

# Bull Market?

## Corporate Venturing and Alternative Proteins

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## Executive Summary

Food systems account for as much as one-third of all anthropogenic greenhouse gas emissions. The single most impactful way in which these emissions could be reduced is by decreasing the proportion of protein in our diets that is derived from animal proteins, in favour of alternative protein sources. Increasing consumer awareness and rising demand for meat and dairy analogues has supported the fast growth of the 'alternative proteins' sector, which has been underpinned by innovation in plant-based and cell-based technologies.

In this paper, we explore the emerging role of established food companies as investors and drivers of alternative protein innovation. Corporate investment is becoming a significant source of capital funding to the sector, and by analysing the disclosures from an index of established food companies, we attempt to develop a systematic basis for understanding how corporate venturing in the alternative proteins sector may influence progress towards a net-zero emissions trajectory.

We hypothesise that with a credible route to market - a core element of the corporate venturing proposition - meat and dairy analogues that look the same, taste the same and cost the same (or less) as the 'real thing' could transform the protein mix in human and animal diets within a single generation.

To help test this hypothesis we are building a dynamic, longitudinal, searchable and open-source record of corporate venturing in alternative proteins. Our ambitions extend to including interviews with key informants in order to better understand strategic objectives and the motivations behind decisions made. Creating such a layered dataset could, we hope, yield richer insights to inform future scholarship. A preliminary version of the database will be publicly accessible later in 2021.

## Introduction

Fundamental changes in global food systems are necessary if 'net zero' emissions are to be achieved. Food systems account for 21-37% of all anthropogenic greenhouse gas emissions (IPCC 2019) when pre- and post-production activities are included. The majority of carbon emissions associated with food and agriculture are not derived from the burning of fossil fuels (Vermeulen et al 2012), but rather from the impact on natural habitats, the manufacturing and use of fertiliser products, and emissions from ruminant livestock. Even in a scenario where all fossil fuel emissions immediately ceased, food system emissions under business as usual would prevent attempts to limit average global warming to 1.5°C and could threaten a 2°C climate target (Clark et al 2020).

Opportunities for reducing food system emissions include improved farming practices, conserving natural habitats and reducing waste (Garnett 2011), but the single most impactful intervention is to decrease the proportion of protein in our diets that is derived from animal sources (Clark et al 2020). Meat and dairy are responsible for 60% of agricultural greenhouse gas emissions and 14.5% of total anthropogenic GHGs, despite providing only 18% of calories and 37% of protein globally (Gerber et al 2013, Poore and Nemecek 2018). Whilst there are a range of production-side mitigation measures that can reduce the emissions profile of livestock products - including feed additives and reformulation, improved feedstock yields, modifications to feeding and grazing practices, and manure management (Hristov et al 2013) - the impact of these measures is small compared to increasing the proportion of protein that is sourced from plants, rather than animals (Springmann et al 2018, Bajželj 2014, Poore and Nemecek 2018).

On average, producing 100g of protein from beef emits 25kg of CO<sub>2</sub>e. Cheese, pork and poultry emit 8.4, 6.5 and 4.3kg respectively. By comparison, tofu, beans and peas emit 1.6, 0.7 and 0.4kg of CO<sub>2</sub>e per 100g protein (Poore and Nemecek 2018). A range of scenario-based studies imply that even modest increases in the proportion of protein derived from plant-based sources in the average UK diet could make a significant contribution to the target of net-zero emissions by 2050. If land previously used for grazing or feed crop production were ecologically restored, the benefits of meat and dairy reduction would be further increased through carbon sequestration.

## Prospects of a protein transition

The most significant climate impact would come from a rapid and widespread transition from animal proteins to plant-based wholefoods, but there are, of course, many economic, social

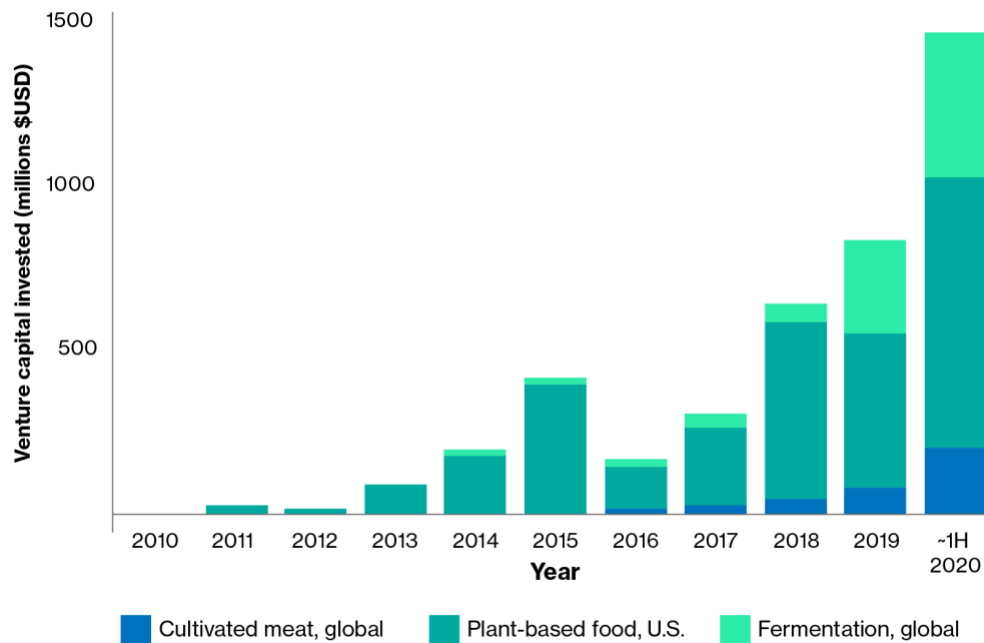


and cultural barriers to this (Sexton et al 2019, Stubbs et al 2018, Stoll-Kleemann & O’Riordan 2015). Meaningful change from the current status quo will likely require political and economic action and the shifting of norms through systemic and cultural interventions (Rust et al 2020). Amongst these interventions, innovation in the production of ‘alternative’ proteins that resemble and replace animal foods will be a key catalyst in driving behavioural change, offering ‘sustainability by stealth’ (Bakker & Dagevos 2012). Alternative proteins include analogue products made using plant protein concentrates or isolates, alongside the emerging technology of cell-based agriculture, which uses animal cells to produce molecularly-identical edible tissue in vitro. Products from cellular agriculture are still largely in development but are benefiting from falling cost profiles and regulatory support. In addition, novel precision fermentation technologies promise to mass-produce molecules on demand that can mimic important functions of meat and dairy when included in manufactured products.

