Harvests Ltd** (Agricultural products)	100%	Almond-derived products
3	**Jonjee Hi-Tech Industrial and Commercial Holding Co. Ltd** (Packaged food & meat)	96.2%	Soy products
4	**Chacha Food Co. Ltd.** (Packaged food & meat)	88.4%	Nuts
5	**Qianhe Condiment and Food Co. Ltd.** (Packaged food & meat)	62.2%	Soy products
6	**Foshan Haitian Flavouring and Food Co. Ltd.** (Packaged food & meat)	57.2%	Soy products

Source: MSCI ESG Research, as of July 15, 2021

Revenue figures are based on data from the most recent financial reporting year available at the time of data collection. When companies listed traditional plant-based and/or alternative protein product as one of their main products within a specific business line, we assumed equal revenue weighting between the listed main products within that business line, unless otherwise stated.

Evaluation of Climate Value-at-Risk results

The Climate Value-at-Risk (Climate VaR) model quantifies the transition risks and opportunities that companies face under different climate policy scenarios when transitioning to a low carbon economy. The model results also estimate future costs and profits in relation to the current enterprise value of the company.

As traditional plant-based and alternative-protein products have relatively lower GHG emissions than conventional animal-based protein products (Chapter 1), their business models are assumed to have reduced transition risks associated with climate policy actions.

We used new data on percentage of revenue from traditional plant-based and alternative proteins collected during market research (Chapter 2 and Exhibit 14) and integrated into the Climate VaR model data from Blue Horizon's study measuring the environmental impacts of animal and plant-based food.[41] We concentrated on the difference in value-chain emissions (Scope 3-related) risks because the market research was only conducted on the food value-chain. Companies' Scopes 1 and 2 emissions were not considered in this study.

This study also does not take physical risks into account. Physical risk assessment for traditional plant-based and alternative-protein products requires granular data on production facilities and their vulnerabilities to physical impacts, which is not readily available. Therefore, we focused on value-chain emissions-related climate transition risks and used them as a proxy to evaluate impact for the food industry.

For this report, we conducted the analysis for three Asia-Pacific Integrated Model -Computable General Equilibrium (AIM-CGE) transition scenarios (Exhibit 15).[42]

EXHIBIT 15: THREE CLIMATE POLICY SCENARIOS USED IN THIS ANALYSIS

Climate Policy Scenarios	Assumption
3°C scenario	Weak climate policy scenario: Climate policy actions align with limiting warming compared with pre-industrial levels to 3°C. AIM CGE Advance 3°C carbon prices are used for this scenario.
2°C scenario	Ambitious climate policy scenario: Climate policy actions align with limiting warming compared with pre-industrial levels to 2°C. AIM CGE Advance 2°C carbon prices are used for this scenario.
1.5°C scenario	Very ambitious climate policy scenario: Climate policy actions align with limiting warming compared with pre-industrial levels to 1.5°C. The transition costs for implementing climate policies to reach a 1.5°C scenario are the highest. AIM CGE Advance 1.5°C carbon prices are used for this scenario.

Source: MSCI ESG Research, as of Oct. 21, 2021

41 Blue Horizon. 2020. "Environmental impacts of animal and plant-based food."

See also Appendix 2: Methodology.

42 The AIM-CGE model was developed by the Japanese National Institute for Environmental Studies (NIES) to analyze the future of climate change mitigation and its impact on economic conditions. AIM/CGE is classified as a computable general equilibrium model, which covers all economic goods while considering production-factor interactions. The trade of goods and services is also considered.

295*

BN USD

of avoided market-cap loss if entire universe shifted to high traditional plant-based and alternative proteins involvement in a 1.5°C scenario

* **USD 295 billion equates to 7% of all market-cap in our 485-company universe. As of Nov. 30, 2021.**

Policy risks capture direct and indirect costs related to emissions reductions required for the transition to a low carbon economy. We compared the average cost and associated risk of emissions reductions for the sample set of six companies (Exhibit 14) in terms of traditional plant-based and alternative protein production with the entire 485-company universe. More specifically, we looked at the costs and risks associated with value-chain emissions of each company.[43]

For food companies, these emissions typically are coming from suppliers upstream in the value-chain, from its agricultural raw materials (e.g., cattle farming, animal feed, crops). For instance, **Beyond Meat** produces plant-based alternative-protein products instead of conventional animal-based products and therefore has lower GHG emissions embedded in its value-chain.[44] **The average company in the initial 485-company universe had a carbon-intensive value-chain four times greater than Beyond Meat's.** On a more general level, comparing the carbon intensity of the 485-company universe with the average of our sample set of six companies' intensity,[45] we see that the six companies with greatest involvement had a 29% lower carbon intensity than the 485-company universe. Therefore, the climate policy risks associated with Scope 3 GHG emissions can be considered lower for plant-based protein producers. For some companies that solely focus on traditional plant-based and/or alternative proteins, this effect is very pronounced. Under an ambitious climate policy scenario (i.e., 1.5°C scenario), **Beyond Meat**'s Scope 3 Climate VaR was marginal (-0.07%) compared with an average of -5.41% for the 485-company universe.[46]

Among the six companies that generated the highest revenue from traditional plant-based and alternative proteins on an aggregated level, we found that **the value-chain risk for companies with the largest share of traditional plant-based and alternative proteins was 95% lower than the 485-company universe.**[47]

In the climate VaR model, what would happen if the 485-company universe transitioned to business models solely using traditional plant-based and alternative proteins, therefore reducing the risks embedded in their value-chain? What would be the total avoidable climate policy risk-related costs under such a hypothetical scenario?

Using the three climate policy scenarios outlined in Exhibit 15, we estimated the avoided market-cap loss if all the 485 companies in the universe were to have the same relative exposure to emissions in their value-chain as these six companies. Under the 3°C Scenario (i.e., weak climate policy scenario), an estimated market-cap loss of USD 5 billion in climate transition-related value-chain risk could be avoided if the entire universe had high traditional plant-based and alternative-protein involvement like the six companies.

44 As of Nov. 30, 2021, Beyond Meat's Scope 3 GHG emissions intensity stood at 152 tCO2e/m USD revenue while the mean intensity of the entire 485-company universe was 523 tCO2e/m USD.

