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Strategic Engagement of Research and Development Secretariat
Department of Industry, Science and Resources
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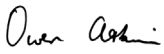
Submission to the *Strategic Examination of Research & Development Discussion Paper* from the ANU Agrifood Innovation Institute

Dear Secretariat,

Please find attached a submission from the Australia National University's Agrifood Innovation Institute regarding the 2025 Strategic Examination of R&D discussion paper.

Sincerely,



Professor Owen Atkin
Director, Agrifood Innovation Institute

Harnessing the interdisciplinary capabilities of Australian universities to deliver transformative solutions to national and global challenges

1. Background

The Agrifood Innovation Institute (AFII) at the Australian National University (ANU) focuses on improving Australia's agrifood systems to support the sector to become more sustainable, profitable and equitable. AFII brings academia, industry and government together to innovate and create a more sustainable, fairer future for all. We play a crucial role in building inter and transdisciplinary R&D teams and providing new pathways into agrifood careers.

AFII welcomes the opportunity to provide a submission to the *Strategic Examination of R&D Discussion Paper*. Australia's future prosperity needs a robust, adaptable and innovative research and development (R&D) system, that brings disciplines and sectors together to address global challenges. Sustainable and substantial R&D funding needs to be guaranteed over the longer-term to deliver significant, ongoing economic, social and environmental benefits to the Australian society.

Given AFII's mission, this submission will focus on our agrifood experience and expertise.

The submission highlights the need for the nation to leverage the full interdisciplinary R&D capabilities of the university sector and broader innovation ecosystem to address complex national and global agrifood challenges.

We align with and support the broader ANU submission and wish to provide a more in-depth view of a specific sector of interest.

2. The problem – declining investment and limited translation of R&D

Australia's R&D sector is world class, supported by the wealth of expertise and experience in our universities and research institutions. We have developed, as a country, some of the world's ground-breaking innovations and are known for our ability to undertake world-leading research. Coupled to our global leadership in fundamental and applied research is our capacity to translate research findings into practical applications. The interconnected nature of the research-innovation ecosystem highlights the need for need to support all its components.

Government support of R&D is significant, especially for research that aligns with national priorities. However, the wider research sector that includes universities is facing significant challenges that include:

- **Decreases in investment that are below that required to ensure Australia remains an innovation leader.** Gross expenditure on R&D (GERD) has dropped from 2.25 per cent of GDP in 2008 to 1.68 per cent[1]; business expenditure in R&D (BERD) has also

[1] Addressing Problems, Not Symptoms: The Decline of R&D in Australia – Causes, Consequences, and Solutions.

significantly decreased while government R&D spending is relatively low, sitting at 0.51 per cent GDP.

- **Policy volatility and changes in government priorities has increased uncertainty and made long-term planning difficult.** The current funding setting focuses mostly on **short-term grants** (the average length of R&D grants in Australia ranges from two to five years), prioritising incremental or commercially near-term research over long-term or high-risk but potentially high-reward research, limiting the potential return from investment and compromising the ability to securely retain a highly skilled R&D workforce.
- **Translating promising research into commercially viable products or services remains difficult.** In part, this is due to limited support and funding for prototyping, market validation or early-stage scaling. The significant investment needed to develop early-stage discoveries to market is a barrier for businesses, especially for small and medium enterprises (SMEs) that represent a larger proportion of BERD in Australia than in other OECD countries, and which often do not have access to the capital needed to translate research findings to create impact.
- **Siloes and collaboration gaps remain a significant issue within and outside of academia**. Most researchers within academia lack experience in working in a multidisciplinary setting, which limits opportunities to address complex societal, economic or environmental challenges.
- **Businesses operate on different timescales and priorities than university researchers**. Businesses often move at a much fast pace and often can't way for the slow funding application/ assessment/contracting timelines that universities need to comply with. Small businesses struggle to engage with universities and to navigate issues such as IP negotiations.

3. Investing in Australia's R&D ecosystem to deliver national impact

As society changes, and the challenges we face evolve, there is a need for R&D to adapt and become more flexible and responsive. Incremental solutions will not be enough to tackle major issues such as climate change or global pandemics in a geopolitically unstable world. These complex challenges require transformative solutions.

