1. INTRODUCTION

PlantTech Research Institute welcomes the opportunity to provide feedback on the Te Ara Paerangi Future Pathways Green paper 2021. These comments are prepared by the executive, endorsed by the Scientific Advisory Committee and the Board.

PlantTech sits within the landscape as an independent Research and Technology Organisation (RTO), positioned between long-range research providers such as universities and CRIs to one side and industry to the other. Our role is to carry out excellent applied and translational research, in response to identified user and market needs, and to deliver de-risked solutions that industry embeds into new products and services.

Our operating model is based on an analysis of international best practice in high-performing, knowledge-intensive, economies. Shown in Figure 1, the model has three pillars of activity designed to link and accelerate excellent scientific research into scalable solutions that can be adopted and scaled for the economic and social benefit of New Zealand.

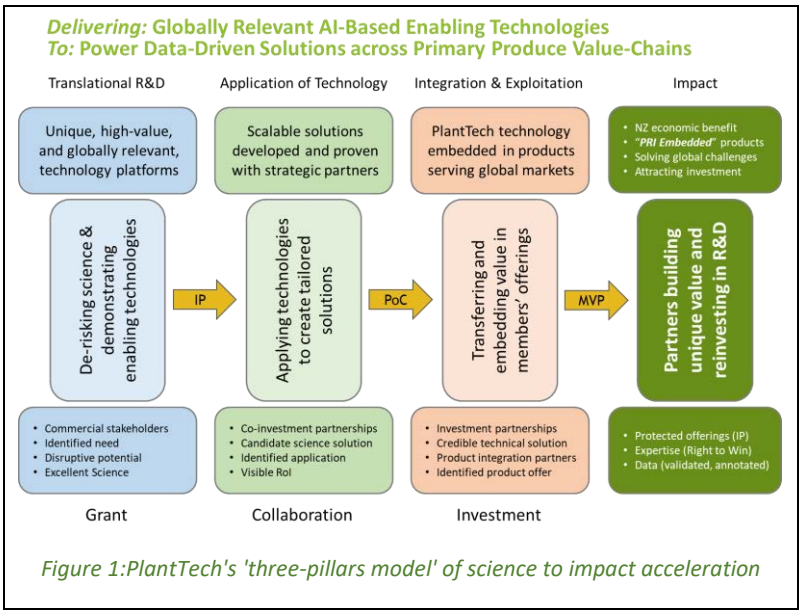

Figure 1:PlantTech's 'three-pillars model' of science to impact acceleration

The first step towards impact is identifying market needs, by maintaining deep relationships with large and small companies and other user organisations in the red pillar. These are the organisations to whom we deliver matured technical capabilities, that they embed through product development and which they use their commercial resources rapidly to scale in-market.

Insights from these user and commercial relationships enable us to identify common technical and scientific gaps, across a range of market needs, which inform our research activities in the blue pillar. Here, we work across the research communities to identify emerging technologies and research outcomes which have potential to address the identified gaps. We apply expertise in translational and applied research to mature new scientific capabilities and to demonstrate the capability for these to address known challenges.

The third element is collaboration within the green pillar, where we apply translational R&D capabilities to specific user challenges. Combining skills, towards de-risking the investment case for product integration and application.

2. EXECUTIVE SUMMARY

Several key characteristics critically influence Aotearoa New Zealand's performance in research science and innovation and the responses required to deliver success.

- Aotearoa New Zealand performs well in international bibliometric research benchmarks[1]
- Only 1% (5,840) of enterprises have 50 or more employees, down 2.9% from Feb '20 to '21[2]
- R&D expenditure is 1.4% of GDP, vs OECD average of 2.5% and top performers at 5% (Israel)[3]
- The CRI model has not delivered impact beyond a small number of large corporations and government departments[4]
- We lack end-to-end excellence in commercialisation across the ecosystem[5]
- There has been a lack of coherence in innovation policy[6]

There needs to be adequate and appropriate support across the full RS&I spectrum, together with a recognition that the expertise and approaches required differ across Research, Development and Innovation. Our standing in international research benchmarks indicates Research is performing well, and the recent growth of international investment fund activity, along with proliferation of domestic incubation support, will favourably impact Innovation. The failure to translate one to the other is due to a lack of capacity around the specialist expertise needed to support Development; market-driven applied research, and collaborative de-risking, to turn new capabilities into the foundations for new products and services.