45 Mean intensity for the six companies: 372 t/m USD.

46 The Transition Climate Value-at-Risk is composed of the Climate VaRs for the individual emissions scopes (Scope 1, Scope 2, Scope 3) and technological opportunities. For this analysis, by far the most influential impact came from the Scope 3 Climate VaR.

47 See Appendix 2: Methodology for more information. Note that food companies usually have higher footprints upstream in their value chain. However, this is not always the case. Some integrated companies also have high Scope 1 carbon emissions footprints because they own farms and croplands. So if such companies only reduce their Scope 3 value chain carbon footprint, their exposure to higher carbon prices or a forced low carbon transition by regulators would still be large.

For the more ambitious transition scenarios, the impact on emissions-intense business models was much more pronounced. In those, we found a potential avoided market-cap loss of USD 97 billion for 2°C, while for the 1.5 °C scenario — the most ambitious policy scenario — potentially avoided market-cap loss in the 485-company universe was **USD 295 billion**.

How hot is this company?

The Implied Temperature Rise is designed to show the temperature alignment of companies with global climate targets. It is measured and expressed in °C, and shows the global rise on average if the global economy were to overshoot (or undershoot) its remaining carbon budget to the same extent as the company in question.[48]

When specifically modeling traditional plant-based and alternative proteins in the Implied Temperature Rise model for **Beyond Meat**, we found the company to be "2°C-aligned" with a temperature of 1.7°C. Had we modeled the company as if it were a conventional meat producer the resulting temperature of 3.6°C would have been highly inaccurate.[49] This shows the importance of including traditional plant-based and alternative proteins in a company's temperature-alignment assessments. As more investors start to integrate global climate targets into their investment processes, the temperature alignment of a company might become an important criterion for investment in future.

Who is getting ready for the protein transformation?

We conducted an analysis of MSCI ESG Research's patent database to identify patents related to traditional plant-based and alternative proteins. Patents can provide valuable insights to identify companies that have a technology opportunity and thus are expected to provide solutions for the transition to a low carbon economy. With our NLP analysis, we identified 409 traditional plant-based and alternative-proteins-related patents, most of which were held by large, established companies, with 10 out of the top 15 total patent-holding companies domiciled in Asia. These results raise the following questions:

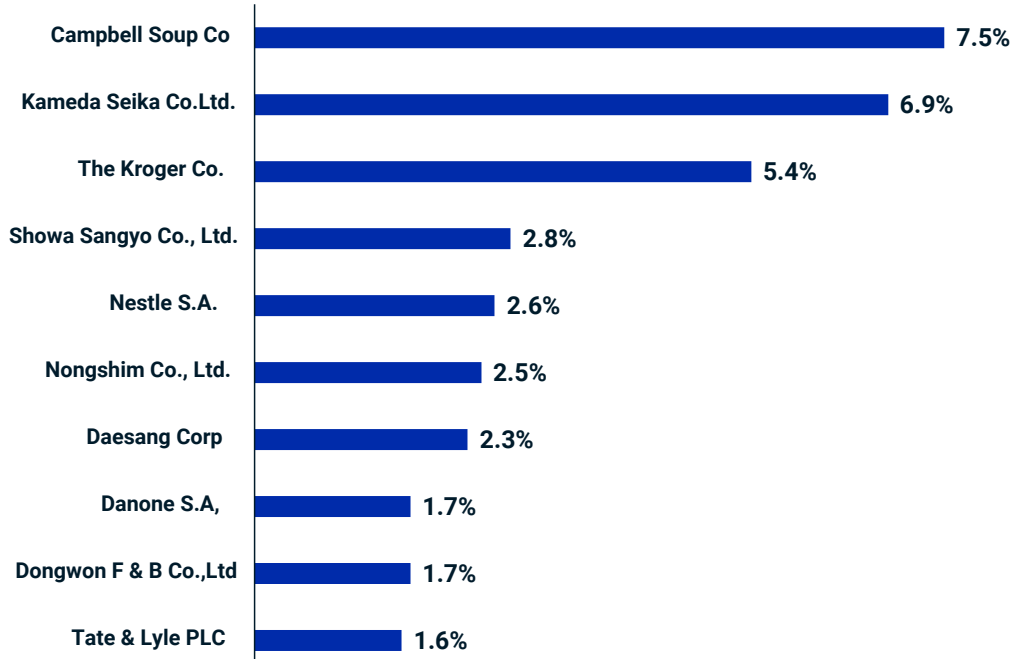
- Are large, international corporations gearing up for the protein transformation?
- Are they diversifying their protein sources to mitigate risk and/or to capture opportunity?
- Is Asia preparing to take the lead in this race?

According to our patent analysis, **Nestlé SA** owned the highest number of patents in traditional plant-based and/or alternative proteins in our 485-company universe. When **Nestlé**'s traditional plant-based and alternative proteins patents were evaluated against the company's total patent holdings, they constituted 2.6% of Nestle's more than 4,000 patents, as shown in Exhibit 16.

48 MSCI ESG Research. 2021. "Implied Temperature Rise."

49 This is because companies like Beyond Meat would still be measured as a conventional meat producer of the same size because they fall under the GICS sub-sector of packaged food & meat.

EXHIBIT 16: PERCENTAGE OF TRADITIONAL PLANT-BASED AND/OR ALTERNATIVE PROTEINS-RELATED PATENTS TO TOTAL PATENT HOLDINGS IN 485-COMPANY UNIVERSE



Source: MSCI ESG Research, based on IPlytics Patent Data, as of Aug. 31, 2021

What is next?

A potential market-cap loss of USD 295 billion (as of Nov. 30, 2021) in a 1.5°C scenario may seem like a small number, as it equates to only 7% of all market cap in our 485-company universe. This interpretation needs some context to understand the limitations of our model considerations.

Factors that could drive the market-cap loss even higher

As illustrated in Exhibit 17, we only looked at the value-chain risk (i.e., Scope 3 transition risk) and associated costs as we adapted the MSCI ESG Research Scope 3 Emission Estimation Model to better reflect upstream emissions for food companies.

This is a crucial but only one part of the climate value-at-risk for the 485-company universe portfolio. Further analysis is needed to understand the total risk exposure. This would include looking at Scope 1 emissions (i.e., direct emissions, for example, for companies that own croplands or farms), Scope 2 emissions (i.e., risks from the companies' electricity consumption) and physical risks and how they would differ for the traditional plant-based and alternative-proteins-producing companies.