Below we highlight the need for the foundations of the Australian university R&D ecosystem to be strengthened – through more complete funding of the indirect costs of running universities (and a wider commitment to bring GERD closer to the OECD average), and through a recommitment to investing in national research infrastructure.

Our submission highlights the importance of universities engaging with industry, along with initiatives that incentivise industry investment in university collaborations.

We also outline a proposal for a new form of large-scale government funding to better leverage the full interdisciplinary capabilities of universities to address national priorities, and a structure through which industry can access those interdisciplinary capabilities.

The submission also outlines initiatives that improve how universities train the workforce of tomorrow.

3.1 The true costs of research need to be recognised and fully funded

At the forefront of challenges facing the university sector's capacity to provide the R&D needed by the nation is the **underfunding of indirect costs**. This includes administrative support, facility maintenance, utilities and infrastructure costs. To address this challenge, universities have long used student fees to subsidise the true costs of doing research. With international student numbers falling, this subsidy model is collapsing.

Going forward, a resolution to financing the indirect costs of research will be needed. If these costs can no longer be subsidised by international student fees, then governments will need to work with universities to design a sustainable funding system. This could include funding models that tie increases in government funding of indirect costs to new initiatives that break down discipline siloes and harness the full interdisciplinary capabilities of universities to address national priorities.

3.2 Commitment to investment in national R&D infrastructure post-2028 is crucial

Current government commitments to NCRIS will stop in 2028. The end of NCRIS would represent a significant risk to universities' ability to conduct long-term research and remain global R&D leaders.

Transformative proposals such as the *National Initiative for Crop and Community Resilience* (see Section 3.4.1 below) being developed by four Australian universities only progress if they are supported by nationwide facilities such as those supported by the National Collaborative Research Infrastructure Strategy (NCRIS). Of particular relevance to agrifood related R&D are investments by NCRIS in BioPlatforms Australia and Australian Plant Phenomics Network (APPN). Such facilities provide access to cutting-edge technologies, state-of-the-art equipment and expertise, as well as data analysis and management.

The commitment made by the Government to NCRIS for the 2024-2028 period has enabled an expansion of infrastructure crucial to creating a step-change in the climate resilience, profitability and sustainability of the agricultural sector. At ANU, the APPN has enabled researchers to have access to state-of-the-art facilities to simulate future climates while also monitoring the impacts of environmental stress on metabolic processes that underpin growth and productivity of a range of broadacre and protected environment crops.

More recently, BioPlatforms Australia has invested in a multi-node Plant SynBio (PSB) facility through which gene edited, and genetically modified plants can be generated. The PSB will enable researchers to create new plants with altered levels of gene expression, after which the functional significance of those changes on performance of crops (e.g. barley, canola) will be tested using the adjacent facilities in the APPN.

Together, the APPN and PSB enable the ANU – along with partners in other parts of Australia - to remain a global leader and attractive destination for crop research and development.

3.3 Links between universities, businesses and industry need to be enhanced

New funding options alone will not solve the current disconnect between research institutions and industry. To leverage our culture of research excellence to create

innovation excellence, we need long-term investments and programs that promote collaboration, knowledge sharing and industry engagement. SMEs must get easier access to research infrastructure and networks, which means that universities and other science institutions must become less siloed, easier to engage with.

Engaging with industry, translating research findings and/or exploring commercialisation of a new product or service are currently not adequately rewarded activities for university researchers. In fact, such activities could be seen as a burden for career advancement: university promotion and funding models still heavily prioritise publications in high-impact journals. On top of the pressure to keep publishing, researchers who want to explore commercialisation of their findings rarely get support with teaching or administrative tasks. As a result, engagement with industry can restrict career advancement of academics. It is crucial to improve career prospects for researchers actively engaging with industry if we want to accelerate innovation in Australia. Research translation and impact must be seen as being as rewarding and prestigious as publications. Recognising the importance of research translation will help foster a culture of entrepreneurship among students and researchers, leading to more opportunities to innovate and positively impact our society.