3. WHAT DOES SUCCESS LOOK LIKE?

We welcome the government's commitment to raising Aotearoa New Zealand's Business Expenditure on R&D, and measures such as the R&D tax system which are designed to support this. For the country to be successful, though, it is essential that we learn from economies of similar scale, where there is a similar bias towards smaller companies, and which look to foreign direct investment and exports as key drivers of local economic growth. At the root of the challenge, there is no getting around the fact that we need to increase total expenditure on R&D. This applies to both government and industry.

Looking to successful knowledge-intensive economies of a similar nature, predominantly across Europe and South-East Asia, we see a number of common factors in success. **New Zealand's science system needs a similar focus on fostering these characteristics:**

- **Translating Research to Outcomes** – Research and Technology Organisations fill a critical niche between the immature technology (in a commercial sense) emerging from the research base and the absorptive capacity of (predominantly) smaller companies. *By focusing on market needs and translational research in the low to mid-TRL[7] space they support rapid de-risking and specialisation of critical enabling technologies.*
- **Stability of Structures and Funding** – Risk-based relationships around translation of research to impact are long-term activities which require trust, time, and specialist skills. *The funding structure must provide stable support, not just for underpinning research but also for translational research and embedding of capabilities and skills in the user base.*

[1] "QS World University Rankings 2022", https://www.topuniversities.com/university-rankings/world-university-rankings/2022
[2] "New Zealand business demography statistics: At February 2021", https://www.stats.govt.nz/information-releases/new-zealand-business-demography-statistics-at-february-2021
[3] "Gross domestic spending on R&D", OECD 2019, https://data.oecd.org/rd/gross-domestic-spending-on-r-d.htm
[4] "Pathways to the Future", https://sciencenewzealand.org/publications/pathways-to-the-future/
[5] "Te Pae Kahurangi", https://www.mbie.govt.nz/assets/te-pae-kahurangi-report.pdf, CRI Review Commission, April 2020
[6] "New Zealand firms: Reaching for the Frontier", https://www.productivity.govt.nz/assets/Documents/Final-report-Frontier-firms.pdf, New Zealand Productivity Commission, April 2021
[7] https://en.wikipedia.org/wiki/Technology_readiness_level

- **Clustering and relevance to place** – *Supporting regions to invest in areas of local excellence and build clusters of activity is a strong enabler of increased innovation.* The mix of large and small enterprises, focused on similar challenges, supports sharing of risk and dissemination of knowledge and capability outcomes. In Aotearoa New Zealand, tangata whenua and the mana they bring as kaitiaki of our taonga, engenders great additional strength to this approach.
- **Diversity of Organisations** – *One organisation type cannot be expected to cover the whole of the RS&I journey; different skills, cultures, structures, and support mechanisms, are required at each stage.* Excellent universities and crown funded research providers are the foundation of knowledge-intensive economies, just as innovative companies are the vehicles for economic return. Successful RTOs bridge the gap between the two, whilst innovative public policy and procurement supports wider societal stimulus and benefit.
- **Skills Matched to Need –** *We need to create a pipeline of highly talented industrial research leaders, in addition to academic researchers*. Whilst mechanism such as PhD are proven in delivering the skills required for further academic research, industry needs people with a wider range of competencies. We should seek also to create research training pathways that include business skills, that are much more closely tied to the needs and timescales of end users, and which accommodate a more agile and outcomes focused approach. The UK EPSRC Engineering Doctorate[8] is an excellent example of such an approach.
- **Appropriate and Varied Metrics** – Both excellence and impact metrics have to be applied at all stages of the journey. Metrics have to be appropriate to each category and the stage of the RS&I and journey to which they relate. *Whilst excellence in fundamental research may be driven predominantly by journal bibliometrics, translational and applied activity needs to consider indicators related to demonstration of value growth, user engagement, and investment attraction.*

Responding directly to a number of questions in the green paper, we offer the following views.