An important factor to consider here is the climate risks faced by the livestock agriculture production system from the increasing frequency and severity of climate change impacts.[50] Furthermore, livestock companies involved in factory farming already face a lot of scrutiny over animal welfare standards and face ESG-related reputational and regulatory risks.[51]

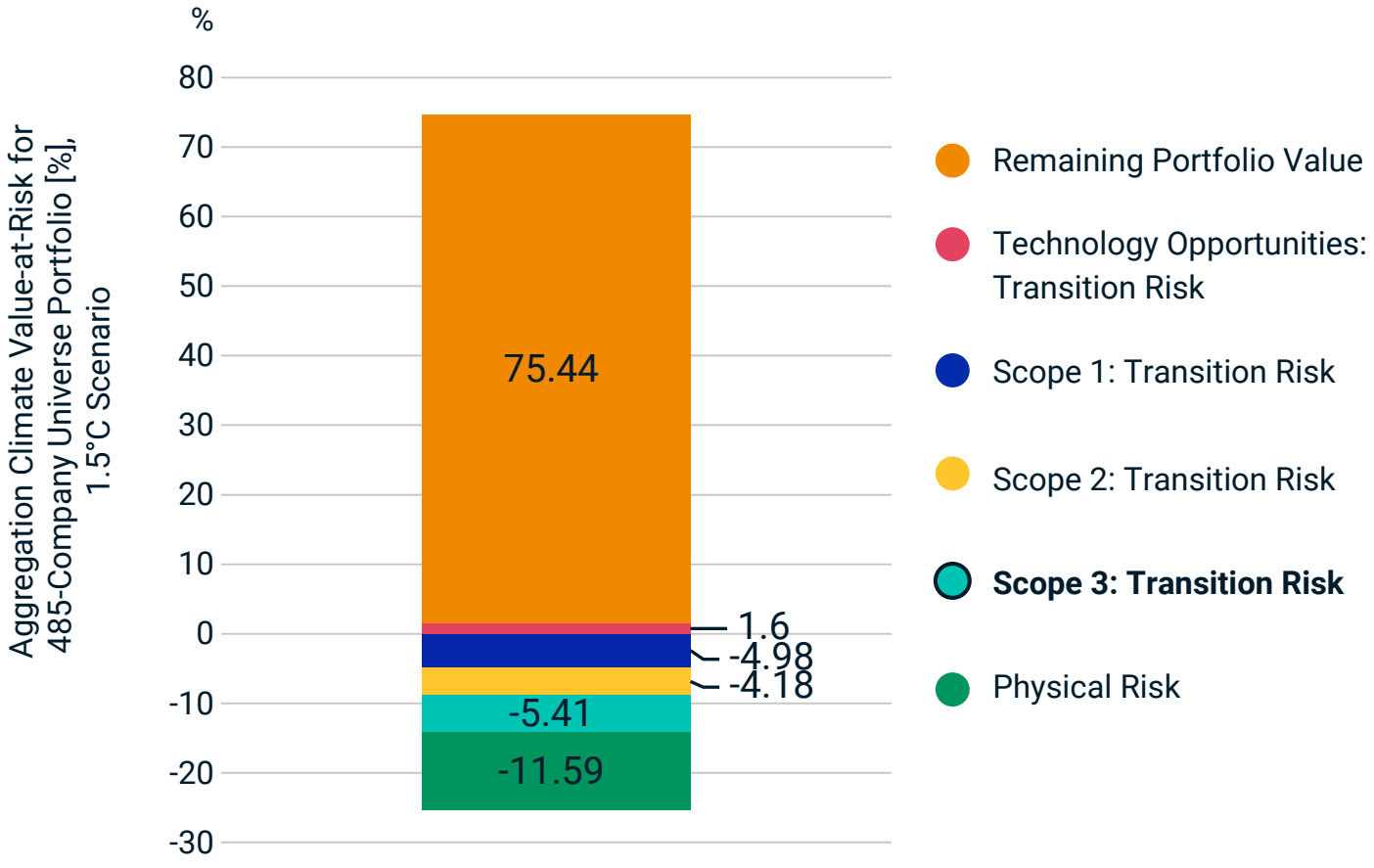
Long term, it's possible we could also see a shift in the allocation of government subsidies to favor less carbon-intensive food production systems. Should this occur, it could also negatively impact costs for intensive livestock production operations, many of which are already operating at low profit margins.[52]

50 Thornton, P.K. 2010. "Livestock production: recent trends, future prospects." Philosophical Transactions of the Royal Society B: Biological Sciences, 365(1554), pp.2853-2867.

51 FAIRR. "Factory farming: Understanding the risks and opportunities." Investor Briefing. December 2015.

52 Boston Consulting Group (BCG) and Blue Horizon (BH) 2021. "Food for Thought: The Protein Transformation."

EXHIBIT 17: CLIMATE VAR FOR 485-COMPANY UNIVERSE PORTFOLIO FOR 1.5°C SCENARIO



Source: MSCI ESG Research, as of Nov. 30, 2021

Chapter 4: Summary and Outlook

Plant-based products and their derivatives, such as traditional plant-based and alternative proteins, can act as a conduit for global food system transformation and mitigate the impact of climate change, biodiversity loss and depletion of freshwater resources. Amid growing scrutiny of the environmental and climate change impact of the livestock value-chain that produces animal proteins — leading to pressure for decarbonization — a dietary shift toward traditional plant-based and alternative proteins is also underway. As the world moves toward a low carbon economy, the technological changes that fuel price, taste and texture parity with conventional animal-based meat, egg and dairy products for alternative proteins are likely to disrupt and reconfigure the entire global food system.

Our research provided some answers to the following questions:

What are the current trends in traditional plant-based and alternative proteins?

According to our NLP analysis, plant-based proteins are gaining momentum. In particular, they are advancing in comparison with MO-based and animal cell-based proteins among the various classes of alternative proteins. Plant-based alternative-protein-related terms were the most frequently mentioned in news articles, company websites and company documents scrutinized across all GICS sub-industries within the research universe.

How widespread are traditional plant-based and alternative proteins?