The alternative protein sector is growing rapidly, driven by increasing consumer awareness of health, welfare and environmental issues around animal protein, and a positive market response to new alternative protein products offering better taste and texture (Nielson 2019, Simpson & Lee 2016, Dagevos & Voordouw 2013). This is particularly evident in North America, Europe and Israel. Sales of ‘plant-based meat’ in the US market exceeded US\$1bn in 2020 (210 Analytics 2020), with growth accelerating sharply during the Covid-19 pandemic. While the segment still only represents around 1% of overall US meat sales, plant-based milks, which now account for 14% of all US milk sales (Good Food Institute 2019), offer a precedent for growth of share. China is also a billion-dollar market, with US\$910m sales of plant-based meat in 2018 and segment growth of 14% annually (Good Food Institute 2018). Globally, the proportion of protein derived from animal products is still increasing, as rising incomes in the global South drive a dietary transition towards the higher meat and dairy consumption evidenced in industrialised countries (Tilman & Clark 2014). However, despite this, the meat alternatives sector is growing at double the rate of the meat and poultry market (Joseph et al 2020).

Providers of risk capital are beginning to respond to the opportunity, with investments in alternative protein start-ups exceeding US\$1.5bn in the first seven months of 2020 (GFI 2020b). Although relatively small in quantum to other new economy sectors such as electric vehicles, growth has been rapid from a standing start less than a decade ago (Figure 1). Investment has historically focused on plant-based protein companies, although in the past two years, fermentation and cultivated meat start-ups have also attracted a material share of funding.

**Figure 1. Venture capital trends in alternative proteins**



Source: Good Food Institute

In this paper, we focus on the role of food companies as investors and drivers of alternative protein innovation. Separate to venture capital, corporate investments are a significant source of funding for alternative protein start-ups. Long-term data compiled by the Good Food Institute (GFI) identify corporates as accounting for 17% of investment in plant-based proteins, behind venture capital (33%) but in line with angel investment (GFI 2020a). Alongside investment and acquisition, established food companies are also increasingly driving ‘open innovation’ activities around alternative proteins, including accelerators, incubators and research programmes. As seen in other industries such as renewable energy, the nature and impact of corporate venturing in the food system has the potential to be fundamental to the growth of alternative proteins and their contribution to net-zero emissions targets. Yet, corporate venturing activity in this sector is not well explored in the literature. Specifically, there has been little systematic analysis about the extent of this activity, the strategies being deployed, or the motivations behind them. As a precursor to a broader programme of research, this paper aims to provide an introductory overview of corporate venturing and open innovation activity by major food companies around alternative proteins, in order to set out various initiatives in play and highlight some of the research questions that they prompt.

## Approach

By analysing the disclosures of established food companies across the value chain, we aim to describe and classify the activities related to alternative proteins that these companies are engaged in. Overall, the ambition is to provide a systematic basis to understand how corporate venturing in the alternative proteins sector may influence progress towards a net-zero emissions trajectory. In defining an appropriate universe for analysis, we reviewed various lists of companies, including the MSCI ACWI Agriculture and Food Chain index, before focusing on the Collier FAIRR Company Universe.<sup>1</sup> FAIRR is an investor-facing membership organisation that produces research and rankings of companies in protein supply chains based on a range of criteria including ESG performance, climate-related risk, and the extent of their pro-active engagement with alternative proteins. We build on FAIRR's insights by further exploring - to the extent that detailed data is accessible - the corporate venturing activities of a subset of companies in this index.

The 106 listed companies in the FAIRR universe include seafood, meat, and dairy producers and processors, as well as branded food companies, retailers and foodservice businesses. We focus exclusively on public listed companies as disclosure is generally higher; although this means that some significant privately held food and agriculture companies are not included in the present analysis. Commodity trading companies are also not included. The companies are headquartered in 29 countries, including the USA (26%), China (12%) and the UK (11%). The FAIRR universe is broadly comparable to the MSCI ACWI Agriculture and Food Chain in terms of sub-sectors and geographies.

The companies in the FAIRR universe were categorised according to: their role(s) in the value chain; the key animal proteins involved in their business; and their level of exposure to animal proteins - medium (animal proteins are important across some of the company's key revenue areas, e.g. a fast food restaurant or packaged foods manufacturer); or high (animal proteins constitute the main revenue stream for the company, e.g. a company engaged in breeding and rearing of livestock). The disclosures for each company were then systematically reviewed to identify corporate venturing activities relating to alternative proteins. In order to assess the level of companies' involvement in alternative proteins more broadly, we also looked for evidence of new product launches. The method used involved searching the three most recent annual reports (as of October 2020) and the most recent sustainability report for each company using a series of search terms to identify relevant

<sup>1</sup> <https://www.fairr.org/research/fairr-company-universe/>

mentions. In parallel, a Google search was run on each company using some of these terms, and the first two pages of results were recorded. Search terms were optimised to identify each company's engagement in the alternative protein sector across a range of activities.

## Results

Our analysis highlights product launches, acquisitions, corporate venturing, and incubation activity relating to alternative proteins across the FAIRR universe of companies, over the review period (2016-2020). Overall, the results show that established food companies are increasingly responding to demand trends by raising the scope and scale of their activities across the alternative protein sector. Notably, there has been a significant expansion over the last four years in the range of new product launches. Forty companies (38% of the universe) have launched a new product in the alternative protein category, with the majority being plant-based meat and dairy analogues. It is increasingly the norm for consumer outlets to offer plant-based analogues as an alternative to meat or dairy products, with 50% of foodservice operators and 75% of retailers in the company universe launching new alternative protein lines. Alongside new products, changing consumer preferences have driven product reformulations such as Unilever's vegan Magnum and Cornetto ice creams, and plant-based foaming coffee mixes from Nestle. Even some companies that have traditionally focused exclusively or almost exclusively on animal products, such as Brazil-based JBS, the largest meat processing company in the world, and China's WH Group, the world's largest pork processor, now offer plant-based alternatives amongst their products.

There has also been a spike in acquisitions of alternative protein businesses, with six large food companies concluding a total of nine acquisitions: five acquisitions in plant-based meats, two in plant-based dairy and two in protein processing and ingredients. In general, acquisitions have enabled companies to rapidly take a share of the plant-based market by purchasing brands with an established presence. As an example from our study, Canadian packaged meats company Maple Leaf Foods acquired two mature companies - Lightlife (est. 1979) for \$140m and Field Roast Foods (est. 1997) for \$120m - giving it out-of-the box coverage in meat analogue products across the US and Canada. The acquiring companies are all manufacturers of consumer branded food products, and two are also active in the farming and processing sectors. Four of the companies have launched new products in addition to their acquisitions. Further details are included in Appendix 2.

