

National Reconstruction Fund Taskforce
Department of Industry, Science and Resources
Industry House
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SUBMISSION – NATIONAL RECONSTRUCTION FUND: CONSULTATION PAPER

Cellular Agriculture Australia is pleased to provide this submission on the implementation of the National Reconstruction Fund (NRF).

Mandating cellular agriculture as a critical industry for investment by the NRF presents the Australian government with the opportunity to:

- Diversify and transform our food system, including the development of new, value-added products for the domestic and export markets
- Develop a secure, well-paid workforce in STEM and non-STEM fields with transferable skills across food, medical science, biotechnology and agriculture
- Invest in transformational research that will contribute to global advancements in food and medical science
- Contribute to climate change mitigation, through the development of an industry with a lower carbon footprint than conventional livestock production and with a higher resilience to climate change induced natural disasters.

Introduction

Australia has an opportunity to capture a share of the global protein boom by investing and scaling up its cellular agriculture capability.

As the world's population is set to grow by another 1.2 billion people in the decade to 2030, there will be vast growth in global markets for food—especially for affordable sources of protein. In “Australia’s Protein Road Map”, CSIRO identifies a \$13 billion market opportunity for Australia to grow and diversify its high-quality protein products from various different sources.¹ Our analysis of Australia’s existing cellular agriculture market shows an expected value of AUD\$270–\$520 million by 2035, that could reach as much as AUD\$1.8 billion.² Increased investment in Australia’s nascent industry will drive additional value and growth.

1

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

² <https://cellularagricultureaustralia.org/advocacy/>

Cellular agriculture uses a suite of technologies that enable the production of agricultural products (animal and non-animal-derived) using cells and biotechnologies. It is an emerging global industry with more than 90 companies founded worldwide since 2015. Since 2018, over eight cellular agriculture companies have been created in Australia including – All G Foods, Change Foods, Eden Brew, Hueros, Magic Valley, MeAnd Food Tech, Nourish Ingredients and Vow. The first cultivated meat product was approved for sale in Singapore in 2020, and in November 2022, the US Food and Drug Administration made a determination that a U.S. cultivated chicken product from Upside Foods, was safe to consume. Total investment in cultivated foods was USD\$1.2 billion in 2021.

Australia has the opportunity to become an early mover in developing new, transformational products. We are renowned for world-leading cell biology and tissue engineering expertise. Combined with our reputation for strong food safety standards, high quality livestock production, existing feedstock supply chains, and proximity to markets seeking additional protein means Australia is well positioned to capture value. Cellular Agriculture Australia is already fielding enquiries from international companies, along the food supply chain, seeking to understand Australia's appetite and capacity to provide new, high-value cellular agriculture products and services.

In addition, cellular agriculture has the potential to address a number of Australia's policy objectives, including enhanced food security using fewer natural resources, resilience to a changing climate and increased scientific and commercialisation expertise, particularly in relation to sovereign capability.

However, we have identified three existing barriers to growth:

1. Developing a skilled and future-fit workforce to enable commercialisation and industry growth
2. Deepening Australia's cross-disciplinary, open access cellular agriculture research
3. Establishing at-scale manufacturing capabilities and infrastructure

The NRF provides an opportunity for Australia to focus investment on transformative technology that will not only diversify our food system, but our economy and workforce. We believe cellular agriculture is a perfect candidate to be a key priority investment area for the NRF.

About Cellular Agriculture Australia

Cellular Agriculture Australia (CAA) is a not-for-profit with charitable status, founded in 2020 by cell biologist Dr Bianca L.ê. We believe that cellular agriculture can play a critical

role in diversifying food production, strengthening food security and helping meet growing global demand for protein and other products, sustainably.

Australia's cellular agriculture industry is led by scientists, engineers and entrepreneurs in emerging companies and at Australia's leading universities including Monash, Melbourne, UNSW, QUT and the University of the Sunshine Coast. Significant seed capital has flowed from reputable investors including CSIRO's Main Sequence Ventures fund, VC firm Blackbird Ventures, the Clean Energy Finance Corporation and Woolworths VC fund, W23. Most recently, a number of local start ups have secured international investment from Horizon Ventures, Aramco Ventures, Toyota Ventures and Argonomics, amongst others. This supported Australian company Vow Foods to secure over AUD70m in 2022, the world's largest Series A funding round for a cultivated meat company to date.

CAA works across the entire cellular agriculture sector in Australia and engages with stakeholders from the private sector, investors, academia, government departments, agencies and regulatory authorities.

What is cellular agriculture?