Forty-six percent of the companies in our 485-company universe invested in, or generated revenue from, traditional plant-based and alternative proteins. The push is coming from companies operating downstream of the value-chain (e.g. restaurants, supermarkets), yet the upstream companies (e.g. suppliers) are disclosing most of the revenue. Our research suggested that European companies were best prepared to tap into growing demand for traditional plant-based and alternative proteins, even though corporate involvement in the sector for that region remains nascent.

What does the protein transformation imply for company valuations?

In our model, the transition risk for the six companies with the largest share of traditional plant-based and alternative proteins was 95% lower than the 485-company universe's average. This translated to at least USD 295 billion in value at risk if 1.5°C climate policies were enforced.

How are traditional plant-based and alternative-protein producers exposed to climate change transition risks, and where do they stand in alignment with net-zero targets and the SDGs?

Traditional plant-based and alternative-proteins companies were much less exposed to climate change transition risks and were much better aligned with net-zero targets than were animal agriculture-based companies. They could benefit from growth opportunities, given their engagement in development and deployment of low-carbon technologies. Such food-system innovations also could contribute to achieving multiple SDGs and, as such, could make these companies more attractive to impact-focused investors.

Engagement in the protein transformation offers opportunities to contribute to a net-zero economy. In fact, protein transformation could be a critical driver for:

- **Companies** to meet their climate targets and capture market opportunities;
- **Regulators** to address the challenges of emissions from the agricultural sector via a fair, transparent and inclusive transition;
- **Investors** to de-risk their investment in transition to a low-carbon economy by capturing the opportunities emerging in the rapidly growing alternative-protein space — across both public and private assets;
- **Countries** to deliver on their Paris commitments defined in their Nationally Determined Contributions and to engage their citizens in making impactful changes;
- **Consumers** to drive climate action, while minimizing deforestation and negative impacts on biodiversity, by choosing what to eat.

Although the food system and animal-based proteins were not discussed, the **COP26 climate summit in Glasgow** concluded with two major announcements crucial to this discourse on the protein transformation:

1. The **Glasgow Leaders' Declaration on Forests and Land Use.**[53] On Nov. 18, 2021, the European Commission followed up with a proposal for an EU Anti-Deforestation Law, which would require companies to collect geographic coordinates and monitor forest loss via satellite images caused by their sourcing of commodities to verify that they are free from deforestation. This proposed law would affect European food producers reliant on cocoa, coffee, soy, beef and palm oil.[54] If approved, this law will be enacted by 2023.
2. Second, the **Global Methane Pledge** to cut methane gas emissions by 30% by 2030.[55] Now, approximately, a third of human-caused methane emissions come from livestock production, meaning that simply shifting diets away from animal-based proteins to traditional plant-based and alternative proteins can help offset these methane emissions.[56]

53 UKCOP26. "Glasgow Leaders' Declaration on Forests and Land Use." Nov. 2, 2021.

54 European Commission. 2021. "Proposal for a regulation of the European Parliament and of the Council on the making available on the Union market as well as export from the Union of certain commodities and products associated with deforestation and forest degradation and repealing Regulation (EU) No 995/2010." Nov. 17, 2021.

55 Global Methane Pledge. "About the Global Methane Pledge" as of November 2021.

World Resources Institute. "COP26: Key outcomes from the UN climate talks in Glasgow." Nov. 17, 2021.

56 UNEP. "Methane emissions are driving climate change. Here's how to reduce them." Aug. 20, 2021.

Appendix

Appendix 1: The Net-Zero Revolution

Transition to low carbon economy

Population growth, production and consumption, technological advancements and land-use management all play a role in the transition to a net-zero economy.[57] All projections of future global GHG emission scenarios suggest that there will be an increased impact and additional stress on land, which is likely to exacerbate existing physical risks to livelihoods, biodiversity, infrastructure, food systems and terrestrial ecosystems.[58] The degree to which climate change is likely to affect daily lives hinges on the degree to which future climate change is mitigated, meaning reducing GHG emissions and maintaining a "net-zero" balance.

The pressure on businesses to adhere to the Task Force on Climate-related Financial Disclosures' (TCFD) recommendations is mounting, and companies are likely to face ever-stricter regulations and stringent public policies in their operations, with tighter GHG targets to limit global warming. As such, any regulation or policy changes could redirect the flow of investment toward greener companies and technologies that limit carbon emissions. Such a shift would affect stock and bond prices, and it presents investors with potential risks as well as opportunities.[59] Institutional investors already are focusing more and more on building greener portfolios, with overarching goals of reduced exposure to climate-transition risk.[60] Thus, many companies may be required to adjust and adapt by changing their policies and strategies to decarbonize their emissions and shift toward a greener economy. These challenges already are more pronounced in sectors such as energy, materials and utilities, and we expect the food sector to follow suit.

How can companies achieve net-zero targets?

Transition to a low-carbon economy can be achieved broadly through three distinct approaches: decarbonization, engagement and benchmarking.[61]

- In the **decarbonization** approach, companies can reach their targets by, for example, diversifying their business models from producing just animal proteins

57 Shukla, P.R., Skea, J., Calvo Buendia, E., Masson-Delmotte, V., Pörtner, H.O., Roberts, D.C., Zhai, P., Slade, R., Connors, S., Van Diemen, R. and Ferrat, M. 2019. 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.

58 Ibid.

59 MSCI ESG Research. "Climate transition and bonds: risks or opportunity?" Feb. 23, 2021.

60 Ibid.

61 MSCI ESG Research. 2021. "The role of capital in the net-zero revolution."

to ones that include traditional plant-based and alternative proteins as well.

- An example of an **engagement** approach would be members of the Farm Animal Investment Risk and Return (FAIRR) initiative, representing USD 45 trillion in assets under management, who actively engage with companies on the ESG risks and opportunities brought about by intensive livestock production.[62]
- The final approach is **benchmarking**, through which capital markets participants such as asset owners can set a benchmark that provides clarity and a roadmap to help portfolios move toward a net-zero trajectory.

Climate change metrics

MSCI's Climate VaR and Implied Temperature Rise are two climate change metrics within MSCI Net Zero Solutions that may offer actionable insights for capital markets participants into how climate change could affect company valuation and transition risks, particularly value-chain risk in the context of this report.