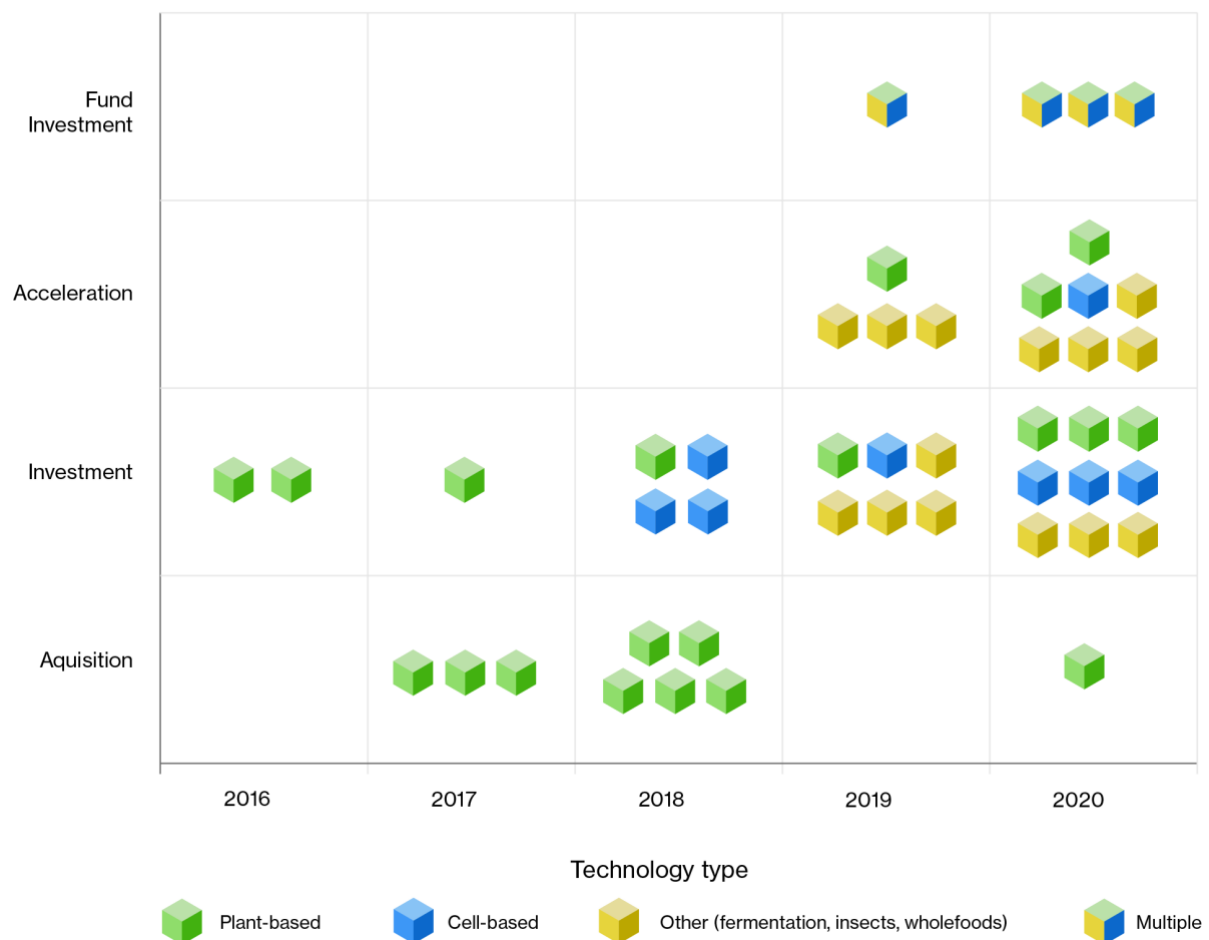
From a near standing start in 2015 there has been a significant upturn in corporate venturing and incubation, with 13 companies making investments in alternative protein start-ups or funds. This is shown in Figure 2, with details provided in Appendix 1. These companies



made a total of 29 capital commitments, including direct and indirect investments in start-up companies and investment in external venture capital funds targeting alternative proteins. In all cases companies target a minority stake in the start-ups. The overall value of investments made by the corporates is not known as most are not publicly disclosed (those that are public have been between \$2m and \$5m), but data on the distribution of investment round size at the time of the corporate investment suggests that earlier stage companies are favoured.

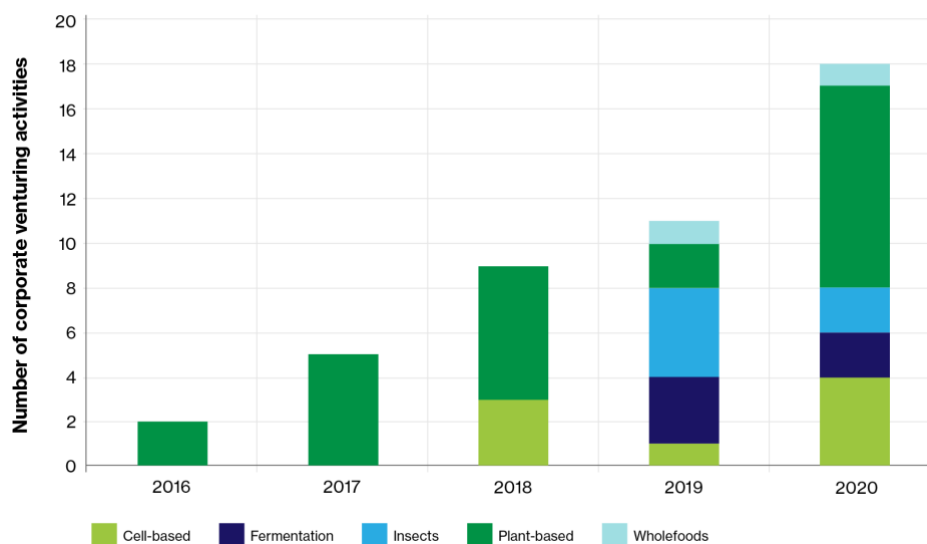
A further 12 seed stage alternative protein start-ups have been supported through two accelerator programmes in which the companies are sole or founding partners. Both of the companies engaging with start-ups through accelerators have also made financial investments. In total, including acquisitions, there were some 50 distinct interactions between 18 corporate players in the food system, 38 alternative protein enterprises, and three alternative protein investment funds.