3.1. Research Priorities

In setting national research priorities, it is essential to consider how the gap between research and application will be bridged. Potential end users and industry should be considered and included from the outset and should be made to feel their voice is heard and valued. Where research outcomes will be applied rather than fundamental, there must be an understanding that metrics should assess real value creation and also indicate steps on the pathway to end-users and/or commercialisation. This includes a realistic assessment of the absorptive capacity that exists and, if this is inadequate, identified steps to increase this in parallel with the research delivery.

The process for selecting national priorities must take account of the diverse range of actors within the RS&I system and positively encourage deep and meaningful collaboration across these. Priorities should be rooted in real challenges that affect our social, economic, and commercial future. The process must look at potential value and impact for Aotearoa New Zealand, at positioning us to export knowledge and solutions globally, and driving international investment in the key strengths we develop. It should work to encourage collaboration, and genuine handover between organisations throughout the journey, not just between research provider and end user.

Finally, it must balance being nimble to adapt to changing demands, with providing sufficient stability for the research process to reach a meaningful stage.

- *The definition of Excellence should be broadened, as it is currently overly focused on academic publication metrics. The broader approach indicated in the Draft RS&I Strategy[9] is to be*

[8] https://epsrc.ukri.org/newsevents/pubs/the-epsrc-industrial-doctorate-centre-scheme-good-practice-guidance/
[9] "New Zealand's Research Science and Innovation Strategy" (P 25), https://www.mbie.govt.nz/have-your-say/draft-research-science-and-innovation-strategy/

commended in its acknowledgement that, "Excellent RSI does not have to result in a publication. It is as likely to occur in a small start-up firm as in a large academic institution. Excellence is a term that can apply just as easily to applied research as it can to basic or fundamental investigation."

- *Both Excellence and Impact should be assessed at every stage of the RS&I journey with the nature and relative weighting of assessment tuned to the stage on the journey.*
- *The pathway, from fundamental research to impact for the nation, and partnerships to deliver this, should be encouraged and provided with appropriate resources to succeed.*
- *Consultation should be across the whole spectrum of interested parties, it should rest on solid foundations that honour Te Tiriti, and give adequate voice to societal, commercial, and economic challenges.*

3.2. What are your thoughts on regionally based Māori knowledge hubs?

Within the primary sector there is a natural alignment between the regional nature of industry and tangata whenua through the local iwi and hapū. Whilst many underlying challenges and enabling technology solutions are common across crops and regions, there is much local variation of climate, environment, and practice. Building local mana whenua relationships, giving voice to this knowledge and these values, will enrich the research and will support better value delivery to local Māori. Locally-focused hubs could also be a powerful tool in building capability among iwi, hapū, and the Māori economy.

- *Applied research in the primary sector has the power to inspire tamariki and engage rangatahi. Research at RTOs, like PlantTech, will lead to better outcomes for Māori in the primary sector through higher productivity whilst reflecting kaitiakitanga by holding sustainability at its core.*

3.3. Do you think a base grant funding model will improve stability and resilience for research organisations, and how should we go about designing and implementing such a funding model?

The stated aspiration, to "provide a level playing field for different types of research organisation" is to be applauded as an enabler of the sort of diverse, fit for purpose, RS&I system that is required.