The financial sector is witnessing a major drive by capital markets participants for systemic transformation to achieve net-zero carbon emissions goals. New zero- and negative-carbon technologies are emerging in the market and will continue to do so. Alternative proteins are one such area in the food industry offering innovation and market growth potential for investors.[63]

Because animal agriculture and the animal-based food industry has a high carbon footprint, there is significant value at risk in each climate scenario for companies exposed to this sector.[64] Factoring the Climate VaR associated with animal-based vs. traditional plant-based and alternative proteins into company valuations is pivotal for investors looking to accurately value their portfolio as they navigate the transition to a net-zero economy.

62 FAIRR. November 2021. FAIRR.ORG.

63 Boston Consulting Group (BCG) and Blue Horizon (BH). 2021. "Food for Thought: The Protein Transformation."

64 Blue Horizon. 2020. "Environmental impacts of animal and plant-based food."

Appendix 2: Methodology

Analyst-driven evaluation of companies' involvement in traditional plant-based and alternative proteins

MSCI ESG Research relies on and supports disclosure that is made publicly available to all market participants in the interest of market transparency. To evaluate companies' involvement in traditional plant-based and alternative proteins we used publicly available corporate documentation (e.g., annual reports, investor presentations, ESG and CSR reports) as well as third-party data from news outlets or industry initiatives.[65] Revenue figures were based on data from the most recent financial reporting year available at the time of the data collection, as of July 15, 2021.

When companies did not disclose their percentage of revenue from traditional plant-based and alternative proteins, yet disclosed that they were involved in this space, through R&D, investment or product development/ commercialization, we assumed a by default 1% revenue generation (out of total sales). Although this estimate could be a conservative assumption for some companies, it is aligned with the limited level of involvement we observed even for companies disclosing such revenue information, and for which traditional plant-based and alternative proteins were not a core product.

When companies listed traditional plant-based and/or alternative-protein products as one of their core products within a specific business line, we assumed equal revenue weighting between the listed core products within that business line, unless otherwise stated.

We ensured that the disclosed or estimated revenue from traditional plant-based proteins were related to human consumption (and not to animal feed). Given that disclosure of the end-use case of protein crops widely used in animal feed, like soy, was rarely available, we only took into account in our estimates soy revenue likely to be used directly for human food products (e.g., tofu, soy milk), using global soy market data as a proxy.[66]

Scope 3 Emissions Estimation Model – A metric for carbon emissions footprinting

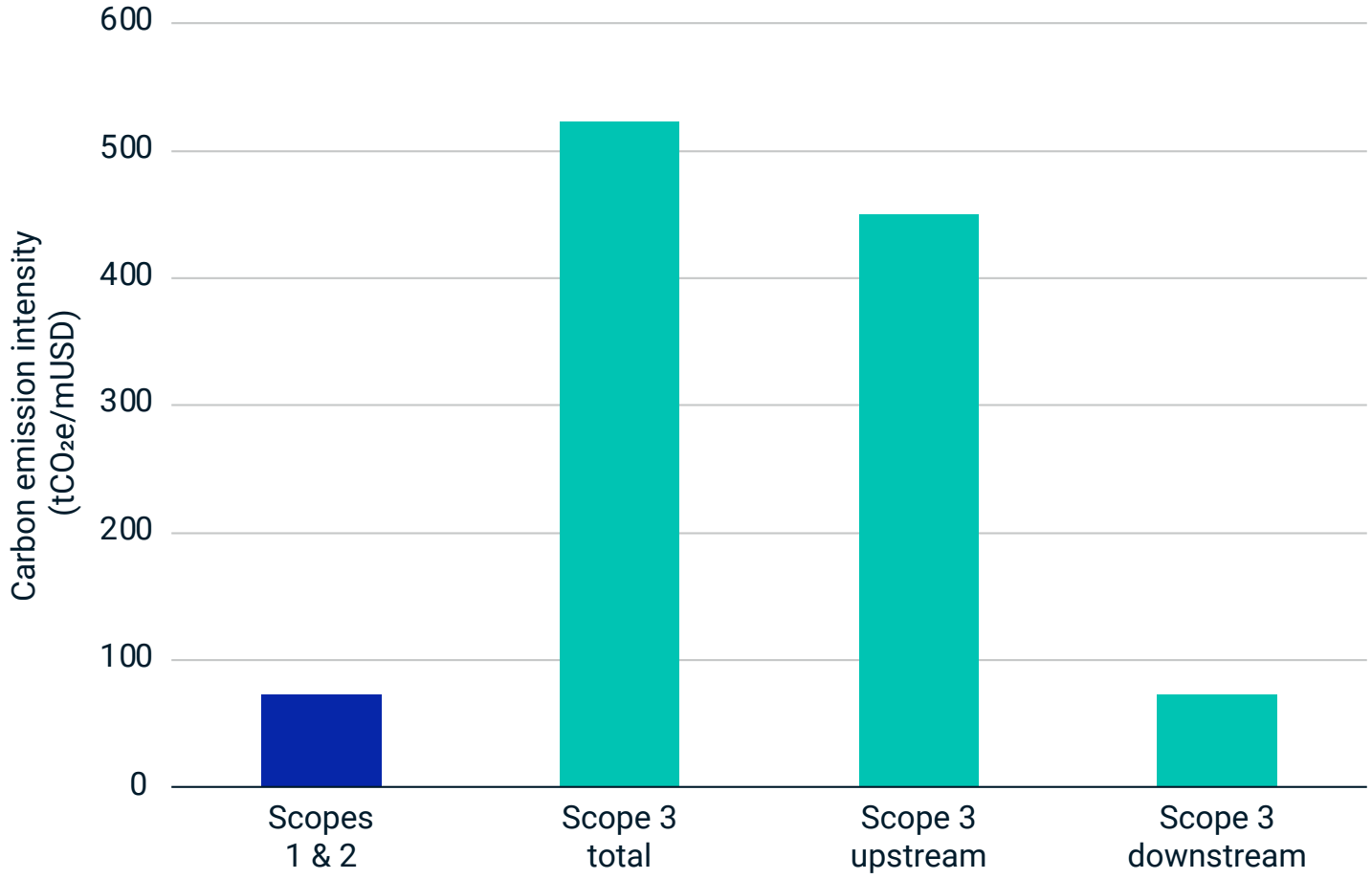
According to the GHG protocol, a global standard for carbon footprinting, companies are required to disclose three types of emissions data: Scope 1 (i.e., direct emissions such as those produced by its own factories/ vehicles), Scope 2 (i.e., indirect emissions such as electricity purchased by the businesses) and Scope 3 (i.e., those produced by suppliers upstream and by distributors downstream from their businesses — or in more simple terms, emissions that originate from the value-chain of a company).[67] These three types of emissions provide a complete assessment of all carbon emissions generated from a company's business.

