

Government investment in the opportunities of alternative proteins.

What are other countries doing and how does Aotearoa New Zealand compare?

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"In a typical Western diet, most of our protein needs come from just 5 animal and 12 plant protein sources. But there's so much more biodiversity and potential other foods on the planet to consider incorporating into our diet."

Michelle Colgrave, CSIRO Future Protein Mission

INTRODUCTION

Background

In May 2021, FoodHQ published *'Emerging Proteins in Aotearoa New Zealand: what will it take for the sector to thrive?'* This was the culmination of a six-month project to gather insights and perspectives from over 185 people involved across the emerging proteins¹ sector.

The report observed that there was significant and diverse activity in emerging proteins throughout Aotearoa New Zealand, with the current focus being on plant-based foods. However, much of the work was being undertaken by entrepreneurial individuals and small businesses with limited connectivity and access to scale.

It concluded that if Aotearoa New Zealand was to succeed in this increasingly competitive space, we needed to do more and do it faster. We needed to remove barriers, increase national and international collaboration, and be prepared to invest in world-class talent and infrastructure.

The report successfully sparked further discussions related to the potential for a more diverse protein sector in Aotearoa New Zealand, what the priorities should be, and how industry and government could work together to support this. A common question raised in these discussions is 'what are other countries and governments doing?'

Estimates of private sector investment into the alternative proteins sector can be found fairly readily online, with the Good Food Institute reporting \$5 B USD went into the sector in 2022 alone, up 60% on the \$3.1 B USD in 2021².

The contribution of governments to the development of the sector can take a variety of forms, from financial investment through to specific acknowledgement in national agrifood strategies and the introduction of supportive regulatory frameworks. We were unable to find an existing summary of government support for the alternative proteins sector across different countries, and so compiled this report.

Purpose

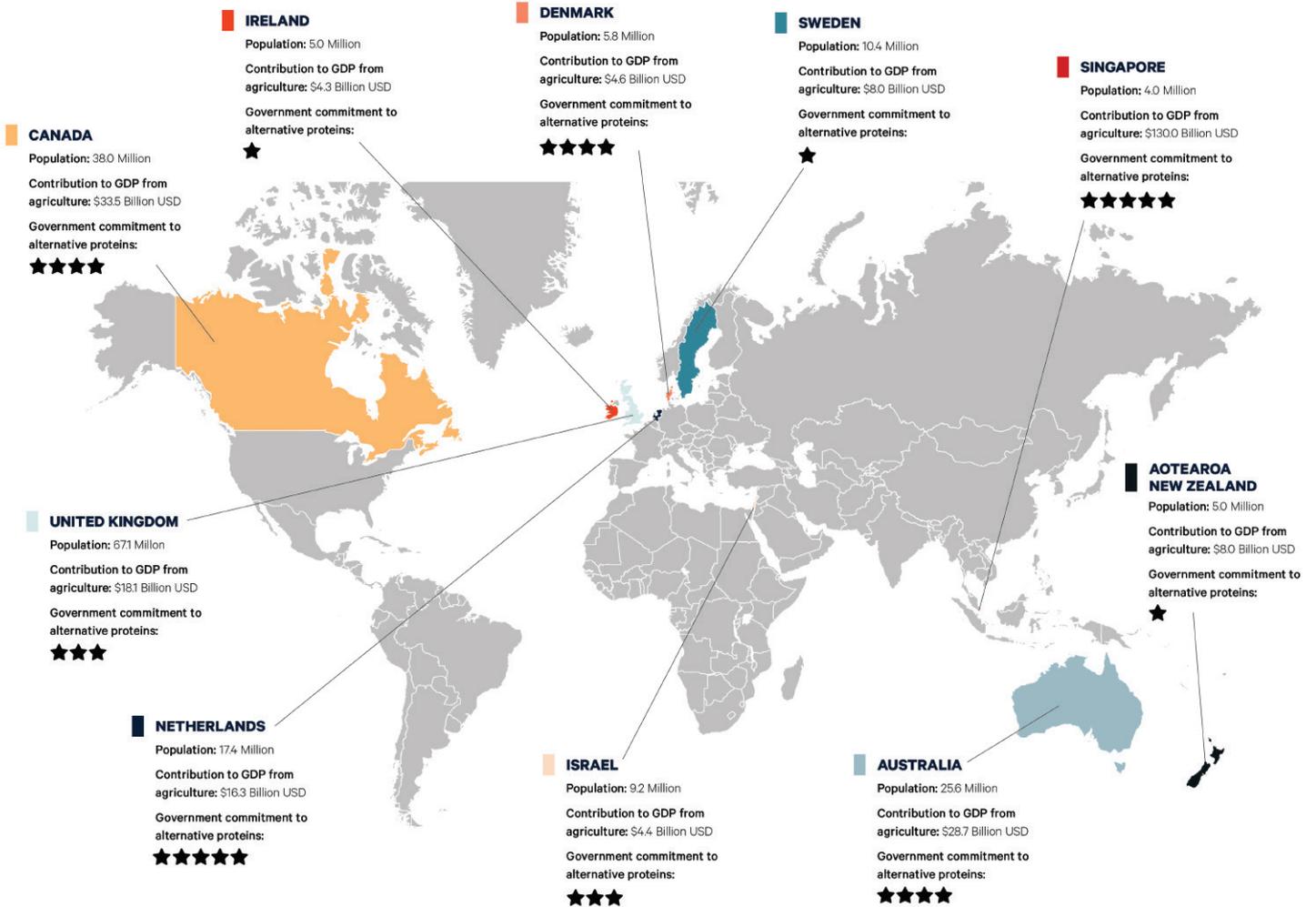
We recognise that what may be appropriate in one country may not necessarily be appropriate in another, and the specific social, economic and environmental contexts need to be taken into account.

This report therefore does not seek to judge whether the choices each government has made are the 'correct' choices for that country. It also does not provide advice on recommendations or next steps.

What this report does do is provide a summary of what governments in ten countries are doing to support the development of their alternative proteins sectors, and use this information to evaluate their overall level of commitment and the key drivers behind this.

We hope that collating and sharing this information may help Aotearoa New Zealand accelerate its own decision making regarding how (or if) it chooses to engage in this rapidly moving new agrifood sector.

OVERVIEW OF COUNTRIES



References for country statistics are provided on pg 54

PROJECT PROCESS AND SCOPE

This report considers the various contributions governments from ten countries (including Aotearoa New Zealand) are making to their domestic alternative proteins sectors.

The countries include those widely recognised as being particularly proactive within alternative proteins (Singapore, The Netherlands, Israel), those with similar sized populations and emphasis on animal protein production systems (Ireland, Denmark), and our closest neighbour (Australia). The United Kingdom and Canada provide comparisons with larger economies with established agriculture systems. Sweden was included because publicity on oat milk company Oatly had highlighted the country's innovative plant-based sector.

Publicly available information on government investment and commitment to various aspects related to alternative proteins was collected for the five years up until 1 July 2022 from online reports, announcements and credible media sources, supplemented by discussions with experts who have significant understanding of the relevant countries.

Summaries of the information related to overall government commitment, investment drivers, and the areas of investment are provided on pages 6-12. More detailed observations on each country and its activities are provided from pages 13-52.

A NOTE ON PROTEINS VS. FOODS

Although much of the international focus in alternative foods is on protein, none of the protein production methods solely generate pure isolated protein.

Plants produce proteins as part of their structure, along with starches and fats and cellulose fibres and other components. Cell-cultured meat contains proteins and fats and carbohydrates as well, just like meat produced via animal production. Even precision fermentation technologies produce proteins within a mixture of the modified microorganisms and the components the microorganisms need to grow. Often the protein can be a relatively small percentage of the total system.

We do not generally eat 'proteins'. We eat foods. Foods that contain protein as part of a complex system of other molecules that provide the flavour and texture we enjoy and the nutrition that our bodies need.

Conversations on alternative protein sources are increasingly also considering how to make the best use of the non-protein components produced alongside the protein. This includes the potential for using protein-rich whole foods and minimally processed ingredients. This approach is beneficial both from an environmental perspective and potentially from an economic one.

It will be interesting to see what direction the different countries included within this report decide to take on this topic. It may be another area that countries choose to differentiate themselves on - a focus on highly refined and pure proteins and ingredients or a focus on whole protein-rich foods and ingredients.

GOVERNMENT COMMITMENT

Assessing government commitment

All governments are taking their own approaches to the development of their alternative proteins sectors, with differing levels of investment and general support across multiple areas. This makes it challenging to compare activity between countries.

To make a general comparison more feasible, a semi-quantitative rating system was developed, with scores given to reflect the level of support provided in 8 key areas that would contribute to the success of a country's alternative proteins sector. The detailed scoring matrix is provided in Appendix 1 (page 53).

The resulting high-level summary (Table 1, page 7) shows which countries are excelling in each of the key areas, and which aspects each country is prioritising. It identifies which governments are most committed to the development of their alternative proteins sectors.

Metrics for providing context to funding

One of the most complex assessments is that of the level of funding.

To enable meaningful comparisons between the funding commitments made by different governments, it is necessary to account for differences in their size, as governments with larger populations and access to funds can obviously invest more money.

Both population and Gross Domestic Product (GDP) were used to provide a relative measure of a country's wealth. The investment in alternative proteins as a percentage of GDP for each country is shown in Table 1. The alternative proteins funding was such a tiny percentage of GDP, and there was limited difference across the majority of the countries.

An alternative approach was to consider the relative importance of agriculture and food to a country's economy. Countries with large agrifood sectors may be better placed to take advantage of the opportunities provided by alternative proteins, or be more aware of the potential impact of new protein sources.

It was not possible to find a single metric that captured the size and value of agrifood in the manner we wanted consistently across the ten countries. Of the metrics we could find, each had their limitations. Export values are readily available, but fail to adequately reflect the importance of the agrifood sector for countries with large domestic consumption. 'Agriculture contribution to GDP' primarily reflects production of agricultural commodities, while 'Agriculture, forestry and fishing value added' includes both forestry and fishing outputs.

In the interests of having some metric that reflected the relative importance of a country's agrifood sector, it was decided to use 'Agriculture contribution to GDP'. We note that this does not capture all aspects of the contribution of agrifood, but it does enable a comparison of relative sizes of the sector and thus adequately serves our purposes for this report.

Table 1. Government commitment to alternative proteins sector

KEY AREA	WEIGHTING	COUNTRIES									
		Singapore	The Netherlands	Australia	Canada	Denmark	Israel	United Kingdom	Ireland	Aotearoa New Zealand	Sweden
Considered in National Food Strategy	3	5	4	4	4	5	2	3	4	1	2
Level of funding	5	5	5	4	3	5	5	4	1	2	1
Total government investment (USD)		\$45M	\$66M (<small>\$25,064M if include funds for farm transition</small>)	\$177M	\$133M	\$290M	\$52M	\$108M	\$6M	\$18M	\$10M
Investment as % of GDP		0.011%	0.006% (<small>2.4% if include funds for farm transition</small>)	0.009%	0.007%	0.073%	0.011%	0.003%	0.001%	0.007%	0.002%
Investment as % of agriculture-related GDP		45%	0.41% (<small>158% if include funds for farm transition</small>)	0.61%	0.40%	6.3%	1.19%	0.60%	0.14%	0.23%	0.13%
Aligned initiatives	4	5	4	5	4	3	4	3	2	2	2
Timelines for outcomes	2	5	5	2	5	4	1	3	2	1	2
Infrastructure and facilities	3	5	4	4	4	3	2	2	1	2	2
Partnerships	1	5	5	4	5	3	4	3	3	3	2
Talent and Capability	1	4	4	4	4	2	3	3	2	3	2
Regulatory Environment	1	5	4	3	3	2	3	2	1	1	1
Overall score [#]		99	88	79	77	76	65	61	38	36	34
Rating [*]		★★★★★	★★★★★	★★★★	★★★★	★★★★	★★★	★★★	★	★	★
GDP (Billion USD)		\$397	\$1,018	\$1,543	\$1,991	\$397	\$481	\$3,187	\$499	\$250	\$627
Agriculture contribution to GDP (Billion USD)		\$130.0	\$16.3	\$28.7	\$33.5	\$4.6	\$4.4	\$18.1	\$4.3	\$8.0	\$8.0
% GDP from agriculture		0.03%	16%	1.9%	1.7%	1.2%	0.9%	0.6%	0.9%	3.2%	1.3%

[#]Overall score was calculated by multiplying the score for each key area (out of a maximum of 5) by the weighting for that area, then adding these together. The overall score for each country is out of a maximum of 100 points. The details for the scoring system are provided in Appendix 1.

^{*}Rating is determined based on overall score.

0-40 points = 1 star, 41-55 points = 2 stars, 56-70 points = 3 stars, 71-85 points = 4 stars, 85-100 points = 5 stars.

References for country statistics are provided on pg 55

Overall government commitment

The governments in Singapore and The Netherlands are demonstrating significant commitment to their alternative proteins sectors across all areas evaluated. Australia, Canada and Denmark also score very well, with clear strategic positioning of alternative proteins reinforced by funding and broader sector support.

Israel and the UK receive three stars. Both are investing large amounts of money into alternative proteins, but have yet to clearly articulate the specific role of the sector within their official national food strategies. It was a little surprising to see Israel only score mid-field, as it has a very active alternative proteins start-up community and is generally regarded as a leader in this area. However, this appears to be due to its established general innovation ecosystem and not through a specific government focus on this sector.

Aotearoa New Zealand achieves a single star rating, along with Ireland (government strategy has been announced, but very limited funds committed to its implementation thus far) and Sweden (minimal government activity or investment in alternative proteins).

Aotearoa New Zealand has no specific strategy, targets or goals related to the role of alternative proteins within its agrifood sector. It has a low level of government investment as a percentage of agriculture-related GDP (0.23%). Its current regulatory framework has not been designed with alternative proteins in mind and it restricts the commercial development of several alternative protein categories.

Existing agriculture sectors

Ireland and Aotearoa New Zealand have large animal protein sectors. They lack the obvious comparative advantages in the production of alternative proteins that they have for animal proteins. This seems to be slowing decision making about how they will respond to the international emergence of this new sector.

In contrast, countries such as Australia and Denmark are also significant producers of animal protein, but each has committed to a strategy that envisages both animal and alternative proteins (primarily plant-based) as complementary parts of more diverse and circular food production systems.

INVESTMENT DRIVERS

There are a number of reasons that different governments are investing in the alternative proteins space. The three most common across the countries included in this report are economic growth, mitigation of environmental impact, and food security.

Figure 1 provides a semi-quantitative overview of the drivers for each country, based on a thematic analysis of the relevant government initiatives and documents.

Economic growth

Countries are investing in the development of their alternative proteins sectors to help drive economic growth. It is seen to be a sector that can create skilled jobs and generate revenue.

The specific mechanism for revenue generation varies between countries.

Examples include Canada's ambitions to produce and export 10% of the world's plant-based ingredients and foods, Israel's focus on the sale of intellectual property and the UK's desire to replace imports with local products within its domestic plant-based alternative proteins market.

Mitigation of environmental impact

This is the second most common theme across the countries, and was particularly strong for those in Europe. Many have made commitments to achieve net-zero carbon status for their food production systems, most by 2050.

Different countries are planning to achieve this through different approaches, often influenced by their reliance on their current agrifood sector. The Netherlands, Denmark and the UK have all committed to reduce livestock numbers and the land area used for livestock production over the coming years, and are investing in production systems with lower emissions.

In many instances it is not clear how net-zero carbon status will be achieved, with explicit or implicit reliance on the successful commercialisation of new technologies.

Food Security

Surety of access to food is essential for a stable society, and therefore the investment required to ensure food security is often significantly more than would otherwise be justified.