- *To provide a level playing field, base funding must be deployed across the full RS&I spectrum. There are specialist skills and long-term relationships required throughout the RS&I journey, particularly at the translational end, which could benefit from greater stability.*

Additionally, if NZ is to achieve the desired increase in R&D expenditure, both the public and private sectors will need to step up to the plate. The role of the public purse, and the relationships between public and private investment, will vary across the spectrum of activities and the funding system needs to accommodate this. However, it also needs to recognise that private investment tends to be a lag indicator that is dependent on continued value delivery, rather than a lead indicator to effect change.

The application of base funding should be approached with great care and investigation of potential unintended consequences. We suggest caution on a number of fronts:

- *Avoid creating advantageous positions for established players within a field, reducing competition and openness to new approaches.*
- *There is potential to unnecessarily limit the types of organisations that can receive such funding, reducing agility to adapt to new delivery models.*
- *Ensure that the nature of base funding, and associated performance indicators, are appropriate to the position of the activity along the RS&I journey. This is so that adequate stability is provided whilst adequate competitive tension is retained.*

3.4. Knowledge exchange

If NZ is to be effective in translating fundamental science investment into national socio-economic benefits, there needs to be a more diverse range of institutions across the RS&I spectrum. We need to support

"Research Science and Innovation Institutions", not just "Research Institutions". PlantTech, for instance, is an example of an organisation which exists in the mid-section of this journey. We aim to excel at translating academic research developments into investable product development opportunities.

Our staff, structures, and processes are specifically designed to support the interface and understanding at both ends of this part of the journey. Our skills profile enables effective interaction and transfer with horizon 3 research activities in the universities and CRIs. Our culture and processes support effective and agile delivery to innovative companies and other adopters of technology. Our current base funding allows us to carry out early stage innovation, which is beyond the risk appetite of adopters and to focus on transferring what we create to whichever organisation is best equipped to scale it rapidly.

Our operating model, shown earlier, is based on >70 years of international best practice development, starting in Germany and resulting in a rapidly growing range of "Triple Helix"[10] organisations globally that deliver a high rate of return on public investment in the exploitation of research.

- *If Aotearoa New Zealand wants to maximise value and impact delivery from its high performing research base, it needs to invest in the skills, expertise, and mechanisms to achieve this. The Triple Helix approach, which partners government, industry, and research around common goals, has proven highly successful in comparable economies and we urge the government to further develop this approach.*

4. INSIGHTS FROM PLANTTECH

Since establishing a delivery capability in early 2020, PlantTech has demonstrated rapid development of the three strands within the Triple Helix:

- Establishing a credible science track record and achieving success in contestable funding (e.g. Endeavour)
- Building collaborative R&D activities and funding through a growing network of commercial and research partnerships and investments (e.g. SFFF, Callaghan, Our Land and Water)
- Working directly with end users to deliver outcomes that they can adopt and integrate into their businesses (direct contract R&D delivery).

Within a short period of time, we are already demonstrating an increase in the R&D spend of companies, a growing list of companies engaged and investing with us, and a high proportion of repeat business. In the research domain, there is increasing interest from CRI's and universities to collaborate both in an ad hoc fashion and through formalised approaches.

A key enabler for this has been the base funding through MBIE, which allows PlantTech to deliver scientifically excellent translational research (the first pillar) that is simply too high-risk (immature) for industry to fund. The quid-pro-quo is that we are bound to transfer and embed (third pillar) the outcomes, and the skills required to develop them, into market partners who take forward and scale products based on these.

The model only works with a primary focus on market needs and pull, coupled to the ability to deliver deep tech de-risking and development. One possible model to support this would be based on:

- *Stability through longer-period (e.g. five yearly) contesting of overall support funding package for translational research, with associated deliverables and KPIs*
- *Focus and drive maintained through shorter-period (e.g. annual) allocation review, with the funding input being driven by performance in attracting private investment in the preceding period.*

[10] "The Knowledge-Based Economy and the Triple Helix Model", Leydesdorff, 2010