3.3.1 One-stop-shops to enable industry to connect with university R&D capabilities

A key ingredient for accelerating innovation in Australia is ensuring that industry has ready access to the full interdisciplinary research capabilities of universities. However, such access is often stymied by the siloed nature of university communities, and lack of entities tasked with facilitating industry connections with multiple university disciplines. To address this issue, the Australian National University has developed a series of industry-aligned innovation institutes, including the **Agrifood Innovation Institute** (AFII – see **Box 1**) and the **Institute for Space** (InSpace). These institutes break down traditional disciplinary siloes to create interdisciplinary teams to tackle complex challenges. The institutes are a portal for industry and government to connect with the university's research community and develop collaboration opportunities.

Having an Innovation Institute act as a single point of entry to the full interdisciplinary expertise of a university offers a compelling alternative to traditional approach where businesses often connect with a single discipline. Innovation Institutes harness and coordinate the university's interdisciplinary capability to deliver integrated solutions to complex problems, offering a more strategic and impactful leverage of R&D.

This model offers more flexibility and can:

- address complex policy challenges by offering interdisciplinary insights
- drive mission-oriented research with greater impact, aligning with national priorities
- streamline contracting, communication and project management with the university
- encourage research translation through close collaboration with end-users
- deliver a more tangible return on investment

Other universities or institutions have thematic or disciplinary centres. The Innovation Institute model run by ANU, with its mandate to act as a primary interface for external partners, and to champion interdisciplinarity, offers a unique/strategic advantage when tackling complex challenges.

3.4 Australia needs a new form of R&D funding that addresses long-term challenges

Australia needs to change the way we fund research to encourage more transformative R&D. The Federal Government could, for example, establish a National Resilience Sovereign Innovation Fund (NRSIF) to sit alongside existing investments. This entity would focus specifically on supporting large-scale, outcome-focused national initiatives, defined based on national priorities.

The proposed NRSIF would:

- provide substantial funding over a long period (10+ years) to enable R&D to address complex, intergenerational inter-generational national challenges
- create incentives and rewards for science institutions to engage with industry, governments, and community groups to translate their research
- provide opportunities for large-scale partnerships and co-funding investments with industry
- proactively engage with businesses to create pathways promoting strong industry engagement and job-ready skills

NRSIF funding would be tied to the delivery of outputs and outcomes of national significance.

Box 1 – The ANU Agrifood Innovation Institute (AFII)

The ANU is not a traditional provider of agricultural training and research, yet has recognised its capacity to drive innovation in the wider agrifood domain. It is for this reason that the ANU invested in AFII. AFII's **mission** is to improve the profitability, sustainability and equitability of agrifood systems, aiming for transformative solutions to national and global challenges.

AFII builds interdisciplinary teams, harnessing the University's research excellence in science, technology, engineering and mathematics, as well as the humanities, arts, social sciences, policy and regulation to collaborate on projects which tackle complex long-term agrifood challenges.

In doing so, AFII helps ANU translate its research into real world impact, while helping to build the capability the industry needs for the future through carefully constructed education and training programs.

Capability development is also a key goal of AFII, with the Institute investing in initiatives that develop and support the skills and capacity of students, researchers and innovators – and in doing so, help develop a future-ready agrifood workforce. AFII also promotes cultural change and process innovation to enable the acceleration of agrifood research translation and commercialisation.

AFII addresses its strategic goals through three initiatives:

- **Agrifood Hub** – a location on ANU campus designed to create an ecosystem for co-location of agrifood businesses, student-researcher-industry collaborations and idea generation
- **Research Translation Initiative** – initiatives to translate research into impactful agrifood innovations through partnerships and co-design
- **Innovation Training Initiative** – developing industry-relevant education and training programs for students, staff and industry while promoting an entrepreneurial culture.

AFII invests in initiatives that address six thematic areas where there is an industry/societal need for novel R&D, and where ANU has aligned R&D capability. The six themes are:

1. **Future Ready Crops**: Improving crop productivity and climate resilience
2. **Emissions and Climate Adaptation**: Reducing emissions and increasing climate resilience
3. **Biosecurity and One Health**: Minimising the impact of pests and diseases
4. **Bioeconomy**: Capitalising on consumer demands for sustainable food production
5. **Trade and Supply Chains**: Developing transparent, equitable & efficient food supply chains
6. **Energy Transitions**: Profitability/sustainability through renewable agri-energy technologies

Addressing the challenges within each of these themes requires an integrated, unifying approach to R&D. For example, addressing **Biosecurity and One Health** challenges created by invasive alien plants, animals and pathogens requires an acknowledgement that lifeforms are deeply interconnected, and that biosecurity threats impact human, animal and plant health as well as the environment. There is also a need to acknowledge links between increased trade pressures and heightened risks of pests and diseases that cause significant crop losses. Collaborative and interdisciplinary R&D, focusing on detection, surveillance, and shared responsibility among all stakeholders, is essential for a connected and resilient biosecurity system.