There are two distinct categories of cellular agriculture technology:

- Cell cultivation (cultivated meat): involves the production of muscle and fat (for meat), skin (for leather or food) and liver (for foie gras) from stem cells isolated from an animal. Cell-cultivation can also be used to produce other non-animal-derived products such as coffee. This technology is well researched for regenerative medicine applications (tissue engineering) but has not yet been applied at scale for commercial food production in Australia.
- Precision fermentation: involves engineering microbes (yeast or bacteria) to produce a range of ingredients used in the production of egg, milk, infant formula and palm oil. This technology has already achieved widespread application in the production of other animal-replacement products, such as insulin and the cheese-making enzyme, rennet.

Alternative proteins (to traditional meat, seafood, eggs and dairy) are the most common applications of cellular agriculture. However, cellular agriculture can also produce a range of traditionally animal-derived ingredients and supplements, food processing enzymes, and biomaterials (e.g. leather, fibre, silk and fur).

Ingredients made using cellular agriculture technology, such as animal fats and oils, are also increasingly being added to "hybrid" food products (i.e. foods that incorporate plants

and cellular agriculture ingredients such as animal cells, fats or proteins) to enhance the taste, texture and cooking performance of products.

The opportunity for Australia

The global demand for food is expected to increase by up to 70% by 2050 and we cannot meet this demand sustainably or ethically with current production methods alone. Research by the Australian Farm Institute for Agrifutures Australia in 2020 concluded animal agriculture will struggle to supply the growing global demand for protein using the finite resources available in current production systems.³

Cellular agriculture is one of many solutions required to ensure an equitable, accessible and sustainable food system into the future.

CSIRO estimates precision fermentation could generate direct revenue for Australia of A\$374 million to A\$1.1 billion and create up to 2,020 jobs by 2030. McKinsey predicts global sales of cultivated meat could reach A\$26 billion by 2030. There are currently 200 skilled jobs across Australia's cellular agriculture sector.

In our recent White Paper (attached) modelling highlights the base case market size for Australian cellular agriculture food products is expected to reach AUD\$270–520M by 2035, and could reach as much as \$1.8b. For this to happen, the sector needs to be supported by significant investment and collaboration across new and existing value chains, in addition to the continuation of private funding.

In 2021, capital of AUD\$44M flowed into Australia's cellular agriculture companies. Globally, over USD\$1.B was invested in the cultivated meat industry in 2021.

Over the next ten years, the sector is expected to grow rapidly, as the technology and regulation of cellular agriculture in Australia and around the world matures. Singapore currently remains the only country in the world to give regulatory approval for the commercial sale of a cultivated meat product. However, in December 2022 the U.S. Food and Drug Administration (FDA) completed its first pre-market consultation for American company Upside Foods' cultivated chicken, concluding the product is safe to eat. Upside is now working with the U.S. Department of Agriculture (USDA) to secure the remaining approvals to allow its commercial sale.

The benefits of cellular agriculture go far beyond economics:

Food security

Cellular agriculture allows for production to scale to match demand without additional

³ <https://agrifutures.com.au/wp-content/uploads/2020/02/20-001.pdf>

land or water use, and has increased resilience to natural disasters like floods, drought, and bushfires.

The opportunity to export diversified types of protein secures regional food security and deepens Australia's reputation as a provider of safe and high-quality protein.

Scientific advancement

Breakthroughs in cutting-edge life sciences embed Australia's leadership as one of the world's top 10 contributors to life sciences research. Foundational skill sets in cellular agriculture can be translated to other industries (e.g. tissue engineering in regenerative medicine).

Climate

Preliminary life-cycle assessments showed that cultivated meat can contribute to a reduction in emissions attributed to meat production. Recent research by CE Delft in the Netherlands suggested cellular agriculture could result in a reduction of up to 92% of greenhouse gas emissions, 63–95% of land use, and 82–96% of water requirements, compared to conventional meat production.⁴

Health

Human health risks are minimised, with a lower likelihood of pathogen (e.g. Salmonella, E. coli) or faecal contamination, reduced odds of zoonotic outbreaks (e.g. swine or avian flu) and antibiotic resistance.

Animal welfare

Globally, consumers are expecting stronger animal welfare practices in food production, evidenced by recent commentary around the finalisation of the Free Trade Agreement between Australia and the United Kingdom (UK). Legislators in the UK continue to raise concerns about Australian practices such as battery-hen cages, hot-iron branding, mulesing, live export and the use of pesticides. All of these concerns are mitigated by cellular agriculture.⁵

Government investment in cellular agriculture

Beyond small innovation grants to entrepreneurs, there has been no investment by the Australian government in building our sovereign capability in cellular agriculture directly.

⁴ <https://cedelft.eu/publications/rapport-lca-of-cultivated-meat-future-projections-for-different-scenarios/>

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<https://www.smh.com.au/world/europe/australia-s-backwards-animal-practices-still-in-the-way-of-free-trade-deal-with-britain-20230124-p5cex5.html>

This is in contrast to the recent global trend of government investment in cellular agriculture and precision fermentation as key to broader national science, environment and food strategies.