**Figure 2. Corporate interactions in alternative proteins by activity and type**



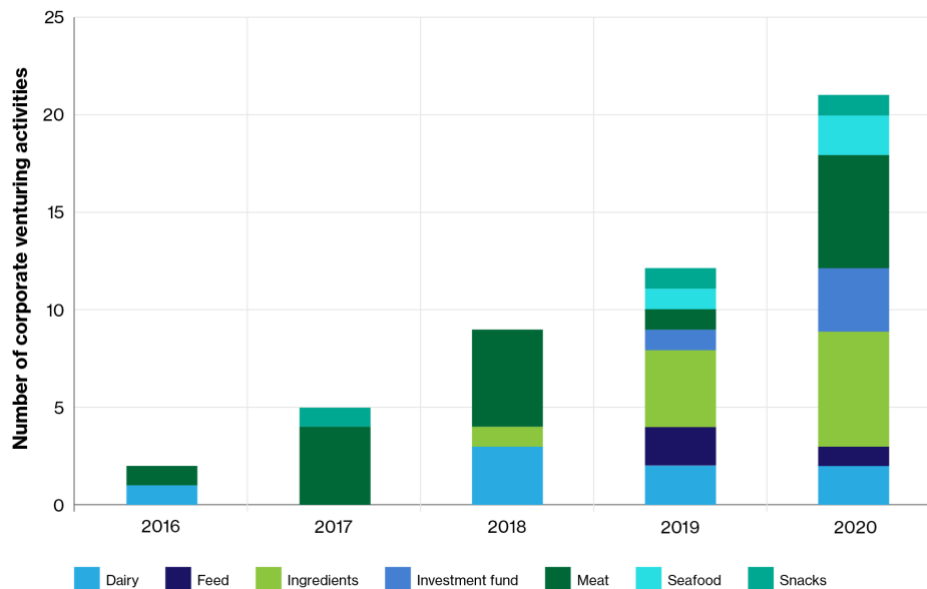
As the number of interactions between corporates and emerging alternative protein enterprises has grown, so too has the diversity of technologies involved (see Figure 3). Whilst in 2016 and 2017, corporate investments focused solely on plant-based proteins, this has branched out into cellular agriculture and precision fermentation as these technologies become increasingly developed and their potential applications explored. Whilst investment in plant-based meat and dairy has come from a wide range of corporates including manufacturers with a diversified product base, interest in cellular agriculture and fermentation has come particularly from companies with a high exposure to animal proteins. Fonterra Group, the world's largest dairy exporter, for example, has invested in Motif Foodworks, whose technologies promise to replicate the lipid molecules found in animal dairy through precision fermentation.

**Figure 3. Corporate venturing activities by technology**



The range of products being produced by start-ups invested in by corporates has also diversified (Figure 4). Whilst consumer-facing meat and dairy analogue products predominated until 2018, since then there has been increasing interest in the development of novel ingredients as it becomes clearer that this may be one of the key factors in improving organoleptic and nutritional properties of future alternative protein products. Developments in this space include, for example, producing cultured fats for inclusion in plant-based meat formulations. Blended products and seafood analogues are emerging categories, and there is also growing interest in alternative proteins for livestock feed.

Figure 4. Corporate venturing activities by product type



## Discussion

### A framework for alternative protein engagement strategies

The activities described above can be classified across a spectrum of internal to external orientation from the perspective of the investor companies. The array of new product launches and proprietary product innovations are, alongside acquisitions, both activities designed to bring new capacity within the *internal* operational scope of the parent business. In this paper, however, we have also identified an incipient but pronounced trend of *external* corporate engagement between ‘big food’ and alternative protein start-ups, through a range of corporate venturing activity. In our current universe these outward facing activities involve relatively fewer companies than new product launches. However, while transaction values are also much lower than observed in traditional M&A, corporate venturing in alternative proteins is growing rapidly (see Figure 2) and involves an increasing number of players representing some of the largest food producers and manufacturers in the world.

The most common vehicle for these external engagements is indirect equity investment via a semi-independent corporate venturing arm (e.g. General Mills’ 301 Inc. or Nestlé’s Inventages). These vehicles allow interactions to expose corporate staff to new innovations and thinking, and potentially give the larger company an early ‘option’ on accessing or purchasing new technologies or products at a later date (Chesbrough 2002). Some companies opt for an arms-length approach by investing in external venture capital funds - a low-risk, passive strategy giving would-be venturers a window on emerging opportunities,

and potential future access to dealflow (Reimsbach & Hauschild 2012, Markham et al 2005). Direct investments from a company's balance sheet are often more explicitly linked to technology transfer or collaboration (Covin & Miles 2002). In our dataset this is evident with Swiss meat company Bell Foods, which has made two direct investments totalling \$7m in pioneer cellular agriculture company Mosa Meats with the aim to "secure direct access to a technology with significant future potential." Additionally, two companies in our universe run corporate accelerators (with others engaging as partners in third party accelerators), which usually carry no immediate financial return but facilitate the transfer of knowledge and act as potential pipeline for future investments and acquisitions (Kohler 2016).

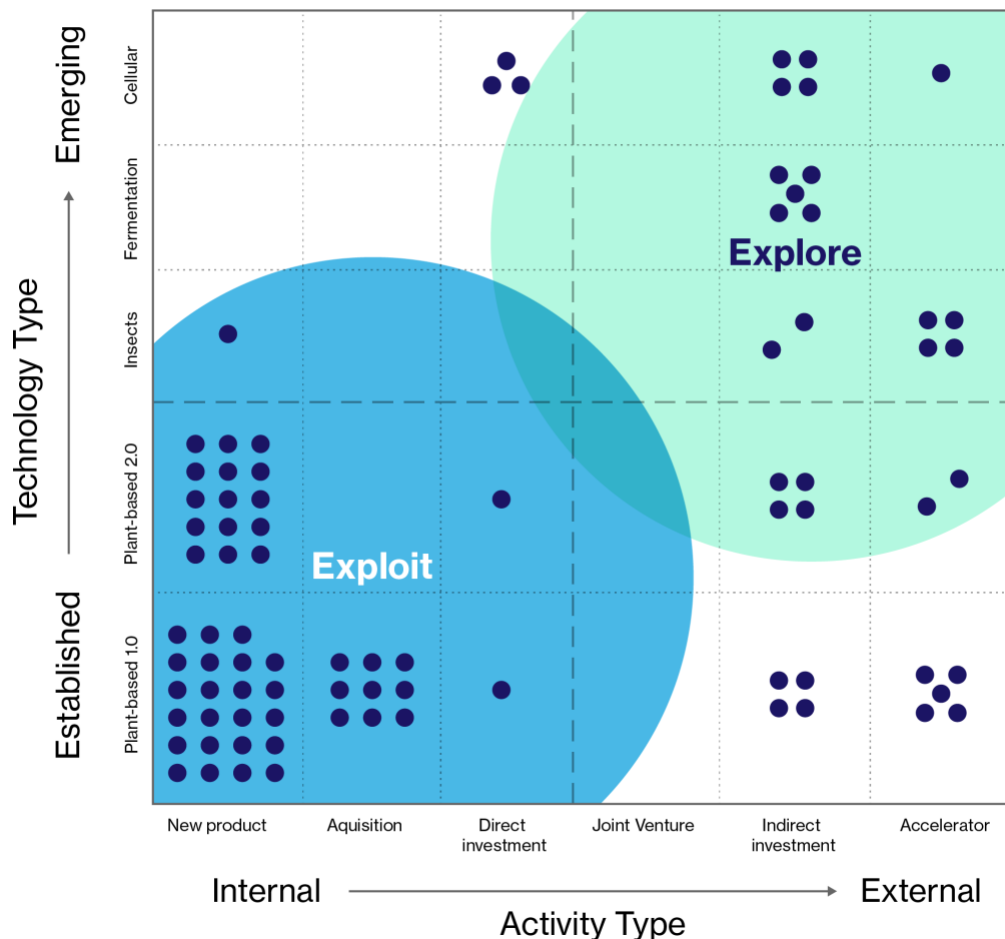
### **Established and emerging technologies**