National initiatives funded by a NRSIF could draw on inputs from leaders in mission-style investments such as Mariana Mazzucato[2], combined with learnings from programs such as the *Trailblazer Universities Program*.

National initiatives could be designed to include incentives for research staff to engage with industry and translate their research, co-funding commitments from industry partners, proactive engagement between universities and businesses, and opportunities and pathways that promote strong industry engagement and job-ready skills for tertiary students.

3.4.1 Example of an NRSIF mission that targets cropping sector challenges

An example of an NRSIF is the proposal by four Group of Eight universities (Australian National University, University of Adelaide, University of Western Australia and University of Queensland) for a bold 10-year initiative - *National Initiative for Crop and Community Resilience* (NICCR) - that addresses challenges facing the cropping sector. The project has an over-the-horizon ambition for intergenerational growth in agriculture (see attached document).

Core to the NICCR proposal is a commitment from the four universities to leverage their cutting-edge research capabilities to meet the complex biological, technological, economic and societal needs of agriculture, support industries, supply chains and communities. Participation in NICCR would be available to other partnering universities, businesses and government agencies.

The NICCR's structure would drive convergence of diverse technologies (synthetic biology, genetic engineering, big data, artificial intelligence, satellite imagery) together with socio-economic-environmental capabilities to ensure that R&D addresses the challenges facing different crop industries, and to ensure that rural communities benefit.

To future-proof the industry, the NICCR would look beyond traditional food and fibre uses for crops and consider research requirements necessary to support emerging market segments such as biofuels, plant-based protein and novel fibre products. In doing so, and through investments in understanding the economic and social landscape of farming communities, the Initiative would contribute to greater regional and rural community resilience.

An example of a NICCR-supported moon-shot an ambitious program of work to dramatically reduce reliance on expensive and environmentally damaging inorganic nitrogen fertilisers (**Box 2)**.

Similar mission-style approaches could be adopted to address complex challenges faced by other industry sectors; for example, critical minerals processing, emissions reductions and cybersecurity. In all cases, funding needs to be tied to delivery of outputs and outcomes of national significance.

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[2] Mazzucato, M. (2018). "Mission-oriented innovation policies: challenges and opportunities." Industrial and Corporate Change **27**(5): 803-815.

Box 2 - Nitrogen-fixing cereals - an example of ground-breaking innovation

An example of how NICCR could transform the agrifood sector – through an agrifood moon-shot – is investment in R&D to produce cereal crops that fix nitrogen from the air instead of relying on fertiliser. Imported nitrogen fertilisers represent one of the biggest input costs for Australian farmers, with their production contributing to climate change.

The Haber-Bosch process used to produce inorganic nitrogen fertilisers consumes approximately 50 per cent of the energy used by agriculture. Moreover, more than 50 per cent of the inorganic fertiliser applied to crops is lost, either as runoff into groundwater or by conversion into nitrous oxide, which has a greenhouse gas potential about 300 times that of carbon dioxide.

Creating cereals capable of fixing their own nitrogen from the atmosphere – as is done by legumes – would transform Australian agriculture and reduce sovereign risk associated with reliance on fertiliser imports. Creating such plants would be a huge challenge requiring long-term, at-scale R&D by Australian researchers partnering with industry in Australia and overseas.

The proposal for ground-breaking ideas projects within NICCR is one way this could

3.5 Attracting, developing and retaining an R&D workforce

Agriculture, like all other R&D sectors, is undergoing a skills revolution: the sector increasingly requires people with a wide range of expertise, including in IT, computer science, engineering, economics, social sciences and policy, in addition to more traditional fields such as biology and agronomy. However, public perception of the sector has not changed, and too few graduates consider agriculture to be a viable career pathway, leading to a shortage of workers. For example, in 2018, only about a third of advertised agricultural scientist positions were filled [3]. Meanwhile, the existing agriculture workforce shows variable levels of digital and technical literacy.