Awareness of the potential for disruption to supply chains to affect food availability was behind Singapore's "30 by 30" strategy launched in 2019. Since then, COVID-19 and the war in Ukraine have caused food security considerations to move up the agenda for those countries dependent on food imports.

The ability for certain alternative proteins technologies to enable food production close to urban centres with relatively small land requirements is attractive to countries with limited space for traditional farming. The dependence on the importation of raw materials remains (such as sugar for use within cellular agriculture or precision fermentation), but these commodities are generally available from a larger number of suppliers in different global markets.

This driver is much less relevant for those countries who are net exporters of food, including Australia, Canada and Aotearoa New Zealand.

Figure 1. Key drivers for government investment in alternative proteins

	Economic growth	Mitigation of environmental impact	Food security
Australia	\$\$\$		
Canada	\$\$\$		
Israel	\$\$\$		
Aotearoa New Zealand	\$\$		
Denmark	\$\$	🌍🌍🌍	
Netherlands	\$	🌍🌍🌍	🔒
Sweden		🌍🌍🌍	🔒
Singapore	\$\$	🌍	🔒🔒🔒
Ireland	\$\$	🌍🌍	🔒
United Kingdom	\$\$	🌍🌍	🔒

Indigenous peoples

Only Australia and Aotearoa New Zealand have published reports or recommendations that reference the potential engagement of indigenous peoples within their alternative proteins sectors.

At this stage, neither country has committed any significant funding or launched any dedicated initiative to progress the ambitions of their indigenous peoples.

AREAS OF INVESTMENT

One consideration for investment is the protein source (plant, cellular agriculture, precision fermentation, insects, fungi and algae).

Of the approximately \$900 million USD government investment by the ten countries included in this report[#], around 73% is for activities related to specific protein sources. The remainder is for initiatives supporting the general development of alternative proteins or where the details of funding allocation have not yet been announced.

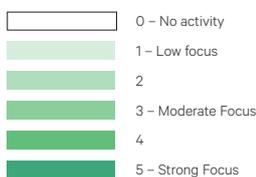
Another consideration is whether the country is investing in the actual production of the protein source, the processing of the protein source into ingredients or foods, or the development of intellectual property with the intention that other countries are likely to undertake the production and food manufacture.

Table 2 provides an overview of the level of focus each country has based on these aspects.

Table 2. Areas of investment

PROTEIN	COUNTRIES																													
	Singapore			Netherlands			Australia			Canada			Denmark			Israel			United Kingdom			Ireland			Aotearoa New Zealand			Sweden		
	PD	PS	IP	PD	PS	IP	PD	PS	IP	PD	PS	IP	PD	PS	IP	PD	PS	IP	PD	PS	IP	PD	PS	IP	PD	PS	IP	PD	PS	IP
Plant based	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	2	2	2	1	1	1	1	1	1	1	1	1
Cell-based & precision fermentation	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1
Insects	1	1	1	2	2	2	1	1	1	1	1	1	1	1	1	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1
Fungi	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Algae / seaweeds	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Rating Scale



Key:

PD – Production is defined as “any activities that are captured in the growing and development of raw materials to be further processed”.

PS – Processing is defined as “any series of mechanical or chemical operations on a primary product to change its form”.

IP – Intellectual property is defined as “any work that is undertaken to develop copyrights, patents, trademarks and trade secrets relevant to alternative proteins”.

[#] The \$900 million USD does not include the €25B committed by The Netherlands government to reducing livestock numbers, nor investments of undisclosed amounts by governments into private companies. Where governments have announced a single investment into several initiatives where only some are related to alternative proteins, it has been assumed the funds are equally shared between the initiatives and only the proportion related to alternative proteins will have been counted.

Plant-based

Plant proteins are receiving more than 5.7x the government investment of any other protein source (almost \$535 million USD).

Canada, Australia, Denmark and the UK have all set significant targets and are implementing ambitious strategies to develop their plant protein sectors. Their activities range from growing the plants through to manufacturing plant-based food products, and includes the development of intellectual property.

Singapore and Israel have limited land for growing plants, but are still active in developing manufacturing expertise related to preparing plant-based food products.

Cellular agriculture and precision fermentation

The next highest level of government investment is for cellular agriculture and precision fermentation (~\$93 million USD).

Although these two areas do cover different types of alternative protein production, they have been frequently grouped together in funding announcements, and so are reported jointly here.

The Netherlands has committed significantly in this area. They have announced investment of €60 million to support the establishment of a cellular agriculture ecosystem (which includes precision fermentation according to their definitions). This is over 60% of the investment in cellular agriculture by the ten countries included in this report.

Israel and Singapore are active in cellular agriculture, especially the development of intellectual property, likely a reflection of their interest in technologies that require limited land area.

Insects

Around \$25 million USD has been committed to projects related to insect protein. Israel has established an industry-led consortium on insect farming, and Denmark has also invested in several large projects. The Netherlands has funded several projects focused on the use of insects for animal feed. Other government funding has been minimal.

Insects can play a valuable role in converting agriculture and food waste into high-quality protein which may be used for either animal feed or human food products. Countries focusing on developing a more circular and sustainable food production system may invest in insect farming to help meet their environmental targets.

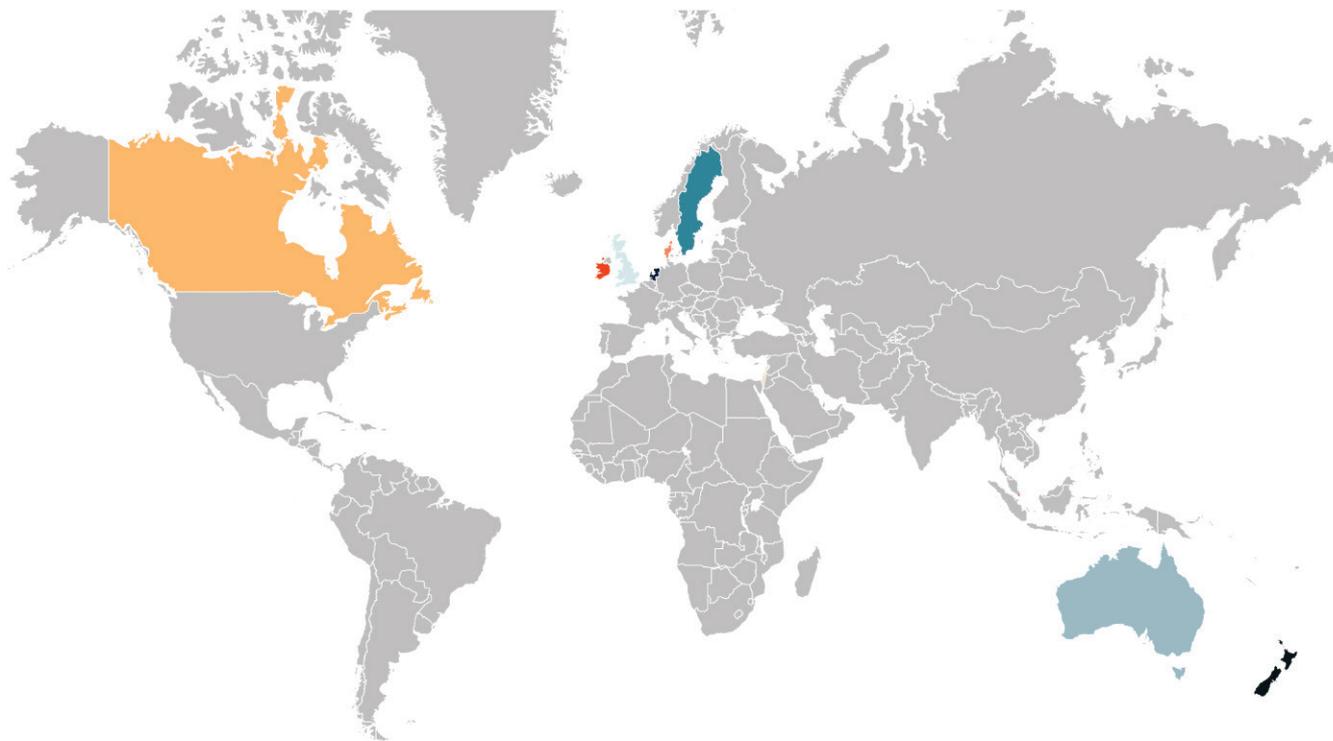
Australia has identified the potential for First Nations Peoples to lead the development of an edible insects industry, but there has been no funding committed at this stage.

Other protein sources

Less than \$7 million USD of government investment has been announced for projects involving fungi and algae (including seaweeds).

The funding has primarily been for small projects and feasibility studies, or to support research infrastructure.

COUNTRY OBSERVATIONS



"Traditional meat and dairy remain strong export sectors for Aotearoa New Zealand, and demand for these products is still growing rather than slowing. However, there is an increasingly broad range of possibilities for future food production being developed by some of the world's smartest thinkers.

It doesn't benefit our existing industry to deny the potential for serious disruption, nor is it necessary to abandon traditional proteins in order to take advantage of emerging ones.

The sooner this becomes an 'and/both' discussion rather than an 'either/or', then the sooner we can work together to identify how NZ can best move forward." ¹

Dr Abby Thompson, CEO FoodHQ

AOTEAROA NEW ZEALAND

Yet to identify if or how the country will leverage alternative protein opportunities.

Aotearoa New Zealand is globally renowned as the producer of meat and dairy products. In recent years there has been increasing recognition of the potential opportunities arising from the international consumer interest in alternative proteins.

However, the government does not yet have a specific strategy for the sector, and investment has been limited.

Population: 5.0 Million

GDP: \$212,000 Million USD

Contribution to GDP from agriculture: \$8 Billion USD

% GDP from agriculture: 3.2%

Government investment as percentage of agriculture-related GDP: 0.23%

Key drivers: \$

Rating: ★

Key observations

'Fit for a Better World' Roadmap² was published by the Ministry of Primary Industries (MPI) in July 2020 with the intention of 'setting the course to accelerate Aotearoa New Zealand's food and fibre economic potential'. It did not include any specific mentions of alternative proteins.

Te Puna Whakaaronui (TPW), a think-tank funded by MPI, recently released 'WELL_Aotearoa New Zealand – reframing New Zealand's food sector opportunities'³, which states that the sector needs to immediately consider the potential impact of alternative protein technologies. The production of cell cultures for use in alt protein technologies, a focus on new molecule development via precision fermentation and the exploration of marine biomass were identified as opportunities. The report states that Aotearoa New Zealand is currently 3-5 years behind other nations in some of these areas.

There are currently three main potential sources of government funding for the sector:

- Ministry of Primary Industries (MPI) via the Sustainable Food and Fibre Futures (SFFF)⁴ has invested \$8M to co-fund Leaft Food's R&D programme related to the extraction of high-quality proteins from green leafy crops, and less than \$0.5M to other alternative protein projects. This represents 4% of its total funding.
- The Ministry of Business Innovation and Employment (MBIE) is contributing \$11.8M over 3 years to four collaborative projects involving Aotearoa New Zealand and Singapore researchers, focusing on non-animal proteins. An additional \$1M was provided to a project related to the application of cellular agriculture to fish.
- The Tertiary Education Commission (TEC) has provided contributions of \$4M towards the development of a sustainable seaweed industry and \$2M for fundamental research on alternative protein food products.

References are provided on pg 55

At a glance

<p>Strategies & Initiatives</p>	<p>MPI's Fit for a Better World Roadmap² sets the course for accelerating Aotearoa New Zealand's food and fibre economic potential. It aims to consolidate and enhance Aotearoa New Zealand's reputation for producing safe, high-quality, sustainable food and fibre.</p> <p>Te Puna Whakaaronui (TPW)⁵ is an independent food and fibre think tank funded within MPI's Fit for a Better World programme.</p> <p>Sustainable Food and Fibre Futures (SFFF)⁶ supports problem-solving and innovation in Aotearoa New Zealand's food and fibre sector by providing government co-investment in initiatives that make a positive and lasting difference in terms of economic, environmental or societal benefits. It has a budget of approximately \$40M per year.</p> <p>New Zealand-Singapore Bilateral Research Programme (Catalyst Fund) on Future Foods⁷ focuses on fundamental R&D in non-animal proteins.</p>
<p>Agencies & Entities</p>	<p><u>Ministry of Primary Industries (MPI)</u>⁸. Government department that helps 'seize export opportunities for our primary industries, improve sector productivity, ensure the food we produce is safe, increase sustainable resource use, and protect New Zealand from biological risk.'</p> <p><u>Ministry of Business, Innovation and Employment (MBIE)</u>⁹. The government department that delivers policy, services, advice and regulation which contributes to Aotearoa New Zealand's economic productivity and business growth.</p> <p><u>Tertiary Education Commission (TEC)</u>¹⁰. Fund and monitor Aotearoa New Zealand's tertiary education organisations on behalf of the government.</p> <p><u>Riddet Institute</u>¹¹. A collaborative 'Centre of Research Excellence' focusing on fundamental and applied research in food and nutrition, with a theme related to future foods. Riddet Institute partners include universities (Massey University, University of Auckland, University of Otago) and Crown Research Institutes (AgResearch, Plant & Food Research).</p>
<p>Funding & Investment¹²</p>	<p>New Zealand-Singapore Bilateral Research Programme (Catalyst Fund) on Future Foods, NZ\$11.8M over 3 years from MBIE in 2020.</p> <p>Entrepreneurial Universities Microalgal Biotechnology Programme, NZ\$4M over 5 years from TEC in 2019.</p> <p>Cellular agriculture of fish: premium seafood from immortalized cell lines, NZ\$1M from MBIE's 2019 Endeavour Fund.</p> <p>Fundamental research related to alternative proteins (primarily related to plant proteins), NZ\$2M over 3.5 years from the TEC's Center of Research Excellence funding for the Riddet Institute.</p> <p>Appointment of a Professor in Cellular Agriculture, NZ\$1.2M over 5 years from the Riddet Institute and AgResearch.</p> <p>Sustainable Food & Fibre Futures (SFFF) total of ~NZ\$8.7M by July 2022 for R&D or feasibility assessments related to the following areas:</p> <ul style="list-style-type: none"> • \$8M (plus \$12M from industry), extracting protein ingredients from green leafy crops; • \$260k (plus \$458k from industry), piloting scaled spirulina production; • \$147k (plus \$214k from industry), development of new plant-based food options; • \$70k (plus \$38k from industry), trialing snail farming; • \$245k (plus \$407k from industry), optimising hemp seed processing and utilisation.

Targets & Dates	<p>No specific targets related to alternative proteins.</p> <p>General food and fibre sector targets from Fit for a Better World:</p> <ul style="list-style-type: none"> • Adding \$44B in export earnings by 2030 through a focus on creating value • Reducing biogenic methane emissions to 10% below 2017 levels by 2030.
Infrastructure & Facilities	<p>The government has provided co-funding for the Microalgal Biotechnology Programme at the University of Waikato (NZ\$4M) and the Leaft R&D programme (NZ\$8M), both of which involve some infrastructure component.</p> <p>The various universities, crown research institutes and other government-supported organisations have a range of laboratory through to pilot scale equipment related to food processing, some of which is relevant to alternative proteins products.</p> <p>Key infrastructure for the development and commercialisation of plant-based ingredients and other emerging proteins sources are not currently available in Aotearoa New Zealand.</p>
Relationships & Partnerships	<p>The New Zealand-Singapore Bilateral Research Programme on Future Foods is a collaboration involving a number of universities and research institutes in both Aotearoa New Zealand and Singapore.</p> <p>The Professor in Cellular Agriculture is a partnership between the Riddet Institute and AgResearch.</p> <p>Projects funded by the Riddet Institute generally involve multiple research organisations.</p>
People & Talent	<p>There are currently no dedicated training programmes focused on alternative proteins.</p> <p>Both the New Zealand-Singapore Future Foods programme and the Riddet Institute are contributing to capability development in alternative proteins related disciplines for researchers and postgraduate students.</p> <p>A number of other PhD and postgraduate student projects have been advertised by universities.</p>
Legal & Regulatory Environment	<p>Regulatory barriers around the use of genetic technologies in Aotearoa New Zealand make it challenging to undertake larger scale development and commercialisation of approaches that require the use of these (i.e. precision fermentation, molecular farming).</p>
Indigenous peoples	<p>As part of the New Zealand-Singapore Bilateral Research Programme (Catalyst Fund) on Future Foods there is a PhD project looking at the opportunities for Māori businesses in plant-based foods.</p>

“The global protein mass-market is not an arena New Zealand can compete in. There is no “silver bullet” product that we can grow at scale.