Technology type provides a second axis of differentiation. Many of the new lines being launched internally by businesses rely on decades-old meat analogue production technologies, albeit increasingly incorporating proteins from a wider range of plant sources, and with reduced use of highly processed ingredients. However, a new wave of technological innovation around alternative proteins is also underway, and largely taking place at a remove from the operations of established 'big food' companies. These innovations include cellular agriculture, and precision fermentation, an emerging technology to produce molecules that can more accurately mimic the taste and other qualities of meat and dairy products. Emerging companies working on the next generation of plant-based products, too, are clear in their ambition to harness research and technology to produce plant-based meat that should be indistinguishable from the 'real thing' (such as using genetically engineered soy leghemoglobin to replicate the taste of meat). With rising consumer awareness of the impacts of animal products and demand for alternatives, it is the promise of the 'full consumer experience' of meat and dairy products that some incumbent protein producing companies see as a potential transformational opportunity.

In Figure 5, we have mapped the spectrum of internal vs. external orientation against the degree to which the technologies in play are established or emerging. Despite the relative paucity of data from this initial study, some patterns emerge. Internally focused activities are oriented around more established manufacturing processes such as extrusion techniques using conventional plant-based protein concentrates and isolates like soy or wheat ('plant-based 1.0'). Increasingly, these internal activities also touch on current innovations in the plant-based space ('plant-based 2.0') such as the development of previously under-represented products such as seafood, novel plant sources, new methods of protein isolation and functionalization, new formulations and ingredients, and new manufacturing techniques. Meanwhile, externally facing open innovation initiatives take in a wider spread, from plant-

based 1.0 and 2.0, all the way up through more novel technologies and approaches, such as insect protein, fermentation and cultivated meat.

**Figure 5. Alternative protein engagement strategies**



These data broadly follow a cross-industry pattern of corporate venturing activities described by Gutmann (2019). Lower risk, more established technologies and product types are associated with higher-commitment corporate activities focused on realising commercial potential in the market ('Exploit'). Meanwhile, new but promising avenues elicit a lighter-touch open innovation scoping approach ('Explore'). At the centre of the diagram, joint ventures and direct investments are boundary-crossing activities that may typically be used to bridge higher risk opportunities into more commercially exploitable activities.

We propose that evaluating 'Exploit' and 'Explore' strategies across activity and technology types in the alternative protein sector is crucially important to understanding the role that corporate venturing could play in decreasing the proportion of protein in our diets that is derived from animal sources. Meat and dairy are responsible for 60% of agricultural



greenhouse gas emissions and 14.5% of total anthropogenic GHGs. If corporate activities can play a role in allowing meat and dairy analogues to capture meaningful market share, there are potentially transformative implications for achieving net-zero emissions, consistent with improved sustainable development outcomes.

### **The power of incumbency**

Corporate venturing is not, of course, the sole (or even the largest) source of capital investment available to fledgling alternative protein ventures. But when it comes to disrupting the oldest and biggest consumer market on the planet – food – incumbency matters. Established food companies have the financial and human capacity, production capability, brand identity and distribution density to scale early-stage ventures from lab experiments to globally available products. They provide that competitive advantage most desired by venture capital firms in prospective investments – a credible route to market.

Equally, incumbents frequently eschew disruption in favour of the status quo. Many will view consumer habits around meat and dairy consumption as ingrained and hard to shift. Upstream, global food systems are characterised by complex and multi-layered supply chains employing millions of people – creating inertia towards step change. Finally, as long as the true costs of the food system are not financially integrated through policy or other interventions, the environmental costs of food production will continue to be socialised whilst the economic benefit is privatised – a classic negative externality that softens the impetus for transformation. It seems safe to assume that while many established companies will regard alternative proteins as an economic and financial opportunity, many others will consider it a threat to their existing and profitable businesses. Still others – perhaps the majority of food companies – will likely be agnostic, with insufficient knowledge of the sector to make a determination.

What implications, if any, does this have for corporate venturing? It is fanciful to predict that incumbents could exert a fundamental and permanent malign influence on the sector: big food is no more likely to prevent the development of alternative proteins than big oil prevented the development of alternative energy. But the analogy is perhaps inexact. Even under the most ambitious scenarios, entirely removing the world's reliance on fossil fuels as a source of energy is a challenge to be addressed across a multi-generational timeframe, for socio-technical reasons that are well rehearsed elsewhere in the literature. But consider the potential for meat and dairy analogues that look the same, feel the same, taste the same and cost the same (or less) as the 'real thing'. With a credible route to market – a core element of

the corporate venturing proposition – we argue that the protein mix in human and animal diets could change markedly within a single generation.

### **Momentum for transformation**

Anecdotal evidence of this potential for transformation is not difficult to find. Although our own study did not feature any significant joint ventures, there have been two significant announcements in the first month of 2021 alone. On January 25th PepsiCo and Beyond Meat announced The PLANeT Partnership, a joint venture to develop, produce and market snack and beverage products made from plant-based protein. In the accompanying press release, the companies announced that, “through the venture, Beyond Meat will leverage its leading technology in plant-based protein development. Meanwhile, PepsiCo will deploy its marketing and commercial capabilities to create and scale new product offerings.” The language of the press release is striking in that it conveys an equivalence that belies the fact that PepsiCo’s business is currently over 200 times the size of its partner.

Meanwhile earlier in the month, the feed additives business Adisseo announced a joint venture with Calysta, a biotech company that ferments natural gas to make food products. The joint venture, called ‘Calysseo’ will build what is expected to be the world’s first commercial-scale aquafeed production facility using single-cell protein. Operating from China, the facility will serve Asia, the world’s largest aquafeed market. This transaction serves to emphasise the point, sometimes lost in the narrative, of the transformational potential of alternative proteins not just for direct human consumption, but also across the food chain.