Breaking down siloes, overcoming pre-held conceptions and building bridges between academia and industry are crucial elements of attracting and retaining talent. Training models must be updated to attract a wider range of graduates, and to ensure an adequate supply of skilled, future-ready workers. When local training is insufficient, Australia must focus on attracting international talent by streamlining visa processes, developing initiatives to attract global talent and supporting research collaborations to remain an R&D destination of choice.

3.5.1 Enhancing the STEM curriculum in primary and secondary schools

Enhancing STEM education and engagement in primary and secondary schools is crucial and will have a longer-term impact. High-quality secondary education must focus on inquiry-based learning, critical thinking, problem-solving and creativity. The STEM curriculum should be regularly updated to reflect advancements in science and technology. Using STEM to approach societal challenges and providing real-world

[3] Office of the Chief Scientist 2020, Australia's STEM Workforce. Australian Government, Canberra

examples, as well as facilitating interactions with industry to showcase career opportunities will increase the number of students choosing STEM fields.

3.5.2 Attracting attract students from non-traditional fields into agriculture

The future R&D workforce needed by Australia – particularly one with increased economic and technical complexity – will be different from that of the past and require the higher education sector to draw on a wider range of disciplines when training graduates for specific industry sectors.

The Australian agricultural sector will need new skills, perspectives and approaches to problem solving, to adapt to and thrive in this environment. This will require a balance between broadening the skills of agricultural graduates, upskilling of existing workers in industry and attracting participants from non-agricultural backgrounds to address skills shortages in agriculture. In particular, the diverse skills to adapt to changes in technology will require access to the global agri-food tech innovation ecosystem and collaboration with traditionally "non-agricultural disciplines".

Innovative programs are thus needed to attract students from non-traditional fields into agriculture. Work-integrated learning has an important role to play in bridging the current workforce gap, as does workforce upskilling. Such programs need close collaboration between teaching institutions and industry to identify future skills and training needs, and innovative approaches to capacity development.

3.5.3 ANU initiatives to connect students with the agrifood industry

Industry-aligned curriculum: AFII has developed successful novel approaches to higher education training and industry engagement in recent years. We first identified a series of crucial skills areas including, but not limited to, business strategy and decision-making; data and digital literacy; regulation, compliance and quality assurance; sustainability and carbon management; people management and interpersonal skills. While many of these skills share common elements with other industries, industry-specific competency is necessary to apply them effectively. For instance, data literacy and interpretation skills are universally needed, but workers must understand the specific production systems they are applied to. Therefore, different RDCs could collaborate to develop training for common base skills, supplemented with specific applied offerings or on-the-job training.

Recognising the need for higher education providers to adopt new training models, AFII developed an *Agricultural Innovation* curriculum at ANU. This curriculum integrates agricultural content into various degrees and courses across the university through guest lectures, case studies, student projects, and placements. With an aim to "do agriculture differently", the curriculum presents non-traditional opportunities in agriculture and improves students' agricultural literacy with the aim of giving them the skills to apply domain knowledge from other disciplines to solve agricultural challenges.

Industry placements: Student engagement with industry has been a key part of the ANU Agricultural Innovation curriculum. Our focus has been on ensuring students are job ready with the skills industry has identified that it needs now and, in the future, with industry placements offering students opportunities to develop those job ready skills. AFII has so far supported the placement of ≈100 students in agriculture-related

projects, across a wide range of disciplines that include engineering and computer science, business and economics, plant and environmental sciences, social sciences and policy.

The success of the scheme is largely due to AFII's involvement at every stage: we support industry partners during project design, help identify most relevant internship programs and co-supervise students. Our expertise has been recognised by the award of an AgConnections Skilled Agricultural Work Grant by the Federal Department of Agriculture, Fisheries and Forestry to increase the number of skilled students from a broad range of disciplines entering the agriculture sector.