65 As per definition and scope of the report described in Chapter 2 - Proteins – What are we talking about?

66 77% of global soy is used for animal feed, while most of the rest is used for biofuels, industry or vegetable oils, and only 7% is used directly for human food products such as tofu, soy milk, edamame beans, and tempeh. Hannah Ritchie and Max Roser (2021) "Forests and Deforestation." Published online at OurWorldInData.org.

67 GHG Protocol. 2013. "Corporate Value Chain (Scope 3) Accounting and Reporting Standard." World Resources Institute and World Business Council for Sustainable Development.

EXHIBIT 18: AVERAGE SCOPE 1 & 2 VS. SCOPE 3 CARBON EMISSIONS INTENSITY FOR MSCI ACWI IMI



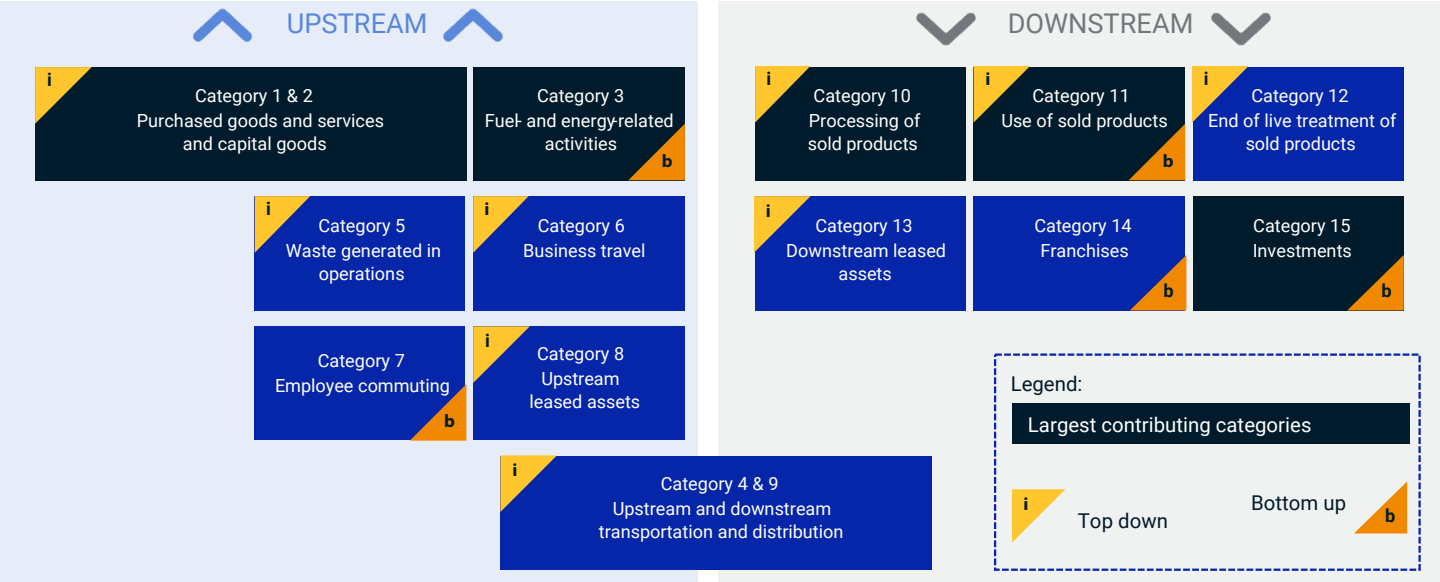
Source: MSCI ESG Research, as of Dec. 14, 2021

Weighted average carbon intensity (WACI) of the MSCI ACWI Investable Market Index (IMI) 485-company universe, as of Dec. 14, 2021. WACI measures the carbon intensity ("Scope 1 + 2 emissions"/ USD 1 million sales) for each portfolio company multiplied by its portfolio weight. Scope 3 total is the sum of Scope 3 upstream and Scope 3 downstream.

Food companies typically have moderate to low Scope 1 and 2 emissions, while Scope 3 emissions dominate their total carbon footprint. While most businesses do not disclose Scope 3 emissions, a larger portion of total GHG emissions stems from Scope 3 emissions (Exhibit 18). The challenge in climate risk and impact modeling arises from such data sparsity. Most measurements are estimates rather than real, in-situ physical measurements, which adds further complexity.

Scope 3 emissions are classified further into 15 categories, as illustrated in Exhibit 19. These 15 categories can be further grouped according to where they stand on upstream or downstream aspect of the value-chain. Most Scope 3 emissions are generated at the downstream end of the value-chain. The introduction of individual models for every category enables us to estimate emissions per category, versus simple aggregation to upstream and downstream emissions. Although not all categories apply to every company, outputs per category deliver insights into the drivers of total Scope 3 emissions across the value-chain.