Corporate venturing is likely to accelerate across activity types and technology types. Left to market forces, the opportunities to disrupt and scale will become progressively evident as information asymmetries are lowered, research advances and partnerships emerge. In terms of scholarly enquiry, if nothing more were at stake than the natural evolution of an industry, then the growth of alternative proteins would likely remain a special interest topic. But its transformative potential in addressing the challenges of climate change, biodiversity loss and linked environmental dimensions, underpins our conviction that the subject will rapidly move from the relative margins of academic enquiry to occupy a more central stage.

Amongst companies, momentum for transformation is increasingly being driven by the twin motivations of profit and purpose. For example, Canadian meat processor Maple Leaf Foods

has framed its acquisitions of plant-based food companies as part of its ambition to be “the most sustainable protein company on earth.”<sup>2</sup> While initiatives such as science-based targets are becoming better established, few companies are yet to make firm commitments in the area of food systems sustainability. However, more are expected to do so as pressure to disclose and reduce supply chain greenhouse gas emissions intensifies. The UK-based retailer Tesco has set a target to increase sales of plant-based products 300% by 2025,<sup>3</sup> while Nestle’s Net Zero Roadmap has the explicit aim of “shifting toward more sustainable alternative ingredients like plant-based foods” in order to cut 1.4m tonnes of CO<sub>2</sub>e from its footprint by 2030.<sup>4</sup> Until such narratives are pervasive across the food industry, our focus is on stimulating further research in this area, and this underpins our call to action.

## Conclusion

### Our call to action

Our call is for interdisciplinary research on the development of corporate venturing in the alternative proteins sector. Interdisciplinarity is necessary to integrate knowledge variously produced across life science, climate science, social science and adjacent fields. Research outputs that are disseminated effectively across enterprise, finance and policy audiences will accelerate the removal of information asymmetries and could engage several sensitive intervention points and amplification systems to advance climate change mitigation (Farmer et al., 2019). Within enterprise, this may help to replace corporate agnosticism with corporate purpose. In finance, better information should improve decision making, helping to mobilise the capital that is necessary for rapid, scalar transformation. And for policymakers an evidence base is necessary to underpin what may be difficult political decisions around the reconfiguration of entrenched food systems.

In short, there is a knowledge gap, and an opportunity for research-intensive applied outputs to bridge that gap. This study is a preliminary, and (given the sample size) rather cursory attempt to highlight the momentum that is building around corporate venturing in the alternative proteins sector.

We conclude by outlining our direction for future work. We believe that the current low visibility and lack of systematic data around corporate transactions in the alternative proteins

<sup>2</sup> <https://www.mapleleaffoods.com/news/maple-leaf-foods-closes-acquisition-of-field-roast-grain-meat-co/>

<sup>3</sup> <https://www.tescopl.com/news/2020/tesco-commits-to-300-sales-increase-in-meat-alternatives/>

<sup>4</sup> <https://www.nestle.com/csv/global-initiatives/zero-environmental-impact/climate-change-net-zero-roadmap>

sector belies the potential importance of these developments and ultimately impedes the rate of progress towards a net zero emissions trajectory. The leading initiative in this space, FAIRR, upon whose work this paper builds, currently provides the investor risk oriented Protein Producer Index, alongside the Sustainable Proteins Hub, which covers protein diversification strategies of 25 manufacturers and retailers. Neither index provides a high-resolution window on all corporate venturing activities for a full range of key food industry players. It may be that there are commercial databases that carry this information in a systematic and searchable format, but neither did we encounter these, nor were we alerted to their existence when consulting industry experts.

We therefore conclude that the construction of such a database would fulfil a key knowledge requirement in supporting the acceleration of a sustainable protein transition. The database would record the details available by type of activity (new product launches, acquisitions, joint ventures, direct and indirect investments, accelerators etc.) and by type of technology (plant-based, insects, fermentation, cellular etc.), along with the various other datatypes including product type, investment size, investment type, location, business stage, market size, and replacement scope - where it is available.

The objective is to create a dynamic, longitudinal, searchable and ultimately open-source record of corporate venturing in alternative proteins. It is being designed with multiple audiences in mind, including academic researchers, enterprise and policymakers. Our ambitions extend to including interviews with key informants, in order to better discern their strategic objectives and motivations for decisions that were made. Creating such a layered dataset could, we hope, yield richer insights to inform future scholarship.

A preliminary version of the database will be publicly accessible later in 2021. For more information about this project, please contact the authors.

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## Appendices

### Appendix 1. Corporate venturing profiles

This section describes in more detail the 13 food companies engaged in corporate venturing activities.

#### High exposure to animal proteins:

##### 1.1 NH Foods

HQ Country: Japan

Sectors: Production, processing, consumer brands

Primary proteins: Multiple

NH Foods, also known as Nippon Ham, is a vertically integrated food producer and manufacturer founded in 1949. Fresh meats account for 50% of revenue, primarily chicken and pork in their Japanese business and also beef in Australia. The group is also active in marine products, dairy and processed foods.

Investments:

Year	Investee name	Investee type	Investee country	Investment type	Investment round
2020	Integriculture	Cell-based meat	Japan	Direct	Series A

Integriculture is a Japanese start-up company founded in 2015 and developing cell culture systems for the production of cultured meat. NH Foods invested as part of Integriculture's \$7.4m Series A and have developed an R&D collaboration.

##### 1.2 Minerva Foods

HQ Country: Brazil

Sectors: Production, processing, consumer brands

Primary proteins: Beef

Minerva Foods is a leading company in the production and sale of fresh beef globally, with operations across a number of South American countries. Minerva operates 25 slaughterhouses, 3 processing plants and 14 distribution centres, exporting to more than 100 countries.

Investments:



Year	Investee name	Investee type	Investee country	Investment type	Investment round
2020	Clara Foods	Fermentation / ingredients	USA	Indirect via VC arm	-

Minerva's \$4m investment in Clara Foods is the first investment by the company's venture capital arm, established in July 2020 to be "focused on start-ups and tech companies with highly innovative skills, strictly related to Minerva's value chain (alternative proteins, logistic, livestock, agritech and food retail), that have a long-term potential to enhance synergies, leverage our capabilities and unlock unique opportunities." Clara Foods is a start-up using precision fermentation to produce animal-free replacement for egg and other culinary ingredients and nutritional supplements. At the time of Minerva's investment, Clara Foods had raised \$46.8m over 5 funding rounds.

### 1.3 Fonterra Cooperative Group

HQ Country: New Zealand

Sectors: Production, processing, consumer brands

Primary proteins: Dairy

Fonterra is a farmer-owned dairy cooperative producing milk, cheese, yoghurt and other products. Owned by around 10,500 farmers, it is New Zealand's largest company and the world's largest dairy exporter, responsible for around 30% of exports.