Industry-aligned, ANU-CSIRO collaborations: As part of a Strategic Relationship Agreement, ANU and CSIRO have co-invested in initiatives to foster greater collaboration – bringing together world class researchers with complementary skills to tackle complex challenges in the agricultural sector. As part of this agreement, AFII facilitated development and implementation of the resulting $1M ANU-CSIRO Agri-Food Collaboration Program (AFCP). Funded projects must address an industry-validated challenge and be thematically linked to one of CSIRO Agriculture & Food's seven impact areas. The successful project – led by an ANU start-up, *Membrane Transport Engineers* (see Box 3) - was one that uses aquaporins (membrane transport proteins) to selectively filter nutrients and metals out of liquid waste streams from aquaculture systems in Tasmania. The technologies developed by MTE are also being used in the mining sector (e.g. with Rio Tinto to extract value from mining impacted wastewater, by harvesting metals of interest).

Box 3. Building entrepreneurial culture in universities

One of the ways AFII has grown the entrepreneurial culture of the University community has been through problem-specific hackathons, each of which harness partnerships with research- and industry-based institutions to support rapid development of solutions to agricultural challenges.

An example is the 'H_2O Hack: solving water challenges from space'. Eight teams participated in workshops, mentoring, and collaboration sessions during the week, culminating in a pitch session. The Hack aimed to foster interdisciplinary collaboration and develop solutions to address Australia's water management challenges using space technology.

Past winners of the Hackathons from the ANU community have gone on to establish and successful develop start-up companies, such as Membrane Transport Engineers (https://membranetransportengineers.com/) and Hazea Analytics (https://hazea.com.au/). Both are based in the AFII Innovation Hub on the ANU

3.6 First Nations knowledge and leadership

AFII recognises the importance of including First Nations' knowledge and culture in R&D, as their perspectives can transform approaches to resilience and innovation and be of benefit to all.

As part of the AgConnections Skilled Agricultural Work Grant, AFII is co-designing workshops with First Nations representatives to co-design culturally safe engagement activities for First Nations students and will develop events that celebrate First Nations contributions to modern agriculture, empowering the next generation.

AFII also supports research bringing together Indigenous knowledge and “western science”. For example, we have funded a project looking at the molecular impact of cultural burning on native and introduced plants in local cattle grazing areas. The project brings together local Traditional Owners, molecular biologists and ecologists. Depending on the results from this pilot study, the same work could be done in other States and Territories, supporting the cattle industry and recognising the importance of traditional knowledge.

4. Conclusions and recommendations

Australia's R&D sector, while possessing world-class expertise within its research institutions, faces significant challenges that threaten Australia's future as an innovation leader. These challenges include a concerning decline in overall R&D investment that investment not keeping pace with the costs of research, a business model for universities increasingly strained by falling international student income, and persistent silos within and beyond academia that hinder the translation of research into tangible impact. Moreover, there is a critical need to train a future workforce equipped with the diverse skills required to meet Australia's evolving needs across various sectors. Addressing complex national challenges, supporting excellence in fundamental research, and ensuring a skilled workforce necessitates a fundamental shift in approach. This requires a recognition and full funding of the indirect costs associated with research, coupled with a renewed commitment to long-term investment in national research infrastructure.

Furthermore, the current funding landscape often prioritises short-term gains over the transformative potential of interdisciplinary research. To truly leverage the capabilities of Australian universities, additional investment must be strategically tied to their capacity to break down disciplinary silos and collaboratively address complex, national challenges, while also actively contributing to the development of a future-ready workforce.

Our submission highlights two key proposals to address these issues.

Firstly, the ANU is actively investing in **Innovation Institutes**, such as the Agrifood Innovation Institute, to serve as crucial interfaces between industry and the diverse research capabilities within the university. These institutes are designed to foster interdisciplinary collaboration and provide a streamlined point of access for external partners seeking integrated solutions, while also creating opportunities for student engagement and skill development.

Secondly, we propose the establishment of a new, outcome-focused government funding program, exemplified by the **National Resilience Sovereign Innovation Fund**. This program would target long-term, complex national challenges through the resourcing of mission-style investments, incentivising collaboration, translation, and the co-creation of solutions with industry and community stakeholders, with a clear focus on developing the skills and pathways for the next generation of researchers and industry professionals.

By strategically aligning investment with interdisciplinary capabilities, fostering stronger connections with industry, and prioritising the training of a future workforce, Australia can unlock the transformative potential of its university sector to deliver

impactful solutions to its most pressing national challenges and secure its future prosperity.