The opportunity to enhance our existing system lies in growing the best, most nutritious natural foods that we can and, at the same time, looking for nutritional compounds to add value to both natural foods and precision fermented foods.”¹³

Te Puna Whakaaronui, :WELL_NZ Summary - reframing New Zealand's food opportunities

AUSTRALIA

Focused on the potential of plant and non-traditional protein systems alongside traditional red meat sector.

Population: 25.6M

GDP: \$1,430,000 Million USD

Contribution to GDP from agriculture: \$28,730 Million USD

% GDP from agriculture: 2.0%

Government investment as percentage of agriculture-related GDP: 0.61%

Key drivers: \$

Rating: ★★★★★

There is a thriving alt-proteins start-up community in Australia, with a particular focus on plant-based, precision fermentation and cell culture approaches.

The Australian government has two main vehicles for investing – a CSIRO-led ‘Future Protein Mission’ that focuses on the research, development and commercialisation activities required, and its ‘Modern Manufacturing Strategy’ which co-invests with industry to help develop the commercial manufacturing infrastructure required.

The Future Protein Mission identified the significant economic opportunities this sector has for Australia and set a target to generate AU\$10-13B in export revenue and 10,000 jobs by 2030.

In this Mission they created a new protein strategy which places high integrity red meat alongside plant and non-traditional protein systems (including precision fermentation, cell culture and insects). Plant-derived ingredients and food products are a key area of focus, building off Australia’s existing (primarily commodity) cropping sector.

“This will help shift Australia’s reputation from being the world’s food bowl of commodities to becoming a global delicatessen of unique higher value exports.

We can supercharge growth in our traditional protein industries by harnessing technologies like digital traceability and integrity systems that enhance the premium status of Australian red meat, and grow new complementary protein markets through techniques like precision fermentation to generate a suite of new Australian products.”¹

CSIRO Chief Executive, Dr Larry Marshall

References are provided on pg 56

“To create almost an additional \$13 billion in science and technology driven protein opportunities for Australia by 2030, products and ingredients must meet or exceed consumer needs.

The industry should focus on value-adding in areas where Australia has a competitive advantage.”

National Protein Roadmap Executive Summary

Key observations

Australia has a rapidly growing alternative proteins community, with more than 15 start-ups. These are primarily utilising plant-based approaches, although there are several using precision fermentation and cell culture. Main Sequence, a government-funded investment agency that has received AU\$690M, has invested directly in 4 of these to date, making up 10% of its current investment portfolio.

In March 2022 the Future Protein Mission produced 'A *National Protein Roadmap*² providing more detail on the key areas of focus and the action steps required. There are no estimates of the funding required to achieve these. It estimates that the implementation of the Roadmap could create 10,000 jobs and create an additional AU\$13B revenue in technology-driven proteins (\$7.5B from alt-proteins, including \$6B from plant-based products, \$1.45B from precision fermentation and \$32M from insect protein sources) by 2030.

The Roadmap specifically states that the protein demand can only be met by bringing together animal, plant and non-traditional protein production systems, with red meat exports underpinned by robust integrity systems still projected to provide the largest contribution to the Australian protein exports in 2030.

CSIRO also published a separate roadmap related to the development of an edible insects industry³ in April 2021.

It was announced in March 2022 that Australian Plant Proteins⁴ (APP) will receive government investment of AU\$178M to help expand pulse protein ingredient production capacity. The majority of this funding (AU\$113M⁵) comes under the Collaboration Stream of the Modern Manufacturing Strategy⁶ (MMS) launched by the Australian government in October 2020. The balance of government funding (AU\$65M) comes from the South Australian government, with industry partners contributing a further \$200M.

The Food and Beverage National Manufacturing Priority Roadmap⁷ sits under the MMS, and is focused on improving the availability of large scale end-to-end production facilities for the sector by 2025.

At a glance

<p>Strategies & Initiatives</p>	<p>Future Protein Mission – led by CSIRO. Aims to create new Australian protein products and ingredients that earn an additional AU\$10B in revenue by 2030.</p> <p>Modern Manufacturing Strategy⁶ (MMS) - launched by the Australian government in October 2020 to help Australian manufacturers be more competitive, resilient and build scale. The MMS has an investment budget of AU\$1.3B to be used across 6 areas of focus, with Food and Beverage Manufacturing being one of these. The Food and Beverage National Manufacturing Priority Roadmap⁷ - sits under the MMS, with ‘new and enhanced proteins’ identified as a key area of opportunity.</p> <p>CSIRO also published a Roadmap related to the development of an edible insects industry³ in April 2021.</p>
<p>Agencies & Entities</p>	<p><u>The Commonwealth Scientific and Industrial Research Organisation (CSIRO)</u>⁸. An Australian Government agency responsible for scientific research and development.</p> <p><u>Main Sequence</u>⁹. A CSIRO-owned venture fund that has received \$690M government funding to invest in commercialisation of science and deep tech. It has invested in 40 companies since 2017, including V2 Food¹⁰, Eden Brew¹¹, Every¹² and Nourish Ingredients¹³. Department of Industry, Science and Resources is the government department responsible for administering the Modern Manufacturing Strategy.</p> <p><u>Department of Agriculture, Fisheries and Forestry</u>¹⁴. The government department responsible for agriculture and food related sectors.</p> <p><u>Food Innovation Australia Limited (FIAL)</u>¹⁵. An industry-led, government-funded, not-for-profit organisation focused on growing the share of Australian food in the global marketplace.</p>
<p>Funding & Investment</p>	<p>AU\$113M from the Australian government’s Modern Manufacturing Strategy and \$65M from the South Australian government as co-investment with industry to expand commercial pulse protein ingredient capacity.</p> <p>AU\$150M government and industry funding to be spread across 3 agriculture-focused Missions led by CSIRO, one of which is ‘Future Proteins’.</p> <p>AU\$12M from the Victorian government for the Horsham Grains Innovation Precinct to support grain crop industries to diversify into the plant-based protein market.</p> <p>AU\$4.4M from the Australian government’s Cooperative Research Centres Projects (CRC-P) Programme for research led by CSIRO and involving GrainCorp and V2 Foods focusing on improving the commercial manufacture of premium plant-based proteins.</p> <p>AU\$5M from Clean Energy Finance Corporation (CEFC, Australian government owned green bank) seed funding for All G Foods to produce proteins via precision fermentation.</p> <p>AU\$3.8M government funding for R&D projects involving industry consortia looking at the industrial scale production of plant protein ingredients.</p> <p>AU\$2M from the Government of South Australia for the South Australian Research and Development Institute (SARDI) to establish a plant-based food incubator laboratory in Adelaide.</p> <p>AU\$1M from Australian Commonwealth Government grant to research the upcycling of Queensland sugarcane into a feedstock for precision fermentation products.</p>
<p>Targets & Dates</p>	<p>To generate an additional AU\$10-13B revenue by 2030 from Future Proteins, including \$7.5B from alternative protein sources.</p>

<p>Infrastructure & Facilities</p>	<p>CSIRO has a broad range of laboratory and pilot scale facilities related to the development and testing of various alternative protein products. A number of the universities also have such equipment.</p> <p>There are existing commercial scale plant protein manufacture facilities in Australia, with several additional ones co-funded by the Australian government and industry also under construction.</p>
<p>Relationships & Partnerships</p>	<p>CSIRO's Future Protein Mission brings together a broad range of research, government and industry organisations.</p> <p>Other Partnerships include the investments by local and central government along with industry in the APP pulse protein ingredient facilities, and various research programmes.</p>
<p>People & Talent</p>	<p>The University of Melbourne's 'Future Food Hallmark Research Initiative'¹⁶ supports the development of early and mid-career scientists through providing opportunities to participate and take leading roles in projects focused on addressing alternative protein challenges.</p> <p>A number of universities and CSIRO have offered PhD and postgraduate positions within research programmes on future proteins, usually funded by government and industry collaborations.</p> <p>The Government of Western Australia has funded PhD students to undertake short industry placements to develop their awareness of cultured meat.</p> <p>Although not restricted to / specifically targeting future proteins, the government has recently announced additional investment in R&D and commercialisation¹⁷. It would be expected that these funds would be focused on areas of focus for the government, with food and beverage (and future proteins) already identified as priority areas:</p> <ul style="list-style-type: none"> • \$21.5M over five years to expand CSIRO's Industry PhD Programme to up to 50 industry PhD students commencing each year. This is part of a \$296M investment designed to add 1,800 industry PhDs and over 800 industry fellows over ten years. This aims to fundamentally reshape the workforce of Australia's universities. • \$150M to expand the CSIRO Innovation Fund, managed by Main Sequence, to accelerate the commercialisation of research and increase industry collaboration as part of Australia's Economic Accelerator.
<p>Legal & Regulatory Environment</p>	<p>FIAL identified lack of regulatory clarity for novel ingredients and products as a barrier to realising the economic and job creation potential of the plant-based and alternative proteins sectors¹⁸.</p> <p>All Australian states except Tasmania permit the growing of genetically modified crops¹⁹.</p> <p>The use of CRISPR gene editing has been approved for plants, animals, and human cell lines under the condition that new genetic material is not created²⁰.</p>
<p>Indigenous peoples</p>	<p>CSIRO's Roadmap for the development of an edible insects industry³ specifically recognises the potential for First Nations Peoples to lead initiatives within this sector. However, there has not been any specific government funding announced for the implementation of this.</p>

CANADA

Government and industry co-investing to secure 10% of the global plant-based food and ingredients market.

Population: 38.0 Million

GDP: \$1,725,000 Million USD

Contribution to GDP from agriculture: \$33,480 Million USD

% GDP from agriculture: 1.9%

Government investment as percentage of agriculture-related GDP: 0.40%

Key drivers: **\$**

Rating: **★★★★**

Canada is positioning itself as the world leader in plant-based innovation and aims to capture 10% of the global market (approx. \$25B) by 2035.

Canada is an established producer of many protein-rich crops, including wheat, canola, barley, corn and beans. It is the world's largest producer and exporter of peas and lentils. The increasing global interest in plant-based foods offers significant opportunities for Canada to capture more value from these crops through converting them to premium ingredients and food products.

The government has invested more than CAD\$150M over the past five years in a plant protein 'supercluster' led by Protein Industries Canada, with matching industry funding giving a total of CAD \$300M to accelerate innovation in the plant protein sector.

Key observations

Canada has invested significantly over many years in the research and infrastructure required to improve the breeding, production and processing of these crops. The move into plant proteins and foods is a natural extension of Canada's existing large scale, highly efficient arable sector.

In 2017, the Canadian government established a plant protein 'supercluster', led by Protein Industries Canada (PIC) a not-for-profit industry-led organisation¹. The supercluster aims to create more than 4,500 jobs and add an additional \$4.5B to Canada's economy, primarily in the less affluent prairie regions.

Projects funded by the include R&D for the development of plant-protein ingredients with improved functionality, the development of new plant-based meat and seafood analogues, new processing technologies, and new pilot and commercial scale ingredient and food manufacturing facilities.

Cellular agriculture opportunity?

An independent report outlining the opportunity for Canada to develop a \$12.5B industry with 142,000 jobs through the development of a cellular agriculture industry was published in November 2021².

The report suggests that Canada would have an advantage in cellular agriculture due to its existing expertise in growing the crops required for feedstock, its established agrifood processing and manufacturing sector, and its strengths in agriculture, biotech and food related disciplines.

Thus far there has been no government response to the proposed opportunity.

At a glance

Strategies & Initiatives	<p>The Canadian government has established a 'Plant protein super cluster', led by Protein Industries Canada (PIC). The supercluster aims to improve collaboration among businesses and research institutions and position Canada as a global source of high-quality plant protein and plant-based co-products.</p>
Agencies & Entities	<p>Protein Industries Canada (PIC)¹. An industry-led, not-for-profit organisation that coordinates the Plant Protein Supercluster. Its mission is to 'Invest collaboratively to accelerate innovation and the competitiveness of the Canadian plant protein sector'.</p> <p>Canadian Agricultural Partnership (CAP)⁴. A CAD \$3B initiative that aims to generate sustainable economic growth in the agricultural sector over five years.</p>
Funding & Investment	<p>The Canadian government has invested CAD\$153M over five years into the Protein Industries Canada Supercluster. This has been matched by industry, increasing total funding to over CAD\$300M.</p> <p>The development of pilot-scale infrastructure and facilities has also received government funding of \$19.5M.</p>
Targets & Dates	<p>By 2025, the Canadian Agricultural Partnership (CAP) is aiming to increase the value of agri-food exports to \$75 billion annually.</p> <p>By 2027, the Protein Industry Supercluster initiative is projected to create more than 4,500 jobs and add an additional \$4.5 billion to Canada's economy.</p> <p>By 2035, the Protein Industry Supercluster is targeting a total of \$25B in annual sales of Canadian plant protein foods, feed and ingredients. This would represent 10% of estimated global sales.</p>

References are provided on pg 56

<p>Infrastructure & Facilities</p>	<p>Funding from PIC has been used to fund or co-fund several plant processing facilities at both pilot and full commercial scale, including using newly developed specialised processing equipment and approaches.</p> <p>Another supercluster (Next Generation Manufacturing Canada, NGen⁵) has also made a \$16.8M contribution to the construction of a pilot facility at the world’s largest fully automated cricket farm.</p> <p>Western Economic Diversification Canada⁶ (a federal economic development agency) contributed just under \$2.7M for new plant based foods and ingredients at the Food Processing Centre, Alberta (a government owned and operated facility with a pilot plant and additional supporting facilities⁷).</p>
<p>Relationships & Partnerships</p>	<p>There appear to be strong relationships between the Canadian government, industry and research communities, all of which collaborate within PIC and the various other initiatives.</p> <p>The ‘Protein Highway’ is an initiative to enhance cross-border collaboration among entrepreneurs, researchers, and end users across the Canadian Prairies and U.S. Midwest-Great Plains region⁸. The mission is to support and facilitate bilateral, precompetitive initiatives that unite industry, academia, and government in advancing the North American plant protein sector.</p>
<p>People & Talent</p>	<p>Capacity Building is one of the two investment streams for PIC. Skills and access to talent is a key plank in this. One programme currently funded is ‘Agri-food Opportunity Awareness for Youth’, which aims to address the future labour shortage in the sector by expanding existing STEM programming for students in kindergarten to grade 12 in the Prairie provinces to make them aware of, and increase their interest in, career opportunities in agrifood, digital agriculture and plant protein.</p> <p>The Natural Sciences and Engineering Research Council has provided \$1.65M to the Universities of Saskatchewan, Alberta and Manitoba for a six-year interdisciplinary Canadian Agri-food Protein Training, Utilization and Research Enhancement (CAPTURE) Project⁹. Through the programme, 10 PhDs, 44 master’s students and 17 undergraduates completed training specifically focused on preparing them for careers in the plant protein sector.</p>
<p>Legal & Regulatory Environment</p>	<p>Canada’s Food and Drug Regulations (FDR) categorise cultivated meat and seafood as “novel foods”, requiring the submission of detailed information in an application for premarket approval before being advertised or sold.</p>
<p>Indigenous peoples</p>	<p>Within PIC’s Capability investment stream, a recently completed project ‘Advancing Innovation in Indigenous Agriculture/Agrifoods sector’ has developed a five-year strategy to address gaps and barriers and explore opportunities to improve indigenous participation in the Agrifood sector, especially in segments such as plant protein¹⁰.</p>

“The Protein Industries Canada Supercluster is great news for the economy of the Prairies and for Canadian agriculture.