Globally:

The **United States** attracts the largest amount of venture and private investment in cellular agriculture, about USD\$1.7 billion, accounting for 60% of all global investment.⁶ The USDA awarded Tufts University USD\$10 million to establish a cultivated protein research center of excellence in 2021.

The second largest investment in cellular agriculture is in **Israel**, where climate constraints to food production (e.g. water scarcity) are similar to those faced by Australia. Total investment via venture capital and private investment is estimated at USD\$589 million.⁷ In 2020, Israel's President, Benjamin Netanyahu declared "Israel will become a powerhouse for alternative meat and alternative protein".⁸ In April 2022, the Israel Innovation Authority granted USD\$18 million to a cultivated meat consortium of 14 Israeli companies and 10 academic labs working to bring down costs and scale up production.⁹ In January 2023, the Israel Innovation Authority allocated a further USD\$14 to build an R&D hub for cutting-edge fermentation technology.

In the **Netherlands**, the Ministry for Agriculture made the world's largest government grant of EUR60 million to advancing cellular agriculture in 2022. This is in addition to providing financing of EUR25 million to the sector. The Dutch government is expecting a financial return based on projected increases in earning capacity by 2050, but the investment is also focussed on emissions reductions, anticipating cultivated meat and similar technology will reduce CO2 emissions by approximately 1.8 million tons and reduce ammonia by 15 to 20 kilotons per year.¹⁰

In our region:

Singapore has dedicated USD\$104 million to the Singapore Food Story R&D programme, which includes a theme addressing advanced biotech protein production (including cellular agriculture).¹¹ Singapore has also established bilateral research programs with

⁶ <https://www.govgrant.co.uk/sector-research/how-well-is-europe-playing-the-cultured-meat-game/>

⁷ <https://www.govgrant.co.uk/sector-research/how-well-is-europe-playing-the-cultured-meat-game/>

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<https://www.al-monitor.com/originals/2020/12/israel-benjamin-netanyahu-aleph-farms-cultivated-meat.html>

⁹ <https://time.com/6237414/israel-lab-grown-meat/>

¹⁰ <https://www.greenqueen.com.hk/the-dutch-government-invests-e60m-in-cellular-agriculture/>

¹¹ <https://www.sfa.gov.sg/food-farming/singapore-food-story/r-and-d-programme>

Australia, New Zealand, the Netherlands and the United Kingdom to progress the development of both plant based and cell-based meat.

South Korea has established the \$USD13.5 million Green Bio Fund which specifically mentions plant-based and cultivated meat companies as a key program component.

Cultivated meat is included in **China's** five-year plan aimed at strengthening innovation in frontier and cross-disciplinary technologies. China's Ministry of Science and Technology is also funding a Green Biological Manufacturing R&D program that will provide an estimated USD\$3.1 million for alternative proteins.¹²

Responding to the Consultation paper

NRF Priority Areas

We are excited by the potential of the NRF to grow Australia's innovation system and provide investment that scales the cellular agriculture sector to capture global opportunities.

Of the seven priority areas identified by the Australian government, the following are most relevant to CAA's mission and the cellular agriculture sector in Australia:

- *Renewable energy and low emissions technology*
Globally, governments are investing in cellular agriculture as a policy mechanism to reduce emissions. Agriculture, particularly livestock production, is a major greenhouse emitter¹³ and while Australian agricultural industries have invested in improving their carbon footprint, large-scale, policy interventions would ultimately be required to achieve the Paris Agreement targets¹⁴. We question whether enough can be done within the required timeframes to meet Australia's Paris Agreement targets.
- *Value-add in the agriculture, forestry and fisheries sectors*
Cellular agriculture offers a way to diversify our food production to address food security challenges and maintain global competitiveness in new protein markets, where demand continues to grow strongly. Australia is well placed to capitalise on this growth by leveraging our internationally renowned expertise in tissue engineering and food science research, and the agricultural and advanced manufacturing industries.

¹² <https://gfi-apac.org/how-governments-are-supporting-sustainable-protein-research-in-apac/>

¹³ <https://agrifutures.com.au/wp-content/uploads/2020/02/20-001.pdf> pg 24

¹⁴ <https://www2.deloitte.com/au/en/pages/consumer-industrial-products/articles/what-does-paris-agreement-mean-australian-agriculture.html>

What types of projects or investments should the Government direct the NRF to focus on, or not invest in, within each of the seven priority areas to achieve the NRF's purpose?

It is our hope that the NRF will invest in truly transformative projects that have the potential to create a stepchange in Australia's economic structure. This includes investing in critical technologies, human capital and cutting edge infrastructure.

We believe cellular agriculture is well placed to meet commercial return requirements as well as deliver environmental and social outcomes for the domestic and export markets. It encompasses a number of priority areas including low emissions technologies, value-added food and fibre, supply chain stability, export opportunities and advanced manufacturing.