EXHIBIT 19: SCOPE 3 EMISSION CATEGORIES



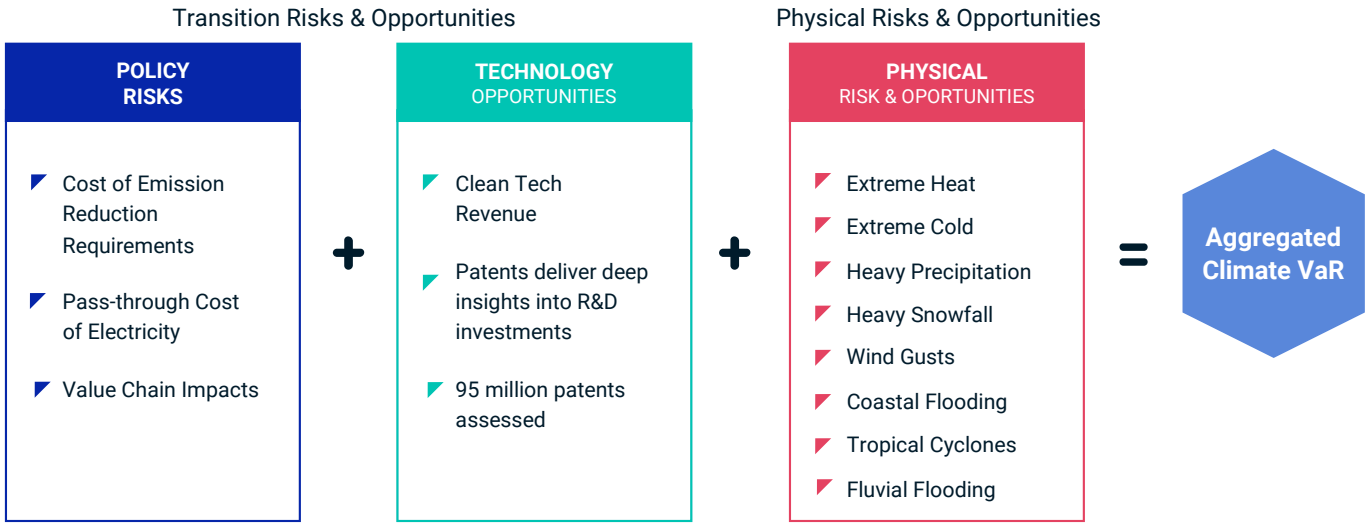
Source: MSCI ESG Research, as of August 2021

In this research, we considered a 485-company universe. Based on the market analysis presented in Chapter 2, we concluded that the emissions from the production of agricultural goods, and more specifically proteins, dominate the value-chain and were therefore the most relevant type. MSCI ESG Research's Scope 3 Emissions Estimation Model was modified accordingly to focus on the upstream part of the value-chain.

Climate Value-at-Risk (Climate VaR) Model — Assessing climate policy risk and technology opportunities

As shown in Exhibit 20, Climate VaR consists of three different parts: Policy Risks, Technology Opportunities and Physical Risks and Opportunities. In our analysis, we focused on Policy Risks and Technology Opportunities because these are the parts of Climate VaR most likely to be affected by the protein transformation. Physical Risks and Opportunities were not included, due to data constraints.

EXHIBIT 20: CLIMATE VALUE-AT-RISK MODEL BLOCK DIAGRAM



Source: MSCI ESG Research, as of August 2021

Policy Risks

As described, MSCI ESG Research analysts researched companies' revenue shares from traditional plant-based and alternative proteins. Changes in revenue distribution led to a change in Scope 3 emissions estimations used for the Policy Risk part of the model. Detailed steps of the methodology are shown in Exhibit 21 and Exhibit 22.

Technology Opportunities

The transition to a low carbon economy presents an untapped growth opportunity for companies and investors who can innovate and lead the development and deployment of key low-carbon technologies. We identified Technology Opportunities in our transition scenario analysis using MSCI ESG Research's low-carbon technology model. This model is based on estimated current low-carbon revenue as well as company-specific patent data. Using patent filings as a proxy for low-carbon innovative capacity, as well as companies' current estimated low-carbon revenue, this model provides an indicator of which companies may benefit if 3ºC-, 2ºC- or 1.5ºC-aligned climate policies are implemented on a global level.

Using estimated current low carbon revenue as a starting point, patent valuation techniques are then used to estimate the level of "future green revenue" that each company could attain from the development and sale of low carbon technologies, thus presenting an upside opportunity. In our patent data coverage, patents related to traditional plant-based and alternative proteins are not considered as green patents, so the Climate VaR results for these revenue estimates were inflated. In this analysis, we used an NLP approach to identify patents for the traditional plant-based and alternative protein sector for our 485-company universe. These newly identified patents were marked and changed to green patents in the relevant patent family of our database. The revised patent data was then provided as input to run the Climate VaR model to yield more accurate results. Detailed steps of this methodology are given in Exhibit 23.

Changes in Climate VaR

The input data changes were made in two different work streams. One focused on the Scope 3 emissions that are a key input for the Climate VaR (Policy Risks), shown in Exhibit 21. By adapting revenue and emissions factors, the Scope 3 footprint changes, influencing all downstream results that depend on these footprints.

EXHIBIT 21: STEP-BY-STEP INPUT DATA CHANGES IN SCOPE 3 EMISSIONS ESTIMATION MODEL

Model step	Description
1	Collection of revenue from traditional plant-based and alternative proteins for 485 companies by the MSCI ESG Research analyst team
2	Update of the revenue breakdown of these companies based on Step 1
3	Estimation of emissions factor for revenue in traditional plant-based and alternative proteins
4	Estimate updated Scope 3 footprints with new revenue breakdown created in Step 2 and by using the emissions factor for traditional plant-based and alternative proteins for that revenue originating from traditional plant-based and alternative proteins, using the MSCI ESG Research Scope 3 Emissions Estimation Model.
5	Use of updated Scope 3 footprints in Climate VaR

Source: MSCI ESG Research, as of Sept. 1, 2021

Following research for the proportion of revenue generated from traditional plant-based and alternative proteins, Step 3 is needed to translate this revenue into upstream carbon emissions. Using Blue Horizon's research on the environmental impacts of animal versus plant-based food, we estimated the emissions factor for revenue from traditional plant-based and alternative proteins as described in Exhibit 22 below.

EXHIBIT 22: CALCULATION OF NEW EMISSIONS FACTOR OF REVENUE FROM TRADITIONAL PLANT-BASED AND ALTERNATIVE PROTEINS

Protein source	Price [USD/kg product][68]	Emissions [t CO2/t product] [69]	Intensity [kg CO2/USD]	Market share [%][70]
Soy	13.0	0.9	0.069	70
Pea	12.5	1.0	0.080	30
Aggregated [kg/USD]				0.073

Source: MSCI ESG Research, as of Sept. 1, 2021

68 Estimates based on commonly used plant-based end products such as burgers or chicken imitations, as of 2020 and Boston Consulting Group (BCG) and Blue Horizon (BH). 2021. "Food for Thought: The Protein Transformation."