By bringing together the best brains from business, academia and non-profits, we're positioning our talented workers to be global leaders in the fast-growing plant protein market.”³

Ralph Goodale, Member of Parliament for Regina – Wascana

DENMARK

Ambitious plans to grow a circular bioeconomy in support of climate neutrality goal.

“Six out of ten Danes agree that Denmark should take the lead in terms of being world leaders at producing plant-based foods.”¹

Vegconomist, 2020 poll

Population: 5.8 Million

GDP: \$357,000 Million USD

Contribution to GDP from agriculture: \$4,600 Million USD

% GDP from agriculture: 1.3%

Government investment as percentage of agriculture-related GDP: 6.3%

Key drivers: \$ 

Rating: 

The Danish industry association for farmers and food manufacturers and government have committed to Denmark having a climate neutral food production system by 2050.

There is a strong focus on developing the Danish plant-based sector, with the goal of capturing 1-3% of the global market for plant-based foods. Much of the investment is in creating a circular bioeconomy approach including some animal (ruminant, fish and insects) and biotechnology production systems.

Between now and 2030 the Danish government has committed a total of 12.5B DKK (USD\$1.76B) to The “AgriFoodTure” Roadmap to enable Denmark to develop climate and environment-friendly agriculture and food production. DKK 1.25B (USD \$176M) of these funds will be used to support the transitioning of land use and the R&D and commercial activities related to a plant-based foods sector.

The government has already provided around DKK 310M (US\$43.7) to projects related to alternative proteins.

Key observations

Denmark has set the goal of capturing 1-3% of the global market for plant-based foods by 2030 which it estimates would be worth 4.5-13.5B DKK (USD \$633M-1.9B) and generate between 9,000 and 27,000 new jobs².

With no current infrastructure in the alternative proteins space, it is making considerable investment now in order to achieve this goal and climate neutral food production by 2050.

References are provided on pg 57

In October 2021, the Danish government committed DKK 1.25B (USD \$171M) to support the transitioning of land use and the R&D and commercial activities related to a plant-based foods sector³. This includes:

- 580M DKK (USD \$82M) for a Plant-based Eco-scheme that provides incentive payments over five years for farmers who grow plant-based crops for human consumption.
- 675M DKK (USD \$95M) for a contestable 'Fund for Plant-based Food Products' ('Plantefonden')⁴ that can be used to support R&D or commercial activities including variety development, cultivation, processing, marketing and education. The Danish Plant-Based Business Association is on the Board for this fund and will have input into how it is allocated.
- 260M DKK (USD \$37M) to support the R&D and commercialisation related to the production of proteins from fermentation, cell-cultured meat, and the biorefining of various green leaf proteins for food and feed.

The Ministry for Food, Agriculture and Fisheries committed an additional DKK 20M (USD \$2.8M) in March 2022 in contestable funding to accelerate the development of the plant based food and feed sector⁵.

The 'AgriFoodTure' Roadmap²

This Roadmap, published May 2021, will form the basis of an industry-government research mission on climate and environmentally friendly agriculture and food production.

It is estimated that its delivery will cost around DKK 12.5B (USD\$1.76B) between now and 2030, funded through a combination of public and private sector sources. This includes DKK 3.9B (USD \$550M) towards the construction of processing facilities.

The Roadmap identifies well defined targets and activities. Two of the four key tracks of work are directly related to alternative proteins:

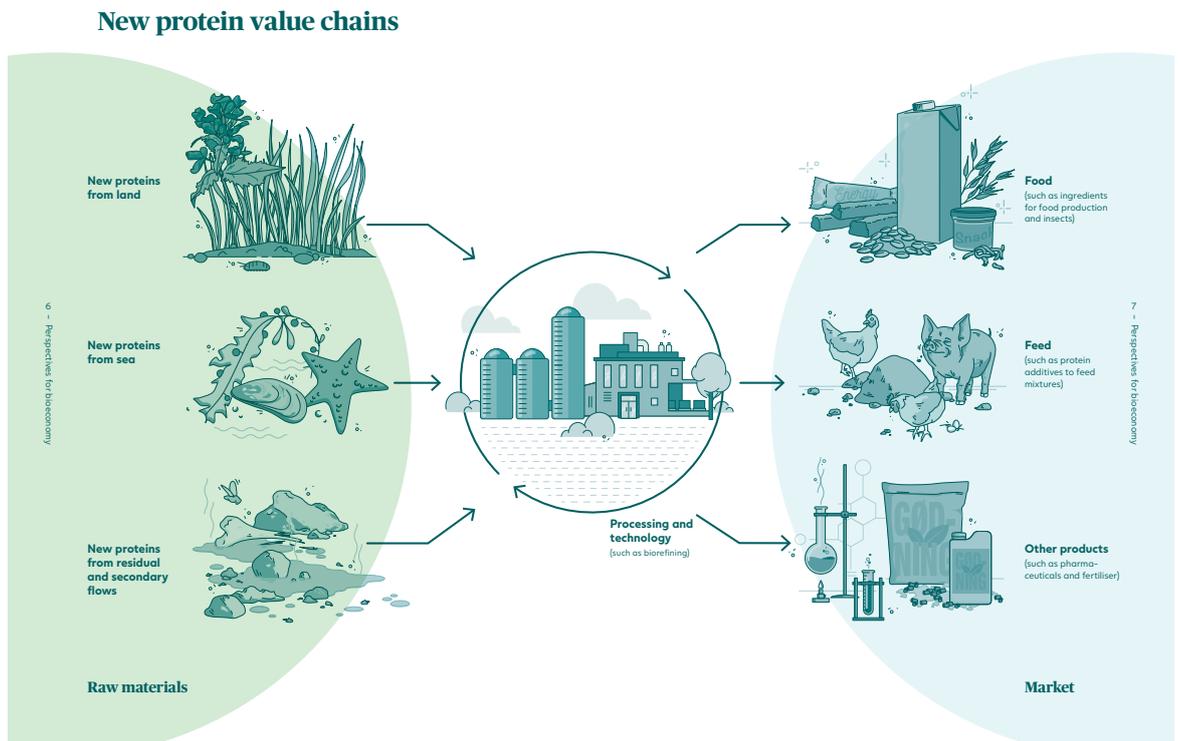
- Plant-based food production. This includes a broad range of initiatives across the value chain that aim to reduce the use of pesticides by 50%, reverse the decline of pollinators and improve water quality, increase crop production efficiency by 10% by 2030, and enable the development of a range of unprocessed, gently processed, and fermented, nutritious, and tasty plant-based food products.
- Biotechnology-based food production and alternative protein sources. This includes green leaf biorefining for feed and food, cellular agriculture, alternative proteins and side-stream upgrades, new functional feed additives and biologicals, and food processing technology to reach circularity

An initial DKK 201M (USD \$28.3M) was been committed by the Danish government to progress the AgriFoodTure agenda in April 2022⁶.

What's driven this investment?

Two reports by Denmark's National Bioeconomy Panel, provide an insight into what led the government and industry to set their ambitious goals and commit funding to Denmark's alt protein economy.

- **'Proteins for the future'** ⁷ July 2018, identified the need to develop new bioeconomy systems and value chains. It states "New protein value chains means the development of new proteins (such as grass or insects), new processing technologies, and new products in the range of feed and food." Proteins from land, sea and 'residual and secondary flows' aka by-products and waste streams are considered within scope, with the resulting materials going into food, feed and 'other' (pharma, fertiliser) applications.



- **'Plan of action for new sustainable proteins'** ⁸ October 2018, concluded that the majority of Denmark's new proteins will likely come from high-protein agricultural crops such as grass, clover, and legumes. The challenge lies in refining the raw material into a product that can compete with other protein products on price and quality.

DENMARK

We created a wind energy sector, because we were not afraid to be first movers and invest in tomorrow's solutions – before everyone else.

If we work together to find climate solutions for the food industry, we have the ability to create a new adventure, where Denmark yet again will be the pioneer for something that does not only benefit ourselves, but also the rest of the world." ⁹

Anne Lawaetz Arnhung, CEO of The Danish Agriculture and Food Council

At a glance

Strategies & Initiatives	<p>In October 2021, the Danish government and many of the other political parties announced a number of ambitious targets related to the ‘Green Conversion of Agriculture’, including reducing greenhouse gas and nitrogen emissions¹⁰.</p> <p>The AgriFoodTure Roadmap² will form the basis of a industry-government research mission on “Climate and environment-friendly agriculture and food production”.</p>
Agencies & Entities	<p>Ministry of Food, Agriculture and Fisheries of Denmark¹¹. The Danish government’s ministry responsible for most of the initiatives related to green agriculture and alternative protein production.</p> <p>The Danish Plant-Based Business Association¹². The trade association for importers and producers of plant-based foods. The Association is well connected with the Danish government, and will be involved in the allocation of the Plant Fund.</p> <p>The Danish Agriculture & Food Council¹³. Represents the farming and food industry of Denmark including companies, trade and farmers’ associations.</p>
Funding & Investment	<p>>DKK 1.25B (>US \$176M) in government funding between 2022 and 2030 for green initiatives³, including:</p> <ul style="list-style-type: none"> • DKK 580M (USD \$82M) to plant-based food farmers over 5 years (2023 – 2027). • DKK 675M (USD \$95M) from 2022 to 2030 to support the transition to plant-based foods. • DKK 260M (USD \$37M) to support the R&D and commercialisation of the biorefining of various green leaf proteins for food and feed. • DKK 201M (USD\$28M)⁶ for industry-government research mission ‘AgriFoodTure’¹⁴ (originally “Climate and environment-friendly agriculture and food production”). • DKK 20M (USD \$2.8M) to accelerate the development of the plant based food and feed sector . <p>The government has also committed to DKK 2.3B (USD \$324M) pa funding for green research, but it is not known how much of this will go towards alternative protein related projects.</p> <p>Other government investments (approx. DKK 310M or US\$43.7M) include:</p> <ul style="list-style-type: none"> • DKK 250M (US\$35M) from the Danish Green Investment Fund (a government loan fund) to help Meelunie GPI A/S build a factory for extracting protein from flava beans. • DKK 8.4M (US\$1.2M) from Innovation Fund Denmark for PlantPro, a collaboration of 15 companies from the food industry and 3 Danish universities, which will investigate how to support a green transition within the country’s food system, focusing on consumer behavior, plant-based foods, and reducing food waste. • DKK 19M (US\$2.7M) from Innovation Fund Denmark for Project inVALUABLE (Insect Value Chain in a Circular Bioeconomy) that will establish the industrial production of insects for feed and food. • DKK 15M (US\$2.1M) from the Ministry of Environment & Food to a consortia of businesses to help establish an industrial black-soldier-fly production site.

	<ul style="list-style-type: none"> • DKK 8M (US\$1.13M) from Innovation Fund Denmark to SUSMEAL (Sustainable Mealworm Production for Feed and Food) for R&D related to converting organic residues and waste into optimised feed for mealworms. • DKK 10M (US\$1.4M) from the Ministry of Foreign Affairs of Denmark - Danish International Development Agency to the University of Copenhagen for 'GREEiNSECT' - a collaborative research consortium of universities and private partners aiming to investigate how insects can be utilized as supplementary sources of protein by means of mass production in small to large scale industries in Kenya.
Targets & Dates	<p>The Danish food industry has committed to being climate neutral by 2050⁹.</p> <p>Targets from the Green Conversion of Agriculture agreement¹⁰:</p> <ul style="list-style-type: none"> • Agricultural greenhouse gas emissions will be reduced by 55-65% by 2030. • Nitrogen emissions will be reduced by 10,800 tonnes by 2027. <p>A selection of targets from the AgriFoodTure Roadmap² for 2030:</p> <ul style="list-style-type: none"> • Minimum 50% reduction in direct methane emissions accompanied by at least a 40% reduction in the carbon footprint of the dairy and meat products. • 10% reduction in excretion of N from livestock production • 5% of Danish animal protein will be from insects • Green protein to displace all imported soy protein in organic feed and 5% of conventional feed. Feed is partially replaced by products generated from waste. • Alternative protein sources will constitute 10-20% of national consumption of protein. • Food Processing sector to achieve a 70% reduction in CO2 emissions, 50% increase in energy efficiency and 30% reduction in water use.
Infrastructure & Facilities	<p>A couple of large infrastructure investments have been announced, with more anticipated as the AgriFoodTure and Plant Fund initiatives get underway:</p> <ul style="list-style-type: none"> • DKK 250M (US\$35M) from the Danish Green Investment fund to help Meelunie GPI A/S build a factory for extracting protein from flava beans. • DKK 15M (US\$2.1M) from the Ministry of Environment & Food to a consortia of businesses to help establish an industrial black-soldier-fly production site.
Relationships & Partnerships	<p>The AgriFoodTure Mission is the most significant government-industry collaboration in the alternative proteins space.</p>
People & Talent	<p>There are a number of PhD projects related to alternative proteins that have been funded by government or industry, but there is not currently any major initiatives focusing on capability development. This will change as the AgriFoodTure and Plant Fund initiatives get underway.</p>
Legal & Regulatory Environment	<p>This has not been noted as either a barrier or an accelerator for the Danish alternative proteins sector.</p>

IRELAND

Climate neutral ambitions for sector focused on grass-based livestock production.

Population: 5.0 Million

GDP: \$385,000 Million USD

Contribution to GDP from agriculture: \$4,330 Million USD

% GDP from agriculture: 0.9%

Government investment as percentage of agriculture-related GDP: 0.14%

Key drivers: \$ 

Rating: 

Ireland has published a 10-year agrifood strategy 'Food Vision 2030' with ambitions of a climate neutral food system by 2050, with verifiable progress by 2030.

The strategy recommends that the Irish agrifood sector become more diversified, resilient and based on circular economy principles. However, the strategy also explicitly states that the future Irish agrifood sector will continue to be built on grass-based livestock production.

Ireland's agri-food sector is very similar to New Zealand's and is positioning itself to be a world leader in the production of natural, premium and sustainably-produced food.

Thus far no funding has been announced to support the implementation of the strategy, and very little funding for alternative proteins has been provided by the government generally.

Key observations

"Food Vision 2030" is a 10-year agrifood Strategy¹ for Ireland launched in August 2021 by the Department of Agriculture, Food and the Marine. The Strategy identifies sustainability as being the key focus for the sector. It states that meeting the highest standards of sustainability (economic, environmental, and social) will also provide the Irish agrifood sector with the basis for its future competitive advantage, and deliver significant benefits for the sector, society and the environment.

"[Food Vision 2030] signals policies to make the sector more diversified, resilient and based on circular economy principles."¹

Tom Arnold, Stakeholder Committee Chair "Food Vision 2030"

References are provided on pg 57

Food Vision 2030 includes two initiatives related to alternative proteins, although it is difficult to ascertain the level of investment proposed:

1. A Climate Smart, Environmentally Sustainable Agri-Food Sector. One of the goals of this Mission is to ‘Embed the Agri-Food Sector in the Circular, Regenerative Bioeconomy’. Some examples of possible actions include: develop microbiome-based and smart protein-based solutions, the recovery of nutrients, bio actives from food and fibre processing to generate bio based materials and energy, reducing energy use and increasing energy efficiency.’
2. Viable and Resilient Primary Producers with Enhanced Well-Being. This includes a goal to ‘Increase Primary Producer System Diversification’, with an associated action to reduce dependence on imported protein crops and open up opportunities in the bioeconomy.