Investments:

Year	Investee name	Investee type	Investee country	Investment type	Investment round
2019	Motif Foodworks	Fermentation / ingredients	USA	Indirect via VC arm	Series A

Motif Foodworks produce fermentation-based ingredients for plant based meat and dairy, and nutrition products. Motif is a spinout from one of the world's largest privately held biotech companies, Ginkgo Bioworks. Fonterra invested as part of Motif's \$90m Series A round via its VC arm Fonterra Ventures, founded in 2016 to "define the future of dairy by embracing and adopting disruptive innovation and end-to-end business models to build new, sustainable revenue streams for the Co-operative." Motif is the first investment in alternative proteins by Fonterra Ventures.

### 1.4 COFCO Meat Holdings Ltd / COFCO Joycome Foods

HQ Country: China

Sectors: Production, processing, consumer brands

Primary proteins: Pork

COFCO Meat Holdings is a subsidiary of state-owned COFCO, China's largest food processing company, which has operations across multiple sectors. Focused on pork production, COFCO has 90 production facilities, with breeding capacity exceeding 2 million pigs per year. The company was listed on the Hong Kong stock exchange in 2016.

Investments:

Year	Investee name	Investee type	Investee country	Investment type	Investment round
2020	Lever China Alternative Protein Fund	Investment fund	China	Fund	N/a

In 2020 COFCO's parent company invested in the Lever China Alternative Protein Fund, a joint initiative between US-based alt protein venture capital investors Lever VC, and Lever Foods, a China based alt-protein consultancy. The fund is also linked to Lever Foundation, a nonprofit which campaigns for animal welfare in Asia. The fund invests in plant-based, cell-based, fermentation and associated technologies, with typical cheque size of \$50,000-300,000 and the option of participation in a 3-month accelerator run by Brinc.

### 1.5 Thai Union

HQ Country: Thailand

Sectors: Processing, consumer brands

Primary proteins: Seafood

Founded in 1977, Thai Union is a processor and manufacturer of seafood products including tuna, shrimp, sardines, mackerel and salmon under a variety of brands, with 12 production facilities in 10 countries across four continents.

Investments:

Year	Investee name	Investee type	Investee country	Investment type	Investment round
2019	Flying spark	Insect protein	Israel	Indirect via VC arm	-
2020	Manna Foods	Insect protein	USA	Indirect via VC arm	-
2020	VisVires New	Investment	Singapore	Fund	N/a

	Protein Fund	fund			
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Thai Union invested an undisclosed amount in the Singapore-based VisVires New Protein Fund, which in turn deployed \$40m to 7 start-ups across a range of food tech including plant-based and cell-based meats, but also other areas including shrimp farming technology and sugar reduction.

Flying Spark and Manna Foods are producers of insect protein based on fruit flies and darkling beetles respectively. They are amongst the first investees of Thai Union's new venture fund, which was launched in 2019 with an initial \$30m to focus on alternative protein, functional nutrition and value chain technology. In addition to investments in insect protein, Thai Union's fund also invested in Alchemy, a diabetes foodtech company and HydroNeo, an aquatech firm.

Thai Union has also engaged with alternative protein start-ups through its food-tech accelerator programme Space-F, which it co-founded in 2019 with Mahidol University and the Thai National Innovation Agency. Manna Foods was part of the first accelerator cohort. The second cohort (2020) includes lab grown fish, microalgae protein, and jackfruit faux meat products.

### 1.6 Tyson Foods

HQ Country: USA

Sectors: Processing, consumer brands

Primary proteins: Beef, poultry

One of the world's largest meat processors, Tyson Foods produces approximately 20% of the beef, pork and chicken in the United States. The company operates 18 beef and pork facilities, 183 chicken facilities (including hatcheries) and 40 prepared foods facilities.

Investments:

Year	Investee name	Investee type	Investee country	Investment type	Investment round
2016	Beyond Meat	Plant-based meat	USA	Direct	Series F
2017	Beyond Meat	Plant-based meat	USA	Indirect via VC arm	Series G
2018	Memphis Meats	Cell-based meat	USA	Indirect via VC arm	-

2018	Future Meat Technology	Cell-based meat	Israel	Indirect via VC arm	-
2019	New Wave Foods	Plant-based seafood	USA	Indirect via VC arm	-
2019	Future Meat Technology	Cell-based meat	Israel	Indirect via VC arm	Series A
2019	MycoTechnology	Fermentation / ingredients	USA	Indirect via VC arm	Series C
2019	Big Idea Ventures	Investment fund	USA	Fund	N/a
2020	Memphis Meats	Cell-based meat	USA	Indirect via VC arm	Series B
2020	MycoTechnology	Fermentation / ingredients	USA	Indirect via VC arm	Series D

Tyson has made investments in start-up companies through its VC arm Tyson Ventures, a \$150m fund established in 2016. There are currently 8 companies in the portfolio, of which 5 are alternative protein companies spanning cell-based, plant-based and fermentation. Tyson have also made one exit, from Beyond Meat prior to its IPO in May 2019.

In addition, Tyson has invested in Big Idea Ventures (BIV), a food sector venture capital investment fund and accelerator. BIV's \$50m New Protein Fund totals \$50m and targets both plant-based and cell-based companies. BIV has made 21 investments to date and includes a 5-month accelerator for companies in New York or Singapore.

In addition to its investments, Tyson has launched its own Raised & Rooted brand of blended plant and animal protein products and has been an outspoken advocate of alternative proteins.

### 1.7 Yili Group

HQ Country: China

Sectors: Processing, consumer brands

Primary proteins: Dairy

Inner Mongolia Yili Industrial Group Company Limited is China's largest dairy company, producing products including milk, powdered milk and ice cream. The company also has investments in milk processing in New Zealand. Yili has a number of plant-based milk lines in its product portfolio.

Investments:

Year	Investee name	Investee type	Investee country	Investment type	Investment round
2020	Lever China Alternative Protein Fund	Investment fund	China	Fund	N/a

In 2020 Yili invested in the Lever China Alternative Protein Fund (see 1.4 above for more detail).

### 1.8 Bell Foods AG

HQ Country: Switzerland

Sectors: Processing, consumer brands

Primary proteins: Multiple

Bell Foods is a meat processor and food manufacturer based in Switzerland. Its products include meat, poultry, charcuterie, seafood and convenience products such as salads, sandwiches and prepared meals, as well as long-life products. Bell operates at 65 locations in 15 countries.

Investments:

Year	Investee name	Investee type	Investee country	Investment type	Investment round
2018	Mosa Meat	Cell-based meat	Netherlands	Direct	Series A
2020	Mosa Meat	Cell-based meat	Netherlands	Direct	Series B

Bell Foods invested \$2m in 2018, and a further \$5m in 2020, in Mosa Meat, a Dutch cell-based meat company, with the aim to “secure direct access to a technology with significant future potential.” Mosa Meat has a high profile in the sector, having grown directly out of the university-based work by Professor Mark Post to produce the world’s first cultured meat hamburger in 2013. Post is co-founder and Chief Scientific Officer of the company.