69 Blue Horizon. 2020. "Environmental impacts of animal and plant-based food."

70 Potential market share was estimated based on analysis of Boston Consulting Group (BCG) and Blue Horizon (BH). 2021. "Food for Thought: The Protein Transformation."

In the second workstream, as shown in Exhibit 23, the low-carbon patents are only used in the Climate VaR metric (Technology Opportunities). In this project, low-carbon patents tied to traditional plant-based and alternative proteins were identified and used in the model, as described:

EXHIBIT 23: STEP-BY-STEP INPUT DATA CHANGES IN TECHNOLOGY OPPORTUNITY MODEL

Model step	Description
1	Performing NLP to identify patents that shown innovation connected to traditional plant-based and alternative proteins
2	Defining the identified patents as "low-carbon" in the patent database
3	Running the Climate VaR model

Source: MSCI ESG Research, as of Sept. 1, 2021

To summarize, Climate VaR is influenced by input-data changes. By only changing the input data using the same model setups, we aim to understand what difference a specific focus on traditional plant-based and alternative proteins can have on the risk assessment for companies.

Calculation of market-cap loss and comparison of value-chain policy risks

In Chapter 3, we showed potentially avoided market-cap loss due to traditional plant-based and alternative-proteins involvement, in addition to a generally reduced value-chain risk. In this section, we elaborate how these numbers were calculated.

95% lower value-chain risk

We compared the weighted average Scope 3 Climate VaR (by market capitalization) of the 485-company universe and the six companies with the largest percentage of revenue share from traditional plant-based and alternative proteins under the 1.5°C climate scenario. The resulting values are shown in Exhibit 24.

EXHIBIT 24: CALCULATION OF VALUE-CHAIN POLICY RISKS (SCOPE 3: TRANSITION RISK)

Weighted average Scope 3 Climate VaR 1.5°C Scenario (AIM CGE) [%] as of Nov. 30, 2021		Difference [%]
Sample set of 6 companies	**485 companies**	**Difference**
-0.25	-5.41	95.34%

Source: MSCI ESG Research, as of Nov. 30, 2021

It is important to note here that food companies usually have higher footprints in the upstream, or supplier end, of their value-chains. However, this is not always the case. Some integrated companies also have high carbon-emission footprints in their Scope 1 because they own farms and croplands. So if such companies reduce only their Scope 3 value-chain carbon footprint, their exposure to higher carbon prices or a low carbon transition forced by regulators would still be large.

Calculation of potential market-cap losses

For this calculation, we assumed that the 485-company universe had the same value-chain climate risk as the six companies (market cap weighted-average value-chain Climate VaR of the six companies was -0.25%, as of Nov. 30, 2021).

We then computed the discounted costs (DC) that would match a risk of -0.25% for the entire 485-company universe, based on the following formula:

$$DC_{as\ 6\ \text{companies}} = Climate\ VaR_{as\ 6\ \text{companies}} * \left(market - cap_{company} + debt_{company} \right)$$

If we compute the costs for all companies in the 485-company universe as if their value-chain Climate VaR were -0.25%, we assume that all companies have the same value-chain risks as the average sample set of six companies.

We summed the discounted costs for the value-chain Climate VaR for both the six companies and the total universe, and compared them. The difference in the sum of discounted costs can be interpreted as potentially avoided market-cap loss if the entire universe had the same value-chain risk as the six companies.

Thus, for the 1.5°C scenario, this difference equals USD 295 billion.

$$\begin{aligned} &Avoided\ market - cap\ loss \\ &= \sum_{company}^{485\ companies} DC\ Scope\ 3_{company} \\ &- \sum_{company}^{485\ companies} DC\ \left(as\ 6\ companies \right)\ Scope\ 3_{company} \end{aligned}$$

Disclosures

Paid Research

MSCI ESG Research received compensation from Blue Horizon Corporation AG (together with its subsidiaries "Blue Horizon") to produce this and related research pursuant to a written agreement between the two parties. Blue Horizon also contributed data, research and editorial input to this research.

Holdings Disclosure

Blue Horizon is an impact investor in the sustainable food industry focusing on biology, agriculture, and technology – sectors covered in this research. With respect to the report on The Protein Transformation: A Critical Driver of the Net-Zero Economy, dated Jan. 18, 2022 (the "Report"), and in particular the following companies mentioned in the Report:

1. Beyond Meat Inc.
2. Select Harvests Ltd
3. Jonjee Hi-Tech Industrial and Commercial Holding Co. Ltd
4. Chacha Food Co. Ltd
5. Qianhe Condiment and Food Co. Ltd
6. Foshan Haitian Flavouring and Food Co. Ltd
7. Campbell Soup Co
8. Kameda Seika Co.Ltd.
9. The Kroger Co.
10. Showa Sangyo Co., Ltd.
11. Nestle S.A.
12. Nongshim Co., Ltd.
13. Daesang Corp
14. Danone S.A,
15. Dongwon F & B Co.,Ltd
16. Tate & Lyle PLC
17. Maple Leaf
18. Ingredion
19. Compass

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(b) No other Blue Horizon employees directly involved in the Report (being Bjoern Witte, Robert Boer, Friederike Grosse-Holz and Olivia Stolt-Nielsen Meinl) or their immediate family members hold or have traded in any shares in any of the Companies since May 31, 2021.

(c) Neither Blue Horizon Corporation AG nor any of its subsidiaries (together "Blue Horizon") hold any shares in any of the Companies nor have they been invested in any of the Companies, with the exception of Beyond Meat Inc., which was fully exited by Blue Horizon on Oct. 29, 2019;

(d) Neither Blue Horizon nor any Blue Horizon employees hold any board seats in any of the Companies.

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About Blue Horizon

Blue Horizon is accelerating the transition to a New Sustainable Food System that delivers outstanding returns for investors and the planet. As a pure-play impact investor, Blue Horizon has shaped the growth of the alternative protein and food tech market. The company invests at the intersection of biology, agriculture and technology, with the aim of transforming the global food industry. Blue Horizon was founded by Roger Lienhard in 2016 and is based in Zurich. To date, the company has raised over USD 850 million and invested in more than 50 companies. Its business model offers an attractive opportunity to invest in the evolution of the global food system while contributing to a healthy and sustainable world.

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