The Food Vision 2030 Strategy has not been without controversy. It is noted in the Foreword that the Environmental Pillar representative withdrew from the Committee in February 2021, stating their view that the Pillar’s recommendations were insufficiently reflected in the draft.

The Strategy does include recommendations that Ireland look to take advantage of the increasing opportunities to provide consumers with meat and dairy alternatives and vegan or flexitarian options.

It is interesting to note that the desired position for Ireland outlined in the Strategy closely parallels the desired position for Aotearoa New Zealand that is articulated by many within our government and agrifood sector – for example, the following from ‘The Place of Irish Agri-Food in the World’ (pg 37):

“The Irish agri-food sector needs to respond to these trends by investing in product development and positioning itself as a global leader in the production of natural, premium, sustainably-produced food.

Ireland’s largely grass-fed livestock production system already has a natural advantage in the marketplace, reflected in the Origin Green programme, but its credentials will be vulnerable to challenge if key environmental indicators are going in the wrong direction.

Increased demand for meat and dairy alternatives, vegan or ‘flexitarian’ choices, offer positive opportunities to grow Ireland’s horticulture and tillage sectors.”

IRELAND

“Worldwide, but particularly in high-income countries, more fruits and vegetables and less ultra-processed foods should be consumed in the interest of public health.

But this does not mean that Ireland should make radical changes from its role as a producer and exporter of safe, high quality and sustainably produced livestock products: this would not make sense from a global environmental or nutrition perspective.”¹

Tom Arnold, Stakeholder Committee Chair “Food Vision 2030”

At a glance

Strategies & Initiatives	Food Vision 2030 ¹ aims to position Ireland as an international leader in Sustainable Food Systems.
Agencies & Entities	<p><u>Department of Agriculture, Food and the Marine</u>². Government department that commissioned the Food Vision 2030 Strategy</p> <p><u>Irish Agri-food Strategy Stakeholder Committee</u>¹. The group tasked with overseeing the development of the Food Vision 2030 Strategy. Its members include representatives from industry, research and government organisations from a broad cross section of agrifood and related areas.</p> <p><u>Teagasc</u>³. The government agency providing research and development, training and advisory services for the agri-food sector.</p>
Funding & Investment	<p>The Department of Agriculture, Food and the Marine funding has been provided to two large multi-year projects various Irish Universities and Teagasc:</p> <ol style="list-style-type: none"> A grant of an undisclosed amount for 'ReValue Protein'⁴, exploring opportunities to obtain additional value from low, neutral or negative value meat processing streams. Approx. €3M for the 'U Protein'⁵, which aims to aid the development of a circular and regenerative bioeconomy. It includes work exploring sustainable crop and marine-based resources as alternative sources of protein. <p>The Department also operates a Protein Aid Scheme⁶, which is effectively a subsidy for farmers who grow beans, peas, and lupins for domestic animal feed. The rate for 2020 was set at €215 per hectare, and approx. €3M was paid out.</p>
Targets & Dates	A climate neutral food system by 2050, with verifiable progress by 2030 ¹ .
Infrastructure & Facilities	Teagasc and several of the Irish universities have facilities that include equipment relevant to alternative proteins R&D at a lab and/or pilot scale. At this stage there have not been any larger scale investments in alternative proteins related infrastructure.
Relationships & Partnerships	Irish universities, Teagasc and industry partners are working together on ReValue Protein' and 'U Protein', funded by The Department of Agriculture, Food and the Marine.
People & Talent	There have been a small number of PhD opportunities advertised for individual projects. At this stage there is no coordinated approach to capability development, nor any alternative proteins-focused education or training opportunities.
Legal & Regulatory Environment	Ireland is part of the EU, and thus comes under the same general restrictions related to the applications of genetic technologies in agriculture and food ⁷ .

ISRAEL

An innovation ecosystem focused on the development of technology and intellectual property.

Population: 9.2 Million

GDP: \$374,000 Million USD

Contribution to GDP from agriculture: \$4,370 Million USD

% GDP from agriculture: 1.2%

Government investment as percentage of agriculture-related GDP: 1.19%

Key drivers: \$

Rating: ★★

Israel's alternative proteins sector is one of the most active in the world. Around \$623M was invested in Israeli-based alt protein start-ups in 2021¹, up from \$114M in 2020.

In 2021 there were more than 100 companies active within the alternative proteins sector², with around 40 of these being start-ups and the rest medium to large firms. An additional 11 alternative protein start-ups were launched in Israel in 2021, the largest number of any country.

This growth is despite there being little government funding dedicated to specifically targeting or growing the sector. This suggests that Israel's innovation ecosystem can provide sufficient support for alternative protein companies and start-ups, just as it has been for the numerous Israeli start-ups in other discipline areas.

Key observations

Israel is a small nation with limited natural resources, which has forced it to be innovative in the use of technology related to agricultural systems and food production. It has a highly functional ecosystem that includes large numbers of start-ups, multinationals, venture capital firms and government.

Israel is unlikely to be the end producer of most of the food products arising from the alt proteins technologies it develops. The majority of Israel's activity is at the intersection of technology/innovation and agriculture/food, with a focus mainly on plant-based foods, cell culture and precision fermentation.

The government does not appear to have a specific strategy for the alternative protein sector nor alignment with government agendas in sustainability or food security at this stage.

A broad economic imperative underpins all government investments the tech ecosystem – financial benefit will accrue to Israel from the export of IP and acquisition of new businesses, and through the attraction of R&D investment due to the highly skilled and entrepreneurial workforce.

"Alternative protein production could prove to be a central economic growth engine for Israel.

If the Israeli government supports this industry, the country could enjoy 11,000 additional jobs that would earn billions of dollars each year.

Moreover, Israel – which currently exports only 5% of the food it produces – could become a global supplier of raw materials and advanced production technologies for alternative proteins.”³

Israel Prime Minister Benjamin Netanyahu

Graphic summary from the 2022 State of the Industry Report:

The most significant government investment in the sector was signalled by the Israel Innovation Authority (IIA) in October 2021 when it announced US\$69M funding for four consortia, two of which are related to alt proteins⁴:

- The Cultivated Meat consortium will be led by the innovation division of Tnuva, an Israeli food company with a significant share in the dairy market. It will work in collaboration with Israeli cultivated meat companies, various startup companies relevant to this field, industrial companies for the production of animal meat products and leading researchers from Israeli academia and aims to help Israel “maintain its status as one of the world leaders in the field”.
- The Insect Farming consortium will focus on the development of technologies surrounding black soldier flies (*Hermetia illucens*) and their larvae, insects that are being touted as an essential part of the agricultural industry to break down organic waste, and protein-packed, inexpensive animal feed.

Summary of the Israel Alternative Proteins Sector



Private investment:

\$623M - total raised in 2021 by Israeli startups

~**450%** YoY Growth

11 - new companies established during 2021



Government funding:

\$13 million in early stage startups and infrastructure

\$15M* cultivated meat consortium

* Initial approval received, pending final approval



Israel as a global leader in 2021:

36% of global investment in cultivated proteins

#2 in the world in global alternative protein investment

#2 in the world in number of cultivated and fermentation startups

#1 in the world in number of alternative seafood startups founded in 2021



Academia:

2 - startups based on GFI research grants established

39 - number of active researchers

GFI grants in Israel: total - **11**, new in 2021 - **7**



Market data:

\$254M - 2021 total plant-based Israeli retail market

Plant-based retail sales showed two-year growth over **7 times** as large as animal-product retail

Plant-based milk made up **16%** of all milk retail sales

Image from the Good Food Institute 2022 State of the Industry report², page 5.

References are provided on pg 58

At a glance

<p>Strategies & Initiatives</p>	<p>The Israeli government does not appear to have a specific strategy for the alternative protein sector at this stage. However, the Israeli Good Food Institute reports it is working closely with the government to develop a National Plan for the alternative protein sector.</p> <p>There are two key initiatives currently underway:</p> <ul style="list-style-type: none"> • The Israeli Innovation Authority (IIA) has provided funding to establish industry-led consortia on Cultivated Meat and on Insect Farming (\$69M spread across four consortia)⁴. • The National Food Institute for Food Innovation will be established, supported by a \$6.2M government grant⁵. It will provide a "one stop shop" for food companies and startups, and will include advanced pilot facilities, analytical equipment, product development services, regulatory and nutritional consulting, and act to disseminate information and build networks.
<p>Agencies & Entities</p>	<p><u>Good Food Institute Israel</u>⁶ (GFI Israel). A very active privately funded organisation that is driving many of the initiatives related to alternative proteins. It released a major report on the state of the sector in April 2021⁹ and report that it is working with the Israeli government to convert this into a National Plan for the sector. They consider themselves the thought leader in Israel for alternative proteins.</p> <p><u>Israeli Innovation Authority</u>⁷ (IIA). An independent government funded agency that provides practical tools and funding platforms aimed at effectively addressing the dynamic and changing needs of the local and international innovation ecosystems.</p> <p>The Israeli government has appointed an 'alternative protein coordinator' to lead the government's commitment across all relevant agencies. There has been at least one Israeli Government Alt Protein Roundtable discussion featuring 30 senior officials across 10 different ministry offices⁸.</p> <p>There are 7 privately funded incubators and accelerators active in the alternative protein space. The most well known are:</p> <ul style="list-style-type: none"> • The Kitchen⁹, which claims it was the world's first food-tech hub. The Kitchen was launched in 2015 by The Strauss Group, one of Israel's largest food producers, as part of the IIA's Technological Incubators Program. • Fresh Start¹⁰ was established in 2019, also as part of IIA's Technological Incubator Program. It is operated by a consortia involving Finistere Ventures, a global agrifood investment leader, OurCrowd, Israel's most active venture investor, Tnuva, Israel's largest food manufacturer, and Tempo Beverages, the leading Israeli beverage company.
<p>Funding & Investment</p>	<p>The IIA has provided \$11M in funding to alternative protein start-ups. It announced in October 2021 it would provide a further \$69M to establish four new consortiums in the fields of cultivated meat (or lab-grown meat), insect farming, fluid sampling for medical diagnosis, and human-robot interface⁴.</p>
<p>Targets & Dates</p>	<p>None publicly disclosed by the Israeli government at this stage.</p>

Infrastructure & Facilities	<p>The government's plans for a 'National Food Institute'⁵ includes state-of-the-art pilot scale facilities (building on those already at Tel Hai Academic College and MIGAL research institute. Other universities active in the alternative proteins space (including Technion, The Hebrew University of Jerusalem, Tel Aviv University and Ben Gurion University have varying levels of relevant pilot plant facilities. public.</p> <p>Many of the alternative protein companies are establishing their own plants and factories without government support (i.e. Future Meat Technologies and Aleph Farms).</p>
Relationships & Partnerships	<p>The two IIA consortia (cultured meat and insect farming) are both formed from established industry, start-ups and academics.</p> <p>The entire Israel Innovation ecosystem is highly connected internationally, both to top research organisations and venture capital firms.</p>
People & Talent	<p>GFI Israel has developed and coordinates a single semester (26hrs lectures + a project) alternative protein academic course for undergraduate and graduate students at The Hebrew University of Jerusalem, Tel Aviv University and Ben Gurion University¹¹. Discussions are underway for other universities in other countries to offer the GFI Israel course as well. Tel Aviv had over 70 students enrol in the course when it was made available in 2020.</p> <p>Technion University has developed its own alternative protein course with support from GFI Israel.</p>
Legal & Regulatory Environment	<p>GFI Israel have noted that obtaining regulatory approvals was one of the key challenges facing the Israeli Alternative Proteins Ecosystem. This was not explained further, but a comment in a press article¹² noted that Israel "does not have a dedicated regulatory body for such products. Instead, Israel waits for at least two other countries to approve a food product before considering it and approving."</p> <p>There are a number of successful start-ups based in Israel that are using genetic engineering at R&D scale, but none that are currently producing these products at commercial scale – instead, they are looking at establishing production facilities in Singapore and/or the USA.</p>

New Institute will assist the alternative proteins sector

The Israeli government has recently announced plans to establish the National Food Institute for Food Innovation⁵, which will strengthen Israel's entire food sector.

The Institute will be co-owned by a business partner and Tel Hai Academic College and MIGAL research institute and supported by a \$6.2M government grant.

The Food Institute will be a "one stop shop" for food companies and startups. It will include pilot-scale facilities, analytical equipment, product development services, and regulatory and nutritional consulting.

The model is based off the industry-led Protein Innovation Centre recently opened in Singapore¹³.

THE NETHERLANDS

Disrupting traditional livestock farming systems to advance plant-based and cellular agriculture and food products.

Population: 17.4 Million

GDP: \$914,000 Million USD

Contribution to GDP from agriculture: \$16,330 Million USD

% GDP from agriculture: 1.6%

Government investment as percentage of agriculture-related GDP: 0.41-158%

Key drivers: 

Rating: ★★★★★

Despite its small size, the Netherlands is already one of the leading proponents of plant-based meat and dairy alternatives internationally.

To enable the Netherlands to meet climate targets and encourage Dutch consumers to have healthy and sustainable diets, the government is providing significant financial support to reduce traditional livestock farming and develop a cellular agricultural ecosystem.

In December 2021, the Dutch government unveiled a €25B plan to reduce the number of livestock in the country by a third. More recently (April 2022) as part of its implementation of the National Protein Strategy, the Netherlands Government has awarded €60M to support the creation of a domestic cellular agriculture ecosystem. The amount represents the largest ever single investment into cellular agriculture by a government globally.

The National Protein Strategy also includes a potential goal for 20% of protein in human food and 10% of proteins in livestock feed to be replaced by insect proteins by 2025

Key observations

The Netherlands is the second-largest exporter of food product by value. It achieves this by a combination of intensive high-tech systems (i.e. it leads the world in the technologies related to highly controlled glasshouses for food production) and taking advantage of its location and long history as a trading nation to import raw materials, add value, then export. It can be more agile in responding to changing consumer expectations and regulatory requirements than those relying on the growing or producing of raw materials, meaning Dutch firms can pivot their production systems faster.

Much of the current focus on alternative proteins within the Netherlands can be traced to a report 'Sustainable and Healthy'¹ released in 2018. This report explicitly stated that meeting climate targets required a new food policy, specifically reducing animal protein in the diet from 60% to 40% by 2030.

References are provided on pg 58

“The Netherlands is often a good staging ground for companies that want to distribute their product to mainland Europe. It's easy to reach several big markets in a day - France, Germany, the UK.

That central location also often helps with research and development because companies can test their plant-based proteins on different consumers.”

Martijn Lammers, Netherlands Foreign Investment Agency

Since then the government has taken a whole of supply chain approach, working with everyone from farmers to manufacturers, retailer to consumers.

1. The National Protein Strategy released in December 2020, aimed to enhance the cultivation of protein-rich crops over the next five to ten years, enabling The Netherlands to increase its level of self-sufficiency for new and existing vegetable proteins. The five key areas of activity are:
 - Greater cultivation of protein-rich crops (i.e., potatoes, grass and legumes, including field beans).
 - Stimulation of the development of alt-protein sources for humans and animals, such as microbial proteins and cultured meat.
 - Production of insects for animal feed and food, with a potential goal of 10% of proteins in livestock feed and 20% of protein in human food could be replaced by insect proteins in the Netherlands by 2025.
 - Monetisation of by-products through their conversion to or extraction of proteins.
 - Increased vegetable consumption and improved sustainability of diets through the offering of new food products and further educating of consumers.
2. The Ministry of Agriculture, Nature and Food Quality's budget increased from €0.8B in 2018 to more than €2B in 2021. The 2021 budget identified 4 key areas for investment, one of which was The National Protein Strategy.
3. In December 2021, the Dutch government unveiled a €25B plan to reduce the number of livestock in the country by a third. Farmers will be offered financial incentives to sell their farms, relocate to another country or transition to less intensive farming methods. This has been framed as a voluntary process, although penalties for excess nitrogen are also being discussed.
4. More recently (April 2022) as part of its implementation of the National Protein Strategy, the Netherlands Government has awarded €60M to support the creation of a domestic cellular agriculture ecosystem². The amount represents the largest ever single investment into cellular agriculture by a government globally. It is anticipated that the proposed Dutch cellular agriculture sector GDP growth will reach between €10-14M per year, with at least 12 megatonnes of CO₂ emissions and 100-130 kilotonnes of ammonia per year negated by 2050. The €60M is reportedly just for the first phase of activity, with more government funding anticipated in coming years.