### Medium exposure to animal proteins:

### 1.9 RCL Foods

HQ Country: South Africa



Sectors: Processing, consumer brands

Primary proteins: Poultry

Originally founded in 1960 as Rainbow Chicken, RCL Foods is now a diversified food business with activities in chicken, sugar, grains and animal feed, plus a range of value-added categories including prepared foods, baking and spreads. The company has expanded into southern Africa through a number of investments, acquisitions and joint ventures.

Investments:

Year	Investee name	Investee type	Investee country	Investment type	Investment round
2020	LiveKindly Collective	Plant-based meat	USA	Direct	-

RCL Foods invested in LiveKindly Collective as part of a \$200m investment round. LiveKindly Co. is an emerging group of alternative protein businesses which has acquired a majority stake in three plant-based brands: Fry's Family Food (South Africa), Oumph (Sweden), and Likemeat (Germany). It also has an equity stake in Puris (pea protein producer) and owns the Livekindly.co plant-based news media platform. The stated aim of RCL's investment in Livekindly is to enter into a strategic partnership to build the ecosystem for plant-based foods in South Africa.

### 1.10 Nestle

HQ Country: Switzerland

Sectors: Processing, consumer brands

Primary proteins: Dairy

Nestle is the largest food company in the world, operating across a range of sectors including snacks, confectionary, dairy, breakfast cereals, and frozen food. The company is not heavily exposed to meat, but does have some meat-based products in its portfolio, as well as many products with a reliance on dairy. Nestle has been active in its environmental commitments and in the alternative proteins sector, launching a range of dairy-free alternative products, and acquiring two plant-based meat brands in 2017.

Investments:

Year	Investee name	Investee type	Investee country	Investment type	Investment round
2020	Ripple Foods	Plant-based dairy	USA	Indirect via VC arm	Series D

Nestle invested via its VC arm Inventages as part of the \$55m Series D for Ripple Foods, a plant milk based on pea protein. Ripple was founded in 2014 and is one of the fastest growing dairy alternative brands, diversifying from original and flavoured milk into yoghurt, shakes and desserts. Launched by Nestle in 2002 and with \$1.5bn committed capital, Inventages has a portfolio of 18 other companies across health tech, pharma and nutrition. There are no other alt protein investments.

### 1.11 Kraft Heinz

HQ Country: USA

Sectors: Processing, consumer brands

Primary proteins: N/a

The fifth-largest food and beverage company in the world, with a presence in more than 40 countries, Kraft Heinz has products across a range of categories including prepared meals, meats, cheese and dairy, sauces and condiments, snacks and beverages. Kraft has an existing plant-based meat brand Boca Burgers, which was rebranded and reformulated in 2018.

Investments:

Year	Investee name	Investee type	Investee country	Investment type	Investment round
2019	New Culture	Plant-based dairy	USA	Indirect via VC arm	Seed

In 2019 Kraft-Heinz's VC arm Evolv Ventures led a \$3.5m seed round for plant-based cheese company New Culture. The company is currently focused on using precision fermentation technology to produce non-animal casein, a protein that gives dairy cheese some of its unique qualities. Evolv Ventures is a \$100m venture fund founded in 2018 to invest in early stage food tech. It has made 7 other investments to date, in areas including food delivery, checkout free shopping, and autonomous distribution yards, but has no other investments in alt protein.

In addition to Evolv, Kraft Heinz runs the in-house Springboard Accelerator, also launched in 2018, with 4 streams: Natural & Organic, Specialty & Craft, Health & Performance and Experiential brands. To date, Springboard has incubated 2 cohorts of 5 companies including Tiny Giants, a US plant-based yoghurt startup, and BRAMI, protein-rich snack products made from lupini beans.

### 1.12 General Mills

HQ Country: USA

Sectors: Processing, consumer brands

Primary proteins: N/a

Founded in 1866, General Mills is an American manufacturer of consumer food brands including cereals, snacks, yoghurts, prepared meals, dough products and pet foods. Well-known brands include Old El Paso, Cheerios, Yoplait and Betty Crocker.

Investments:

Year	Investee name	Investee type	Investee country	Investment type	Investment round
2013	Beyond Meat	Plant-based meat	USA	Indirect via VC arm	-
2016	Kite Hill	Plant-based dairy	USA	Indirect via VC arm	Series B
2018	No Cow	Protein snacks	USA	Indirect via VC arm	-
2018	Kite Hill	Plant-based dairy	USA	Indirect via VC arm	-
2019	Good Catch	Plant-based seafood	USA	Indirect via VC arm	Series B

General Mills has invested in alternative protein start-ups via its VC arm 301 Inc, founded in 2015 to 'partner with emerging food brands'. 301 is currently invested in 10 companies, 3 of which are in the alternative protein space. Other investees have a healthy foods focus and include superfood snacks, probiotic foods, granola, and organic cottage cheese. 301 Inc exited from Beyond Meat in 2019 at its IPO.

### 1.13 Groupe Casino

HQ Country: France

Sectors: Retail

Primary proteins: N/a

Groupe Casino is a French supermarket group with 11,000 shops in France and Latin America.

Investments:

Year	Investee	Investee type	Investee	Investment	Investment
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	name		country	type	round
2020	Magic Bean	Plant-based meat	France	Services for equity	-

Magic Bean produces prepared meals in sachets based on plant-based meats. Casino Group has engaged in Magic Bean via a new entity within the business to work with start-ups. This is done by providing services around marketing, packaging, product composition, and sales, and providing access for products to 200 stores (exclusive for first 6 months). In exchange Casino gets 10-15% minority stake in the business. By October 2020, 3 start-ups had been involved in the programme.

## Appendix 2. Acquisitions

Company	Country	Acquisition	Year	Country	Date founded	Business area
Maple Leaf Foods Inc	Canada	Lightlife	2017	USA	1979	Plant-based meat brand
		Field Roast Foods	2018	USA	1997	Plant-based meat and cheese brand
Kerry Group plc	Ireland	Pevesa	2020	Spain	1996	Plant protein ingredients
		Ojah	2018	Netherlands	2009	Plant protein ingredients
Unilever	Netherlands	The Vegetarian Butcher	2018	Netherlands	2010	Plant-based meat brand
Nestle	Switzerland	Sweet Earth Foods	2017	USA	1978	Plant-based meat brand
		Garden Gourmet	2017	Israel	1986	Plant-based meat brand
Beijing Sanyuan Foods Co Ltd	China	St Hubert	2018	France	1904	Plant-based dairy (spreads)
Conagra Brands Inc	USA	Gardein	2018	Canada	2003	Plant-based meat brand