However, at the time of writing, investing in cellular agriculture in Australia means investing in predominantly startup stage companies. Therefore, the NRF needs to embrace risk, seek opportunity and have the flexibility to invest in partnership with private and venture capital investors.

Investment needs and opportunities

Infrastructure

Based on our consultations with industry, the key immediate infrastructure required to develop, prototype and scale the manufacture of cultivated meat and precision fermentation products includes cell line repositories, scaffold databases, scale-up demonstration facilities and at-scale manufacturing plants.

Large scale manufacturing facilities will also be required, bringing economic and job opportunities for areas with an existing industrial base, including regionally.

At this pre-competitive research and development stage, cellular agriculture facilities are unlikely to attract private sector investment, particularly if they are focused on enabling the broader field as opposed to a particular company. Government financing at this early stage, like that provided by the governments of sectoral leaders such as the U.S. and Singapore, would place Australia at the forefront of the cellular agriculture sector as it develops.

Complementary reforms

In 2022, CAA released a White Paper (attached) outlining the policy and investment requirements to grow the cellular agriculture sector in Australia. They include:

Developing a skilled and future fit workforce to enable commercialisation and industry growth

Through investment in the development of broad-based future skills, Australia can grow a pipeline of talent to support the commercialisation of these emerging technologies and products. Investment in these skills would effectively bridge the gap in specialised knowledge required in cellular agriculture as well as supporting other technologies in the medical technology or agricultural industries.

This includes the development of undergraduate subjects in Australian universities in synthetic biology relevant to food applications, livestock-relevant cellular biology subjects, and biomedical or other engineering subjects focused on developing the required skills to design large scale bioprocesses and required manufacturing.

As the industry matures, Vocational Education and Training (VET) programs that train the labour workforce to work in cellular agriculture factories will become increasingly important. Practical skills such as the production and maintenance of cellular agriculture bioreactors, harvesting of food-grade cells and fermentation-derived ingredients, and quality assurance of cellular agriculture will be required.

Deepening Australia's cross-disciplinary, open access cellular agriculture research
High-risk, pre-competitive, and multidisciplinary R&D is key to the cellular agriculture sector overcoming its barriers to growth and widespread adoption. Such research typically requires strategic public investment. While private investment in cellular agriculture technologies has rapidly grown over the past three years globally, driving major technological innovations, public research in the sector is disproportionately underfunded. As a result, scientific discoveries and breakthroughs are locked up in incumbent private companies, which widens the so-called "valley of death" between basic research and research translation for product commercialisation.

Food regulation

Food Standards Australia and New Zealand (FSANZ) has confirmed the Food Regulation System in Australia and New Zealand is already equipped to deal with new types of foods, including foods produced by the new technologies linked to cellular agriculture. It has also shown a willingness to work with and support companies to engage with the regulation framework in Australia. The regulatory pathway to approvals is critical to the sector's success as is its ability to adapt to meet the evolving needs of the sector as it grows.

Conclusion

CAA congratulates the Australian Government on its commitment to investing in innovations that will transform our economy and diversify our manufacturing base.

We support the concept of the National Reconstruction Fund and believe cellular agriculture is best placed to support the development of a diversified, sustainable and accessible food production system in Australia. We have natural, scientific and regulatory advantages, and believe cellular agriculture will not only be an important source of food and nutritional products, but it will also drive the positive innovation required across our entire food system. However, Australia risks being left behind as governments around the world have already started financing and investing in this technology.

We would be happy to speak in more detail about the opportunity cellular agriculture presents, and how its focus as a priority for the National Reconstruction Fund will provide financial and policy returns to Australia. We are also happy to facilitate introductions to the founders of Australia's cellular agriculture companies to get firsthand insights into the challenges of development at scale.

As referenced throughout the submission, our 2022 White Paper on the opportunities and challenges of scaling cellular agriculture in Australia is attached for your reference.

Finally, Cellular Agriculture Australia has drafted this submission on behalf of the cellular agriculture sector in Australia. The following stakeholders have formally supported this submission: Nourish Ingredients, Food Innovation Partners, Eden Brew, All G Foods, Vow Food, Change Foods, Magic Valley, Noumi Limited, Good Food Institute Asia Pacific, Alt Protein CRC, University of Sydney, Queensland University of Technology and Better Bite Ventures. Appendix A of this submission lists the logos provided by each of these organisations.

If you require more information or would like to discuss the contents of this submission, please do not hesitate to contact me at 0455 855 451 or sam@cellagaustralia.org.

Best regards,



Dr Sam Perkins
CEO
Cellular Agriculture Australia

Enc : Cellular Agriculture: An Opportunity to Diversify Australia's Food System, (White Paper) 2022

Appendix A: Logos of Companies Formally Supporting This Submission