At a glance

<p>Strategies & Initiatives</p>	<p>The National Protein Strategy (2020) forms part of a wider EU ambition for food sovereignty, to reduce the dependence on imported plant protein.</p> <p>In December 2021, the Dutch government unveiled a €25B plan to reduce the number of livestock in the country by a third. Farmers will be offered financial incentives to sell their farms, relocate to another country or transition to less intensive farming methods.</p> <p>More recently (April 2022), the Government announced a €60 million investment into the development of a cellular agriculture ecosystem.</p> <p>Other initiatives of interest include:</p> <ul style="list-style-type: none"> • Foodvalley NL’s Sustainable Protein System theme and The Protein Community, which both bring together large numbers of different stakeholders to explore collaborative opportunities; • The Green Alliance, which is a collaboration of food manufacturers, food service providers, knowledge providers and government that is focusing on getting more plant-based products into Dutch diets; • The New Food Challenge that provided funding for start-ups in plant-based protein products; • A renewed framework for public food advice, called The Wheel of Five³, which specifically promoted choosing plant protein sources over animal protein sources; • The Netherlands Government has confirmed that it is prepared to introduce taxes on less sustainable foods, with the proceeds being used to support more sustainable food options. Meat and sugary drinks have been proposed as two potential groups that may be considered for taxes.
<p>Agencies & Entities</p>	<p>Ministry of Agriculture, Nature and Food Quality⁴. Responsible for agricultural policy, food policy, food safety, fisheries, forestry, natural conservation and animal welfare.</p> <p>Ministry of Economic Affairs and Climate Policy⁵. Promotes the Netherlands as an innovative, entrepreneurial, powerful and sustainable country.</p> <p>Dutch Research Council (NWO). One of the most important science funding bodies in the Netherlands. Each year, NWO invests almost 1 billion euros in curiosity-driven research, research related to societal challenges and research infrastructure.</p> <p>Netherlands Nutrition Centre. An independent government-funded organisation that promotes healthy, safe, and more sustainable food.</p>
<p>Funding & Investment</p>	<p>The Ministry of Agriculture, Nature and Food Quality’s budget increased from €0.8B in 2018 to more than €2B in 2021. The 2021 budget identified 4 key areas for investment, one of which was The National Protein Strategy.</p> <p>Specific funding from Government includes:</p> <ul style="list-style-type: none"> • €25B to support the reduction of livestock numbers and transition to other farming systems. • €60 million to support the establishment of a cellular agriculture ecosystem in The Netherlands. This is the initial phase of a proposed larger investment plan. • €1.8M for promising ideas and start-ups related to plant-based foods in the ‘New Food Challenge’. • A range of R&D projects involving university and industry consortia, including €1.7M for yeast production of milk, €1.0M for research on how to increase the market share of meat and dairy replacements, and an unknown amount to support the Green

	<ul style="list-style-type: none"> • Funding from NWO for a range of R&D projects involving university and industry consortia. These include €1.7M for yeast production of milk, €1.0M for research on how to increase the market share of meat and dairy replacements, and unknown amounts for projects on insect farming, protein utilisation from legumes, and the use of coconut water as a substrate for growing recombinant proteins, • Undisclosed funding to support the Green Protein Alliance, The Protein Community, and FoodValley NL's Sustainable Protein theme.
Targets & Dates	<p>A key target for the National Protein Strategy is to reduce animal protein in the Dutch diet from 60% to 40% by 2030.</p> <p>A second target is to reduce the environmental footprint of protein production (measured in land use, greenhouse gas production, nitrogen, etc.) by 50%.</p> <p>The National Protein Strategy also includes a potential goal of 10% of proteins in livestock feed and 20% of protein in human food could be replaced by insect proteins in the Netherlands by 2025</p>
Infrastructure & Facilities	<p>There have been no large Government grants specifically for the development of infrastructure thus far, although universities such as Wageningen and Utrecht have invested in laboratory and pilot scale facilities themselves.</p> <p>The €60M for development of a cellular agriculture ecosystem does include funding for establishing open access pilot scale facilities, but this has only just been announced so is likely to be 2023-24 before such a facility is available.</p> <p>The Netherlands has a large number of contract manufacturing facilities that can produce various plant-based food products at a range of scales.</p>
Relationships & Partnerships	<p>The Netherlands has a strong emerging proteins ecosystem with a number of consortia in various parts of the sector. The 'quadruple helix' of industry, knowledge providers, government and public being core stakeholders within many initiatives.</p> <p>The government recognises the value of the ecosystem management and consortia approach, and has provided funding to assist with the establishment and/or operation of a number of these, including Foodvalley NL, The Protein Community, Green Protein Alliance, a range of R&D projects, and most recently Cellular Agriculture Netherlands.</p>
People & Talent	<p>There have been a number of funded research grants for PhD positions with both Utrecht University and Wageningen.</p> <p>Founded in 2020, the Wageningen Alternative Protein Project is a student-led initiative that advocates for the research and development of alternative sources of protein to the conventional meat, eggs, and dairy. This includes plant-based protein, biomass and precision fermentation, and cultured meat. The project is supported by the Good Food Institute, an international non-profit working to foster research and innovation in alternative proteins. It now has a network of student participants from across multiple universities, each defining their own projects and priorities.</p>
Legal & Regulatory Environment	<p>In parallel with the recent investment in cultured meat development, the Dutch House of Representatives adopted a resolution in March 2022 to enable tastings of cultured meat under controlled conditions within The Netherlands. The intention here is to create a regulatory environment that will build consumer understanding and acceptance of cultured meat products in parallel with the new product development.</p>

Consumer attitudes

According to a 2021 survey, the majority of Dutch citizens are in favour of more government action to reduce meat consumption and promote alternative proteins.

The research involved more than 8,500 participants, and found most Dutch consumers supported a reduction of animal protein consumption by at least a third over the next five years. More than 7 in 10 participants said that they believe in swapping out meat and dairy products for vegan alternatives. Although 85% of respondents said that dietary preferences should remain a personal choice, approximately 70% said that the government should actively encourage choosing more plant-based options.

Tangible indications of the level of consumer support for plant-based foods within The Netherlands, a fully vegan supermarket, Vegan Fresco, opened in Amsterdam in late 2020, and in early 2022 leading Dutch supermarket Albert Heijn has pledged to ensure 60% of proteins available in-store are plant-based by 2030.

European Union initiatives – relevant to all EU members

As part of the EU's priorities for 2019-2024, 'A European Green Deal' outlines initiatives that will transform the EU into a modern, resource-efficient and competitive economy, ensuring:

- no net emissions of greenhouse gases by 2050;
- economic growth decoupled from resource use;
- no person and no place left behind.

One third of the €1.8 trillion investments from the NextGenerationEU Recovery Plan, and the EU's seven-year budget will finance the European Green Deal.

The European Commission adopted a set of proposals to make the EU's climate, energy, transport and taxation policies fit for reducing net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels.

The Deal is directing the agrifood industry towards initiatives that will improve the sustainability of existing animal production systems. It is also promoting the development of 'sustainable' alternative proteins, such as plant, unicellular and insect-based proteins.

SINGAPORE

Providing food security and economic opportunities through embracing cutting edge technologies for food production.

Population: 4.0 Million

GDP: \$377,000 Million USD

Contribution to GDP from agriculture: \$130 Million USD

% GDP from agriculture: 0.02%

Government investment as percentage of agriculture-related GDP: 45%

Key drivers:  

Rating: ★★★★★

Singapore is rapidly establishing itself as the global centre for ‘future proteins’. It has the most forward-looking regulatory position for new foods; an increasingly skilled talent pool; and strong connections between research, government and industry (including significant government funding for R&D). This is attracting increasing numbers of firms from start-ups through to multinationals to establish R&D and even manufacturing facilities in Singapore, which is in turn attracting increasing levels of venture capital.

The Singapore Government has committed to producing 30% of the country's food locally and sustainably by 2030 (“30 by 30”). Its ‘Green Plan 2030’ outlines a portfolio of initiatives designed to put Singapore on a path to achieving net zero emissions as soon as possible after 2050. It has also recognised the significant economic benefits arising from becoming an international leader in R&D and production for future proteins.

Much of the visible focus is on ‘biotech-based proteins’ (i.e. cellular agriculture and precision fermentation), but there is also significant R&D activity related to developing the technologies and insights to underpin the next generation of plant-based products. Singapore was the first country in the world to approve the sale of cell cultured meat in 2020.

Key observations

The Singapore Food Agency launched “30 by 30” in March 2019¹, supported by up to S\$140M (US\$101M) of government funding.

- It sets goals to develop Singapore’s agrifood capability and capacity and produce 30% of the country’s nutritional needs locally and sustainably by 2030 - 20% of the fruits and vegetables and 10% of the proteins. Singapore currently imports 90% of its food.
- It is a part of the Green Plan 2030², launched in February 2020, which maps out Singapore’s green targets over the next ten years, specifically to halve its 2030 peak greenhouse gas emissions by 2050, with the aim of achieving net-zero emissions ‘as soon as viable in the second half of the century’.

References are provided on pg 59

- Although much of the focus for protein production is on urban egg farming and sea-based fish farming, new technologies for ‘future foods’ such as cellular agriculture and fermentation-based systems have also been identified as potentially providing both an economic benefit as well as helping achieve the ‘30 by 30’ goal.

Singapore is a small country with a population of 5.45M people³ on approximately 720 square kilometres of land. Around 1% (720 hectares) of this is currently used for farming⁴. Therefore, to achieve the “30 by 30” targets, it will be necessary to utilise high intensity land-based food production systems, distributed urban food production in underutilised spaces, and marine-based systems.

In many instances, the required technology is not yet available, especially at commercial scale, and so the Government is investing significantly into R&D, streamlining the food regulatory system, and providing incentives for international start-ups and innovative firms to locate in Singapore.

The Singapore Food Story R&D Programme, led by Singapore Food Agency (SFA) and A*STAR, has been established to fund R&D that will advance progress towards the “30 by 30” goals as well as provide economic benefits to Singapore.

Within the ‘Future Foods: Advanced biotech-based protein production’ theme of this programme there is a clear focus on cellular agriculture for meat and milk, and precision fermentation.

There are also companies seeking to develop more advanced technologies for the next generation of plant-based foods, as well as a small number of companies looking at insects and microalgae as two other protein options with relatively low land use requirements.

Technology being developed includes protein identification, food safety, nutrition profiles (particularly for the Asia phenotype), protein functionalisation (i.e. developing desirable texture interactions with carbohydrates, fats, etc), and protein extraction (i.e. using sustainable approaches at commercial scale while retaining functionality and desirable flavour profiles).

Singapore is positioning itself as the global centre of biotech-based food proteins.

- Its regulatory environment is supportive and responsive with international credibility. Singapore was the first country in the world to approve the sale of cell cultured meat (2020).
- Singapore has strong relationships between researchers, government and private sector; a skilled talent pool that is being further developed through targeted courses; respected and progressive intellectual property laws⁵; and proximity to both agriculture exporters in Southeast Asia and large numbers of consumers in nearby countries.
- The overall attractiveness of Singapore is reflected in the number of companies opening R&D facilities, including Eat Just, Perfect Day, Next Gen, Givaudan and Buhler. This has led to an influx of venture capital firms and funding. Government agencies have provided funding to assist in businesses establishing R&D, pilot or commercial scale facilities.
- Temasek, a government-owned investment firm, has launched GenZero⁶, a green investment organisation, and made an initial pledge of US\$5B to help accelerate global efforts to cut carbon emissions.

“We have to support innovation in a timely manner; regulators and safety assessors have to work closely with industry scientists and integrate safety as part of the development process, so that we can make sure these novel innovations safely hit our plates now and not 10 to 20 years down the track.”

Dr Benjamin Smith, Director of Future Ready Food Safety Hub (FRESH)

Government investment in infrastructure and business support

Temasek launched the Asia Sustainable Foods Platform in Nov 2021. It aims to provide solutions and support to alternative protein companies as they progress from product development to commercial scale-up.

This includes:

- Providing R&D advisory and pilot-scale manufacturing facilities to support food-tech businesses accelerate their product commercialisation;
- Providing manufacturing capabilities and market insights to support scaling up in Asia; and
- Providing a network of strategic connections and allocation of capital to promising food-tech start-ups.

A key initiative is the establishment of the Food Tech Innovation Centre (FTIC), a one-stop shop where aspiring food-tech start-ups will have access to a food grade pilot scale facility with shared labs and test kitchens, A*STAR's deep R&D know-how, assistance in navigating regulations and support in understanding unfamiliar markets.

The Asia Sustainable Foods Platform and A*STAR's Singapore Institute of Food & Biotechnology Innovation (SIFBI) have committed to investing over S\$30 Million in FTIC over the next three years.

The regulatory environment

Future Ready Food Safety Hub (FRESH)⁷ is a key part of Singapore's alternative proteins ecosystem. It was established to provide a regulatory environment that enables future foods and technologies to be launched first in Singapore, with high standards of food safety.

The FRESH R&D pillar will research, develop, and validate new safety and risk assessment protocols for novel foods and technologies, and support the development of standards and regulations.

FRESH also offers a collaborative environment for start-ups, multinational companies, researchers and regulators to work together to ensure food safety.

At a glance

SINGAPORE

Strategies & Initiatives

The Singapore Food Agency's "30 by 30" vision⁸ is to produce 30% of the country's nutritional needs locally and sustainably by 2030.

The Singapore Food Story R&D Programme⁹, led by Singapore Food Agency (SFA) and A*STAR, has been established to fund R&D that will advance progress towards the "30 by 30" goals and provide economic benefits to Singapore.

The Green Plan 2030¹⁰ maps out Singapore's green initiatives through to 2030.

FRESH¹¹ is providing the regulatory platform to ensure food safety as well as enabling the launch of new-to-market technologies and food products.

**Agencies
& Entities**

Singapore Food Agency (SFA). A statutory board formed under the Ministry of Sustainability and the Environment to oversee food safety and security in Singapore.

Research, Innovation and Enterprise Council (RIEC). Oversees long-term strategy to build strong capabilities in research and technology. It is chaired by the Prime Minister and supported by the National Research Foundation (NRF) Board, which formulates the 5-year plans and policies to grow Singapore's research capability, support economic growth and meet Singapore's future national challenges

Agency for Science, Technology and Research (A*STAR). A government research organisation that undertakes R&D aligned to areas of competitive advantage and national needs for Singapore, including future proteins.

Singapore Institute of Food & Biotechnology Innovation (SIFBI)¹². Part of A*STAR that focuses on 'strain engineering' (synthetic biology and metabolic engineering approaches for biological systems).

Future Ready Food Safety Hub (FRESH)⁷. Established as a joint initiative between NTU, A*STAR and SFA. It aims to strengthen Singapore's food safety ecosystem and support food security goals, meeting the needs of consumers for safe food whether it has come from traditional or future food production systems.

Nanyang Technological University (NTU). One of the top universities in Singapore, and the most active in the Future Foods space.

Temasek. A Singapore government-owned global investment firm that has invested in sustainable proteins, affordable nutrition, and urban food systems. Temasek Foundation is a Not-for-Profit arm which has also been providing funding for agrifood related initiatives.

