ZNE-Ag CRC draft submission to the DAFF Agriculture and Land Plan.

1. *What are the opportunities and barriers in carbon reduction within the agricultural and land sector?*

The opportunities to reduce emissions differ by industry. For broadacre cropping, reducing nitrous oxide emissions from fertilisers, for example through slow release coatings, represents the major opportunity. For grazing cattle and sheep, there are a range of opportunities including feed additives (*Asparagopsis* and 3-NOP, with more methane mitigating additives the topic of active research), genetic selection to reduce methane emissions, and early in life modification of rumen microbiomes to reduce emissions. Pastures designed to reduce emissions, will also play a role, as will incorporation of legumes in grazing systems. Two challenges with all these technologies is that no single technology will reduce emissions to net zero, and the technologies will also need to improve profitability of farming systems to be adopted.

The CRC for Zero Net Emissions from Agriculture (ZNE-Ag CRC) is a major opportunity to overcome these barriers. This CRC (with all State and the Northern Territories Governments, ten universities and 57 industry partners) is the ideal opportunity to co-ordinate, demonstrate and scale up emissions reduction technologies for Australian agriculture. The CRC will run a series of producer demonstration sites, representing Australia's major agro-ecological zones, where emissions reduction technologies can be scaled and run in combination (stacked), to evaluate impact on farm system emissions. At the same time, the demonstration of these technologies (including impact on profit) at a farming system scale, together with close co-operation from grower and producer group representing thousands of farmers, will be a major route to adoption.

The CRC will clearly demonstrate and validate commercially viable pathways to net zero for Australian agricultural businesses, overcoming the high level of confusion that is the current situation, the result of many fragmented efforts in this space. Our industry partners have time and time again reiterated that the current confusion is the major barrier for adopting emissions reducing technologies. The ZNE-Ag CRC will overcome this barrier by providing a national flagship, a nation-wide. coordinated joined up response to the very substantial challenge of reducing our agricultural emissions to net zero.

2. *How can the sector best reduce emissions? Are there any good case studies or examples?*

For broad-acre cropping, pre-coating of fertilisers can clearly substantially reduce emissions of nitrous-oxide, the major source of green gas emissions from this sector. A shared business model to pre-coat all fertilisers with the fertiliser retailers and government could achieve a 50% reduction in emissions from the entire cropping industry with no adoption profile required.

For livestock, feed additives such as *Asparagopsis* and 3-NOP can achieve reductions in methane emissions of between 30% and 90% in feedlot situations. Delivering these additives on a daily, cost effective basis to grazing animals remains a challenge. Genetic selection for reduced methane emissions is possible, given methane emissions are heritable (Donoghue et al. 2016, Hayes et al. 2016). Hayes et al (2016) demonstrated it was possible to derive DNA marker predictions of genetic merit for methane emissions levels, which would allow rapid selection for reduced emissions. This strategy is now being pursued at scale in Australia,

Ireland and the UK. Meale et al. (2022) demonstrated that it was possible to alter long term emissions from cattle by altering the rumen microbiome early in life, by feeding dairy calves a methane mitigating additive (3-NOP). This strategy has enormous promise for reducing emissions from grazing cattle.

It is now clear that not one technology will lead to zero net emissions for any agricultural sector. Rather technologies will have to be combined (or "stacked") to achieve this. The ZNE-Ag CRC offers a unique opportunity to evaluate the impact of emissions reduction technology stacks on total emissions from farming systems.

Donoghue KA, Bird-Gardiner T, Arthur PF, Herd RM, Hegarty RF. Genetic and phenotypic variance and covariance components for methane emission and postweaning traits in Angus cattle. J Anim Sci. 2016 Apr;94(4):1438-45. doi: 10.2527/jas.2015-0065.

Hayes BJ, Donoghue KA, Reich CM, Mason BA, Bird-Gardiner T, Herd RM, Arthur PF. Genomic heritabilities and genomic estimated breeding values for methane traits in Angus cattle. J Anim Sci. 2016 Mar;94(3):902-8. doi: 10.2527/jas.2015-0078.

Meale SJ, Popova M, Saro C, Martin C, Bernard A, Lagree M, Yáñez-Ruiz DR, Boudra H, Duval S, Morgavi DP. Early life dietary intervention in dairy calves results in a long-term reduction in methane emissions. Sci Rep. 2021 Feb 4;11(1):3003. doi: 10.1038/s41598-021-82084-9.

3. *What can the government do differently to better support the sector as it transitions towards net zero emissions?*

A higher level of investment and a long-term commitment to enabling policies, research, industry transformation and upskilling are clearly required to tackle a problem of this magnitude.

In research, while implementation of existing research is an essential aspect, attention to higher risk areas is also required to develop breakthrough technologies, such as use of (such a RNA approaches to reduce emissions in livestock. These technologies could have a have a major impact in areas where there are no current affordable and effective solutions, particularly for example, to solve the on the wicked challenge of reducing emissions from grazing livestock.

Industry transformation needs a more coordinated approach, with clear and comprehensive validation and demonstration of pathways to net-zero, that either increase profit or at least do not decrease it. This is a pre-requisite, required for wide spread industry adoption of net zero transition pathways by Australian farmers and the farm support sector. The ZNE CRC will be the exemplar of this approach.

The CRC has also been designed to inform government policy (state and federal), such that policy does not become a barrier to adoption of emissions reduction technologies (which is occurring in some cases as the moment, for example there is a lack of clarity regarding if farmers implement emissions reducing technologies, will they be rewarded for it in ERF schemes, and this is delaying uptake of some of these technologies).

4. *Where are the workforce/skills gaps that need to be addressed to make the transition successful?*

The waxing and waning of Australian funding in this area over the last two decades has meant it is difficult to retain expertise in this area. The ZNE CRC will address this directly by, training 50 PhD students in emissions reductions technologies and strategies; delivering undergraduate university and VET training to over 6000 students across Australia; as well as working closely with Indigenous enterprises to develop a workforce with unique skills to harness the combination of Indigenous knowledge and western science to reduce emissions from their agricultural ventures.

5. *How can we make the sector more resilient to the impacts of climate change?*

The network of producer demonstration sites in the CRC present an ideal opportunity to assess how technologies improving adaptation and resilience to climate change impact emissions. There may be some valuable co-benefits from these technologies as strategies, for example more heat tolerant cattle and crop varieties may also be able to produce beef and grain with less inputs, improving efficiencies and lowering system emissions. The CRC will coordinate with entities such as the Regional Drought Hubs to ensure multi-dimensional evaluation of technologies and strategies in farming systems.

6. *Is there anything else you'd like us to know as we prepare our submission to this consultation?*

The ZNE CRC has been successfully funded in round 24 of the CRC program and represents a $300 million dollar co-investment between the Federal Government and CRC partners in addressing the critical challenge of achieving net zero in the agriculture and land sector. The CRC will be national flagship, a nation-wide. coordinated joined up response to the very substantial challenge of reducing our agricultural emissions to net zero. initiative, which coordinates industry-led research, development and extension activities. The CRC will work closely with the whole of Australian Government at both the Federal, State and Territory jurisdictional levels to provide the science-based approaches and evidence required for Australian agriculture to transition to net zero. We stand ready to work in partnership with the Department of Agriculture, Fisheries and Forestry, as well as other key stakeholders in Federal Government on the design and implementation of the Agriculture and Land Sectoral Plan.