Enterprise Singapore. The government enterprise development agency that works to help companies to build capabilities, innovate and internationalise.

**Funding &
Investment**

Singapore Food Agency has committed S\$140M (US\$101M) for the "30 by 30" Agenda, which includes biotech-based proteins as one of three themes.

A*STAR:

- S\$1.2M for a joint New Zealand-Singapore Future Foods research programme.
- funded 21 R&D projects through Singapore Food Story's Industry Alignment Fund (IAF). Specific funding per project is undisclosed, but website for the IAF states funding was available of up to S\$15M per project.

Temasek:

- Invested in Seed and Series A funding rounds for both Growthwell Group and Next Gen Foods to help them establish plant-based R&D facilities in Singapore.
- Temasek Foundation has provided grants of S\$1M (US\$0.7M) each to Turtletree Labs (cell cultured milk) and Sophie's Bionutrients (microalgae) to assist them in developing facilities and capability in Singapore.

SEEDS Capital (the investment arm of Enterprise Singapore) invested in a US\$12.6M Series A round for Shiok Meats to establish its first commercial pilot plant for cell based meat production in Singapore.

The Economic Development Board of Singapore invested in a US\$350M Series C round for Nature's Fynd, a US based business using fungi. Nature's Fynd has committed to establishing a facility in Singapore by 2023.

The Government of Singapore Investment Corporation invested in a S\$1B IPO for Monde Nissin, a Philippines-based firm, to support its alternative meats business.

<p>Targets & Dates</p>	<p>Singapore will produce 30% of its nutritional requirements locally and sustainably by 2030.</p> <p>Singapore wants to halve its 2030 peak greenhouse gas emissions by 2050, with the aim of achieving net-zero emissions “as soon as viable in the second half of the century”.</p>
<p>Infrastructure & Facilities</p>	<p>Temasek and A*STAR will invest S\$30 million in the Food Tech Innovation Centre (FTIC) over the next three years. FTIC is to be a one-stop shop where aspiring food-tech start-ups will have access to a food grade pilot scale facility and wrap-around support.</p> <p>Singapore Institute of Technology (SIT) has recently opened a small batch food production facility, FoodPlant, in partnership with Enterprise Singapore (ESG) and JTC. It is not specifically focused on future proteins but has a range of equipment commonly required for producing alternative protein food products.</p> <p>A*STAR and NTU both have existing facilities related to future proteins R&D.</p> <p>The Singapore Government has contributed to the costs of establishing R&D, pilot or small commercial scale facilities in Singapore for a number of companies.</p>
<p>Relationships & Partnerships</p>	<p>Future Ready Food Safety Hub (FRESH) is the joint initiative between Nanyang Technological University (NTU) and government entities A*STAR and SFA.</p> <p>The New Zealand-Singapore Future Foods Research Programme is a bilateral research initiative funded by the New Zealand and Singapore governments.</p>
<p>People & Talent</p>	<p>Nanyang Technological University (NTU) is collaborating with The Good Institute Asia-Pacific to offer Future Foods – Introduction to Advanced Meat Alternatives’. It covers the science of developing and scaling meat alternatives based on plant proteins, cultivated meat and fermentation. It is being taught by an international panel of experts and aims to ensure students learn about the real-world challenges of the industry, including consumer response to products and the regulatory environment in Singapore.</p> <p>Various universities are offering PhD and Postdoctoral positions related to future proteins topics. In many instances these are funded through Singapore Government grants, but often are also funded by the start-ups and multinationals funding R&D in Singapore.</p> <p>The overall level of activity (both government and private sector funded) means that there is a significant pool of talent in Singapore. This in turn attracts more funding, which in turn attracts more talent. It is an overall virtual cycle that is helping drive the acceleration of this sector.</p>
<p>Legal & Regulatory Environment</p>	<p>The third ‘Desired Outcomes’ from the Singapore Food Story R&D Programme¹³ is related to a regulatory environment that ensures safe food but also enables Singapore to be internationally recognised as a place where companies can launch ‘first in market’ products and technologies.</p> <p>Singapore was the first country in the world to approve the sale of cell cultured meat in 2020.</p>

SWEDEN

Focused on climate neutral, locally grown and produced plant-based foods.

The Swedish government has committed to being climate neutral by 2045 and recognises that to achieve this its agriculture and food sectors will need to be climate neutral. However, specific activity and funding for alternative proteins appears very limited.

Only SEK 55M (US\$5.7M) of funding for various small R&D projects related to alternative proteins (particularly plant-based) has been provided by the government to date.

Population: 10.4 Million

GDP: \$555,000 Million USD

Contribution to GDP from agriculture: \$8,000 Million USD

% GDP from agriculture: 1.4%

Government investment as percentage of agriculture-related GDP: 0.13%

Key drivers: 

Rating: 

Key observations

The Swedish 2017 Climate Act commits Sweden to becoming climate neutral by 2045. The Climate Neutral Food Production mission overview¹ includes mention of low-emissions agriculture and 'climate-smart proteins', but there is no information on specific initiatives or targets for these categories, nor any dedicated funding.

In November 2020, Formas (the governments Research Council for Sustainability) provided a SEK 48M (USD \$5M) grant to Örebro University to establish a new multi-disciplinary research centre. The press release from this announcement stated that the centre will study the entire chain of plant-based proteins: from food production to people's wellbeing².

A small amount of government funding (SEK 2.6M; USD \$0.27M) was also provided to Sweden Food Arena for a project to scope a Swedish plant-based value chain³, with a goal of eventually being able to offer consumers (particularly Swedish consumers) more plant-based foods grown and manufactured in Sweden. This work was due for completion in late 2021 but no public report appears to be available.

The Swedish government has been involved in encouraging the development and promotion of the "New Nordic Diet," to improve health and enhance food tourism opportunities. The New Nordic Diet guidelines include more calories from plant foods and fewer from meat, more foods from the sea and lakes; and more foods from the wild countryside, which could be seen as also promoting the alternative proteins sector.

References are provided on pg 59

At a glance

Strategies & Initiatives	<p>There do not appear to be any specific government-funded strategies or initiatives for alternative proteins despite Sweden's focus on climate neutrality.</p> <p>The Sweden Food Arena has a Climate Neutral Food Production mission but there is limited information available on this.</p>
Agencies & Entities	<p><u>Vinnova</u>⁴. Sweden's innovation agency", a government agency that administers state funding for R&D efforts that aims to help to build Sweden's innovation capacity, contributing to sustainable growth. Its vision is that Sweden is an innovative force in a sustainable world.</p> <p><u>Formas</u>⁵. The government's Research Council for sustainable development. It funds research and innovation, develops strategies, conducts evaluations and communicates results in the areas of environment, agriculture and spatial planning.</p> <p><u>Sweden Food Arena</u>⁶. A national industry collaboration established by the government's Swedish Agency for Economic and Regional Growth but now run as a membership organisation. Its members include companies and industry organisations from across the entire food supply chain, with the aim of enhancing collaboration on research and innovation.</p>
Funding & Investment	<p>Funding from Vinnova (government innovation agency):</p> <ul style="list-style-type: none"> • SEK 25M (USD \$2.6M) for 17 different industry-led projects related to the development of ingredients or foods from plant-based raw materials including legumes, cereals, hemp, algae, mushrooms and potatoes.⁷ • SEK 7.5M (USD \$0.79M) for 15 projects related to lab and pilot scale R&D for meat product replacements from plant, insect or fungi raw materials⁸. • Smaller contributions to projects such as the development of a plant-based value chain, the building of a small-scale production facility for Mycorena's mycoprotein products, and an R&D project for Oatly to explore options to repurpose its waste from oat milk production. • SEK 2.6M (USD \$0.27M) to Sweden Food Arena to explore the development of a Swedish plant-based food value chain³. • A call recently closed for projects on plant-based proteins, with a total funding pool of SEK 20M (USD \$2.1M)⁹. Successful projects have not yet been announced. <p>Formas has provided a SEK 48M (USD \$5M) grant to Örebro University to establish a new multi-disciplinary research centre that will study the entire chain of plant-based proteins: from food production to people's wellbeing². The Centre collaborators include most of the other Swedish universities and a number of large food companies.</p> <p>Forma has also provided an undisclosed sum to Swedish University of Agricultural Sciences and Lund University for research on plant-produced heme proteins for use in meat substitutes¹⁰.</p>
Targets & Dates	<p>Sweden has a goal to be climate neutral by 2045 which includes the Swedish agriculture and food sectors. However, there are no specific targets for the alternative protein sector.</p>

Plant-based proteins grown in Sweden are an important investment that reduce both our climate footprint and those of our customers. These products are tasty, healthy, high in protein and contribute to the Swedish cultural heritage because they are grown and harvested in Sweden.

*Jacob Ahlström, CEO of Ahlströms and Ahlgood*¹¹

<p>Infrastructure & Facilities</p>	<p>The 'PlantProtein Factory' will be a pilot plant for the extraction of high-value proteins and other nutrients from unused green mass (currently either left in the fields after harvest or separated during processing). It has been funded by Vinnova which provided SEK 10M (USD \$1M) to a subsidiary of the Swedish University of Agricultural Sciences to fund the purchase and/or fabrication of specialised equipment and the initial experiments.</p>
<p>Relationships & Partnerships</p>	<p>Örebro University has been funded to establish a new multi-disciplinary research centre that will study the entire chain of plant-based proteins: from food production to people's wellbeing².</p> <p>The Centre collaborators include most of the other Swedish universities and a number of large food companies. There does not appear to be any information on this Centre available in English after the announcement of the funding to set it up.</p>
<p>People & Talent</p>	<p>The new Örebro University research centre being established to research plant based value chains has begun recruiting PhD students to work on projects, and there have been other PhD opportunities for individual projects. At this stage there is no coordinated approach to capability development, nor any alternative proteins-focused education or training opportunities.</p>
<p>Legal & Regulatory Environment</p>	<p>No mention of these aspects being either barriers or accelerators to the alternative proteins sector in Sweden were found.</p>

Seafood made of seaweed; meat analogues made of peas, oats and gluten; and yeast. These will be the cornerstones of the protein on our plates in the future.

*RI.SE, Swedish plant-based proteins - our new everyday food?*¹²

UNITED KINGDOM

Considering how to grow an alternative protein sector to satisfy increasing domestic demand.

Population: 67.1 Million

GDP: \$2,901,000 Million USD

Contribution to GDP from agriculture: \$18,100 Million USD

% GDP from agriculture: 1%

Government investment as percentage of agriculture-related GDP: 0.60%

Key drivers: \$ 

Rating: 

The UK government's Climate Change Committee has stated the UK must reduce the amount of meat eaten domestically by 20–50% for the UK to reach its carbon net zero goal by 2050. It has also pledged to ensure that 30% of UK land is 'protected for nature' (likely to mean retired from food production) by 2030.

The independent 'National Food Strategy' (NFS) published in 2021 estimated that growing and manufacturing alternative proteins in the UK would create an estimated 10,000 new factory jobs and secure 6,500 jobs in arable farming. It recommended investment of £125M over 5 years to support the development of the alternative protein sector. The government has not yet committed to this funding.

The only tangible government investment in the alternative protein sector currently is £16M from the UKRI's 'Transforming Food Production' challenge. It has committed to supporting progress on regulations related to gene editing and alternative proteins.

Key observations

UK consumers purchase a third of all the plant-based alternatives sold in Europe. There is an opportunity to match the potential supply of plant protein with this growing demand sides.

The National Food Strategy (NFS)¹ is an independent review of England's entire food system commissioned by the government and released in two parts in 2020 and 2021.

The NFS recommendations include a shift in land-use, the adoption of a range of technologies to enable sustainable intensification, and the development of an alternative proteins sector including the growing and harvesting of plant-based crops from both land and ocean.

To achieve these changes, the NFS recommends the government invest £75M in research and innovation related to alternative proteins (£15m/year over next five years) and spend £50M to establish and support an innovation cluster to accelerate the development, testing and scale-up of alternative protein products.

References are provided on pg 60

The ‘Government Food Strategy’² released in June 2022 stated it was important to ‘keep the UK at the front of this growing and innovative sector by supporting alternative protein research and innovation’ and referred to existing commitments of £120M for research across the food system. No new or alternative protein-specific funding has been committed.

A meat tax was considered as part of the NFS, but this had very limited support among the general public and it was feared it would increase food inequalities and insecurities.

The UK Research and Innovation (UKRI)’s Transforming Food Production (TFP) challenge is investing up to £90M to help create more resilient, efficient and sustainable food production systems and enable the UK agriculture sector to realise net-zero emissions by 2040. It has invested around £16M in research related to alternative proteins, including insects, algae and producing single-cell proteins from CO₂³.

The ‘Plant Science Research Strategy: a green roadmap for the next 10 years’⁴ was published in January 2021, and aims to deliver completely new plant-based production systems.

The purpose of the UK food system since the Second World War has been to produce as much food as possible as cheaply as possible. This purpose needs to change.

The UK’s National Food Strategy, 2021

At a glance

<p>Strategies & Initiatives</p>	<p>‘National Food Strategy’ (NFS)¹, a government-commissioned independent review of the entire English food system that released reports in 2020 and 2021. The government responded with its ‘Government Food Strategy’² in June 2022.</p> <p>UK Research and Innovation (UKRI, the government’s research funding agency) has an Industry Strategy Challenge fund. Within this, the Transforming Food Production (TFP) challenge is looking at various aspects of the alternative proteins area. This includes the development of an ‘Alternative Protein Roadmap’⁵ which provides detailed guidance on what is needed to advance the UK’s alt protein sector.</p> <p>The ‘Plant Science Research Strategy: a green roadmap for the next 10 years’⁴ aims to deliver new plant-based production systems for foods and protein feedstocks, achieved through biological engineering and the development of innovative culturing technologies.</p> <p>The UK’s £22bn Innovation Strategy⁶ was launched in July 2021, which aims to make the UK a global innovation hub by 2035, and to harness innovation to address social and environmental goals.</p>
<p>Agencies & Entities</p>	<p>The Department for Environment, Food and Rural Affairs⁷ (Defra) - the government’s ministerial department responsible for most agrifood related activities.</p> <p>UK Research and Innovation⁸ (UKRI) - the government’s research and innovation funding agency.</p> <p>The Food Standards Agency⁹ (FSA) - responsible for protecting public health in relation to food including setting food regulations and legislation.</p>

<p>Funding & Investment</p>	<p>The UKRI's Transforming Food Production (TFP) challenge is investing up to £90 million to help create more resilient, efficient and sustainable food production systems. This sets the UK agriculture sector on a trajectory to realise net-zero emissions by 2050. Specific projects include:</p> <ul style="list-style-type: none"> • £10M for the development of a large-scale insect farm to produce protein for use in animal and possibly human food, through the Insectrial Revolution project¹⁰ led by Entocycle. • £4M for the AGRI SATT project¹¹, led by SuSeWi Limited, to develop and scale an algae growing system that uses seawater to produce protein in the desert. • £2M for the REACT-FIRST project, led by Deep Branch Biotechnology, which is based around proprietary technology for growing single-cell protein from CO₂¹². <p>Innovate UK, part of UKRI that focuses on start-ups, has provided funding (often for undisclosed sums) related to cell cultured meats, seafood alternatives from seaweeds, new plant protein concentrates and new methods for producing mycoprotein.</p> <p>The National Food Strategy recommends the government invests £75m for research and innovation related to alternative proteins (£15m/year over next 5 years) and £50m to help build, fund and support an innovation cluster where scientists and entrepreneurs can develop, test and scale up new alternative proteins. Whether either of these recommendations will be accepted by the government is yet to be seen.</p>
<p>Targets & Dates</p>	<p>The UK government has committed to reduce the UK's carbon emissions to net zero by 2050, including the farming sector. It has also pledged to ensure that 30% of UK land is protected for nature by 2030.</p> <p>To achieve net zero for the farming sector, the government's Climate Change Committee has said the UK must reduce the amount of meat eaten by 20– 50%. The NFS sets an interim goal of a 30% reduction over ten years.</p>
<p>Infrastructure & Facilities</p>	<p>The £10M for the industry insect farm¹⁰ is the largest government investment in infrastructure specifically related to alt-proteins thus far. Many of the universities and industry research and development centres have laboratory and pilot scale facilities related to food more generally.</p> <p>The NFS and the Alternative Proteins Roadmap have both recommended government support for infrastructure to specifically support development and scale up of alternative proteins.</p>
<p>Relationships & Partnerships</p>	<p>Projects funded under the TFP challenge (Insectrial Revolution, AGRI SATT, REACT-FIRST) are all partnerships involving industry and researchers from along the relevant value chains.</p> <p>The FoodBioSystems Doctoral Training Partnership (DTP)¹³, funded by UKRI, brings together six university partners: University of Reading, Cranfield University, University of Surrey, Queen's University Belfast, Aberystwyth University, and Brunel University London. Its aims to develop the next generation of bio scientists with in-depth knowledge and technical expertise of food systems and biological processes across the Agrifood system.</p>

People & Talent	The FoodBioSystems DTP has a number of PhD projects on different aspects of alternative proteins, including scaling up of bio-process for cultured meat production, sensorial and nutritional value of plant based milk alternatives, insect-based foods for human nutrition and consumer acceptance and more. Some of the opportunities are provided in partnership with companies such as Arla Foods, PepsiCo, Quorn etc.
Legal & Regulatory Environment	The UK government has announced it will review and update its regulatory framework for approving novel foods, now it is no longer required to use the EU regulations ¹⁴ .

Figure 16.1 from the National Food Strategy

Changes needed to the national diet by 2032 (compared to 2019) to meet health, climate and nature commitments.



*HFSS – foods high in fat, sugar or salt

APPENDIX 1 – COMMITMENT SCORING MATRIX

The below scoring matrix was used to assess each country, with the results provided in Table 1. Key areas were identified and the activity of each government in each key area was scored out of a maximum of 5.

CRITERIA COMPONENT	DEFINITION	RATING SCALE				
		VERY LOW 1	LOW 2	MODERATE 3	HIGH 4	VERY HIGH 5
National Strategy Focus	Clearly defined purpose for the focus on Alternative Proteins	No specific, publicly declared government stance on the development of the alternative proteins sector. No alternative proteins strategy prepared by any organisation related to or funded by the government.	No specific publicly declared government stance on the development of the alternative proteins sector. An alternative proteins strategy prepared by an organisation related to or funded by the government but no government commitment to this yet.	Specific themes, framing or purpose identified by the government for how the country will respond to the alternative proteins sector.	Specific themes, framing or purpose identified for the focus of alternative proteins. A strong link is drawn between the type(s) of alternative proteins of focus and the countries targets and goals	Specific and clearly articulated themes, framing or purpose identified for the focus of alternative proteins. There is clear alignment between the framing is linked to the targets and goals, as well as the types of alternative proteins chosen
Level of investment and funding	The level of funding that has been pledged to alternative proteins	Research indicates very low level (up to 0.15% agriculture GDP) of investment, either pledged or actual investment.	Research indicates low level (0.16-0.30% agriculture GDP) of investment, either pledged or actual investment.	Research indicates moderate level (0.31-0.50% agriculture GDP) of investment, either pledged or actual investment.	Research indicates high level (0.51-1.0% agriculture GDP) of investment, either pledged or actual investment.	Research indicates high level (1.01% agriculture GDP or more) of investment, either pledged or actual investment.
Initiatives	Detail of initiatives that aid in commercialisation to meet ambitions and align with National Strategy Focus	Research reveals few meaningful initiatives supported by government that are relevant to alternative proteins.	Research reveals few meaningful initiatives supported by government that are relevant to alternative proteins.	Government has launched some initiatives designed to support alternative proteins sector R&D and commercialisation. There is no clear interaction or connection between them.	Government has launched significant initiatives designed to support alternative proteins sector R&D and commercialisation. These receive government funding and support over the short-medium term.	Government has launched significant initiatives to support alternative proteins sector R&D and commercialisation. These are well-defined and connected, with medium-long term funding commitments.
Timelines	Clearly defined timelines with targets and goals incorporated	No specific targets or goals relevant to alternative proteins have been made by the government.	High level, non-specific targets or goals relevant to alternative proteins.	Specific targets or goals relevant to alternative proteins are disclosed	Specific targets or goals , that are time bound and relevant to alternative proteins are disclosed	Specific targets or goals , that are time bound and relevant to proteins are disclosed. Links between other industries and the alternative proteins sector are drawn and outlined.
Infrastructure and Facilities	Specific detail of intended investment into infrastructure and/or suitable facilities	R&D organisations have equipment relevant to alternative proteins. No specific government funding to address gaps at R&D scale or for commercialisation.	R&D organisations have equipment relevant to alternative proteins. A small amount of government funding specifically to address gaps at R&D scale or for commercialisation.	Early stage or medium scale government initiatives focused on infrastructure and facilities.	Government programmes of significant scale and material impact focused on infrastructure and facilities.	Government programmes of material impact, leading to successful advances in areas of infrastructure and facilities.

		RATING SCALE				
CRITERIA COMPONENT	DEFINITION	VERY LOW 1	LOW 2	MODERATE 3	HIGH 4	VERY HIGH 5
Partnerships	Partnerships are clearly defined	Research indicates relationships and partnerships specific to alternative proteins are limited .	Research indicates partnerships are in early stages, and require focus and strengthening .	Research indicates partnerships are mature and utilised, but offer room for strengthening .	Research indicates partnerships are well supported and working well . The partnerships are across most key areas of the ecosystem.	Detailed information on the strong and well-functioning domestic (and where appropriate, international) partnerships across the relevant areas of the alternative proteins ecosystem .
People, Talent and Capability	Investment in programs that support people, talent and capability development.	Research reveals limited information disclosed on initiatives focused on people, talent and capability development.	Research reveals only generic initiatives focused on developing talent and capability, no specific alternative proteins initiatives focused on capability development.	Research indicates early stage or small scale initiatives focused on people, talent and capability development.	Research indicates programs of significant scale and material impact are being implemented focused on people, talent and capability development.	Research indicates evidence of programs of material impact, leading to successful advances of in areas of people, talent and capability development.
Legal and Regulatory Environment	Legal environment specifically developed around alternative proteins	Research indicates legal and regulatory requirements have not been developed with alternative proteins applications in mind, nor updated to accommodate the needs of this sector. Statements by local organisations indicate current settings negatively impact sector development. No public commitments to address this.	Research indicates legal and regulatory requirements have not been developed with alternative proteins applications in mind, nor updated to accommodate the needs of this sector. Statements by local organisations indicate current settings negatively impact sector development. But the government has committed to addressing this.	Research indicates legal and regulatory requirements have been established or modified to enable the development of the alternative proteins sector , although more work is required.	Research indicates the government is actively engaged with the alternative proteins sector, seeking to make the necessary changes in the legal and regulatory requirements to enable the sector to develop rapidly.	Legal and regulatory requirements related to alternative proteins are easy to interpret and responsive to new technologies and approaches . Government departments are proactively engaged in supporting the sector to meet requirements.

APPENDIX 2 – REFERENCES

Introduction

¹We used the term 'emerging proteins' in this initial report to reflect our view that these protein sources are often complementary to existing protein sources, and that it is not necessary to position one as being 'alternative' to the other. However, 'alternative proteins' is used internationally for this category of protein sources, and thus given this report is a comparison of international government activity, we will use this term for the remainder of the discussion.

²<https://gfi.org/investment/>

Country statistics

Population is defined as all nationals present in, or temporarily absent from a country, and aliens permanently settled in a country. Population data for all countries retrieved from <https://data.oecd.org/pop/population.htm>

Gross Domestic Product ("GDP") at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. Data for all countries retrieved from <https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?end=2021&start=1960&view=chart>

Individual country data on contribution to GDP from agriculture:

- Aotearoa New Zealand <https://www.statista.com/statistics/1026489/new-zealand-agriculture-forestry-fishing-industry-gross-domestic-product/>
- Australia <https://www.statista.com/statistics/375558/australia-gdp-distribution-across-economic-sectors/>
- Canada <https://www.statista.com/statistics/271248/distribution-of-gross-domestic-product-gdp-across-economic-sectors-in-canada/>
- Denmark <https://www.statista.com/statistics/317288/share-of-economic-sectors-in-the-gdp-in-denmark/#:~:text=In%202020%2C%20the%20share%20of%20sector%20contributed%20about%2064.55%20percent>
- Ireland <https://www.statista.com/statistics/375575/ireland-gdp-distribution-across-economic-sectors/#:~:text=In%202020%2C%20agriculture%20contributed%20around,percent%20from%20the%20service%20sector>
- Israel <https://www.lloydsbanktrade.com/en/market-potential/israel/economical-context>
- The Netherlands <https://www.statista.com/statistics/276713/distribution-of-gross-domestic-product-gdp-across-economic-sectors-in-the-netherlands/#:~:text=In%202020%2C%20agriculture%20contributed%20around,percent%20from%20the%20service%20sector>
- Singapore www.statista.com/statistics/1007274/gdp-of-goods-producing-industries-singapore
- Sweden <https://www.statista.com/statistics/375611/sweden-gdp-distribution-across-economic-sectors/#:~:text=In%202020%2C%20agriculture%20contributed%20around,percent%20from%20the%20service%20sector>
- UK <https://www.statista.com/statistics/270372/distribution-of-gdp-across-economic-sectors-in-the-united-kingdom/>

Aotearoa New Zealand

¹ <https://www.emergingproteins.co.nz/reports/> 'Emerging proteins in Aotearoa New Zealand' page 18
[https://fitforabetterworld.org.Aotearoa New Zealand/](https://fitforabetterworld.org.Aotearoa-New-Zealand/)

² [https://fitforabetterworld.org.Aotearoa New Zealand/assets/Te-Puna-Whakaaronui-publications/Reframing-New-Zealands-Food-Sector-Opportunities.pdf](https://fitforabetterworld.org.Aotearoa-New-Zealand/assets/Te-Puna-Whakaaronui-publications/Reframing-New-Zealands-Food-Sector-Opportunities.pdf)

³ [https://www.mpi.govt.Aotearoa New Zealand/funding-rural-support/sustainable-food-fibre-futures/](https://www.mpi.govt.Aotearoa-New-Zealand/funding-rural-support/sustainable-food-fibre-futures/)

⁴ [https://fitforabetterworld.org.Aotearoa New Zealand/](https://fitforabetterworld.org.Aotearoa-New-Zealand/)

⁵ [https://fitforabetterworld.org.Aotearoa New Zealand/partnership-groups/te-puna-whakaaronui/](https://fitforabetterworld.org.Aotearoa-New-Zealand/partnership-groups/te-puna-whakaaronui/)

⁶ [https://www.mpi.govt.Aotearoa New Zealand/funding-rural-support/sustainable-food-fibre-futures/](https://www.mpi.govt.Aotearoa-New-Zealand/funding-rural-support/sustainable-food-fibre-futures/)

⁷ [https://www.mbie.govt.Aotearoa New Zealand/science-and-technology/science-and-innovation/funding-information-and-opportunities/investment-funds/catalyst-fund/catalyst-strategic-new-zealand-singapore-future-foods-research-programme/](https://www.mbie.govt.Aotearoa-New-Zealand/science-and-technology/science-and-innovation/funding-information-and-opportunities/investment-funds/catalyst-fund/catalyst-strategic-new-zealand-singapore-future-foods-research-programme/)

⁸ [https://www.mpi.govt.Aotearoa New Zealand/](https://www.mpi.govt.Aotearoa-New-Zealand/)

⁹ [https://www.mbie.govt.Aotearoa New Zealand/](https://www.mbie.govt.Aotearoa-New-Zealand/)

¹⁰ [https://www.tec.govt.Aotearoa New Zealand/about-us/](https://www.tec.govt.Aotearoa-New-Zealand/about-us/)

¹¹ <https://www.riddet.ac.nz/>

Aotearoa New Zealand (continued)

¹² As with almost all the countries in this report, additional funding has been announced by the government after the 1 July 2022 cut-off for inclusion in this report. A loan or equity stake of up to NZ\$6M (\$2.75M USD) for the construction of an oat milk factory was announced mid July <https://www.stuff.co.nz/business/129235460/government-pumps-6m-into-southlandbased-oat-milk-plant>. This increases the government investment to \$21.8M USD, 0.27% of GDP from Agriculture. This would not change the country's score for investment or overall star rating.

¹³ <https://fitforabetterworld.org.nz/assets/Te-Puna-Whakaaronui-publications/WELL-NZ-summary.pdf>

Australia

¹ <https://www.csiro.au/en/news/News-releases/2022/Roadmap-to-put-uniquely-Australian-protein-on-the-global-menu>

² <https://www.csiro.au/en/work-with-us/services/consultancy-strategic-advice-services/CSIRO-futures/Agriculture-and-Food/Australias-Protein-Roadmap>

³ <https://research.csiro.au/edibleinsects/>

⁴ <https://aproteins.com.au/>

⁵ <https://www.minister.industry.gov.au/ministers/taylor/media-releases/transforming-sa-powerhouse-plant-protein-manufacturing#:~:text=Today%2C%20the%20Morrison%20Government%20has,meet%20the%20growing%20global%20demand>

⁶ <https://www.industry.gov.au/news/modern-manufacturing-initiative-and-national-manufacturing-priorities-announced>

⁷ <https://www.industry.gov.au/data-and-publications/food-and-beverage-national-manufacturing-priority-road-map>

⁸ <https://www.csiro.au/>

⁹ <https://www.mseq.vc/about>

¹⁰ <https://v2food.com/>

¹¹ <https://www.edenbrew.com.au/>

¹² <https://theeverycompany.com/>

¹³ <https://hourishing.io/>

¹⁴ <https://www.agriculture.gov.au/>

¹⁵ <https://www.fial.com.au/>

¹⁶ <https://research.unimelb.edu.au/research-at-melbourne/multidisciplinary-research/hallmark-research-initiatives/future-food>

¹⁷ <https://www.csiro.au/en/news/news-releases/2022/2022-23-federal-budget>

¹⁸ <https://www.fial.com.au/plant-based-and-alternative-proteins>

¹⁹ <https://theconversation.com/from-this-week-every-mainland-australian-state-will-allow-genetically-modified-crops-heres-why-thats-nothing-to-fear-159976#:~:text=On%20July%201%2C%20the%20New,groups%20have%20welcomed%20the%20move>

²⁰ <https://smallcaps.com.au/australia-approves-cutting-edge-crispr-gene-editing-technology/>

Canada

¹ <https://www.proteinindustriescanada.ca/>

² https://www.ontariogenomics.ca/wp-content/uploads/2021/11/CELL_AG_REPORT_FULL-FINAL.pdf

³ <https://www.proteinindustriescanada.ca/news/protein-industries-canada-supercluster-kicks-into-high-gear>

⁴ <https://agriculture.canada.ca/en/about-our-department/key-departmental-initiatives/canadian-agricultural-partnership>

⁵ <https://www.ngen.ca/>

⁶ <https://www.wd-deo.gc.ca/eng/36.asp>

⁷ <https://www.alberta.ca/food-processing-development-centre.aspx>

⁸ <https://proteinhighwaywixsite.com/protein-hwy/about-us>

⁹ <http://plantproteintraining.ca/>

¹⁰ <https://www.proteinindustriescanada.ca/projects/promoting-inclusion-of-indigenous-groups-in-canadian-agricultur>

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