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Te Ara Paerangi – Future Pathways

DairyNZ welcomes the initiation of the Te Ara Paerangi Future Pathways review. We agree that an open and wide-ranging review of the New Zealand research system is warranted.

This submission contains initial reflections from DairyNZ on the Green Paper. We will provide more specific feedback as proposals are progressed in a White Paper and beyond.

DairyNZ scientists have experience working in both the New Zealand science system and in systems abroad. DairyNZ asks for the opportunity to engage with you continuously over the course of the Te Ara Paerangi review.

Key submission points are highlighted in the body of the submission. Individual answers to submission key questions are contained in an appendix to this submission.

Summary of our submission

- DairyNZ agrees that a review of the science system in New Zealand is warranted. We welcome the opportunity to engage in this process.
- DairyNZ is working to support agriculture to continue to be world leading. We believe for this innovation to happen there needs to be clearer pathways in a research system. For both the research and people to grow knowledge and innovation.
- In our experience there is no one perfect model for a research system. All systems have their strong-points and drawbacks. The Green Paper highlights some the drawbacks of the current system and some alternative design considerations. At times, the Green Paper does not consider adequately potential negative consequences of alternative designs. Our submission highlights some examples of potential outcomes from different funding models that need to be considered.
- **Overall, we believe a balanced system achieves the best outcomes.**

- We support the use of research priorities to provide long-term direction. Priorities should be designed in a way that they enable long-term planning without constraining short-term responses to crisis or opportunity.
- Long-term research priorities and strategies will only be successful if they have a balance of inputs from all the users of the science. This must include input from producers and exporters alongside the research requirements of operational government departments, regional councils and Māori. Note that much of the critical research required to meet the needs of current users is not ‘transformational’.
- Investment in new ‘transformational’ research is high-risk high reward. We need a balanced research portfolio that has a majority spend on improving existing industries and solving existing economic, environmental and social issues. New ‘transformational’ research may form a sizable minority of research spend.
- There is an important balance to be struck between desirable attributes of a core funded system (stability, long-term perspective, research career pathways, persistency of research effort) and the undesirable (internal focus, lack of responsiveness to science users and change).
- However the funding system is designed, DairyNZ wants to see a stronger relationship with CRIs and more government research effort being directed to the ‘non-transformational’ solutions required by New Zealand.
- A change to a system where some entities are core funded, and others aren’t, risks non-Government science investment also being directed to the government funded (and therefore cheaper) CRIs, with no incentive for sector or private companies to built research capability. This point is critical for DairyNZ which holds and funds a nationally important dairy related research capability and infrastructure.

About DairyNZ

DairyNZ is the industry-good organisation representing all 11,000 of New Zealand’s dairy farmers.

We deliver value to farmers through leadership, investment in research and development, lead on-farm adoption of best practice farming, promote careers in dairying, and advocate for farmers with central and local government.

DairyNZ is a major investor and practitioner of science in New Zealand

DairyNZ collects a levy from each kilogram of milksolids collected in New Zealand. In the most recent season DairyNZ collected a total of \$70 million from the milk levy. Of this, \$21 million was invested in research, science and innovation. DairyNZ also co-invests with government to deliver nationally important science and research.

There is no doubt that DairyNZ’s science investment and operations will be hugely affected by the proposals contained in the Green Paper. We write this submission as a first step in our

engagement on this issue. We are eager to discuss all the issues raised further with those leading the work and be involved in this work as the White Paper is developed.

<i>DairyNZ Inc funds science through:</i>	
DairyNZ Limited (internal provider)	\$18,200,000
External Providers	\$3,300,000
Total	\$21,500,000

Figure 1: DairyNZ science, research and innovation funding

Dairy farmers are major users of science

New Zealand’s dairy farmers are the best in the world at what they do. We can compete with competitors abroad who are heavily subsidised and enjoy a closer proximity to large markets. For each litre of milk produced in New Zealand our farmers use less fertiliser, less imported feed and less chemical inputs than typical competitors abroad. Carbon footprint analysis has shown our farmers can produce a litre of milk with a lower carbon footprint than any global competitor.

Our success has many drivers. In part it is due to a climate well suited to dairy farming, and in part it is government policy that doesn’t pick winners through subsidies or regulation. Critically, it is also in a large part due to decades of investment in science and research by both government and industry. Dairy farmers have always valued research outcomes and have consistently sought to incorporate them into their farm systems.

Dairy farmers, through our Dairy Tomorrow Strategy, are committed to continuing to reduce their carbon footprint, improve their animal care and enhance our farm biodiversity.

In short, dairy farmers are also key stakeholders in this review. In order to maintain our competitive advantage and continue to improve our environment, dairy farmers need access to robust and relevant science and research.

New Zealand science system

In our opinion, New Zealand’s science system is currently not performing to its potential. While the New Zealand government has funded a large amount of beneficial research over the last thirty years this is now considerable space for evolution and improvement. In this light we support the initiation of the review and some of the proposals within the Green Paper. We note below the risks that some of the proposals presented in our opinion.

Research priorities and strategy development

The Green Paper proposes that a “single set of system level priorities” are established for the research system. These priorities will then have a role in directing government investment in research.

Overall, the proposal to have clear research priorities is positive. These research priorities should anchor government research funding and send a signal to CRIs on the long-term needs for government research.

Research priorities will only be successful if they are developed in a balanced way. We highlight below three areas where balance is needed in the research priority and strategy process.

Balanced time horizons

We don't believe *all* government funding should flow through long-term research priorities. From time to time there will be instances where a research project is needed but doesn't fit into one of the research priorities. Priorities should function in a way that they enable long-term planning without constraining short-term responses.

Balanced perspectives

The process to determine research priorities needs to allow a balanced perspective to be achieved. A process that is government-centric and signed off by Ministers risks becoming political in nature. CRIs need to be involved but will have an interest in promoting their individual fields of research. Producer organisations are needed to ground the priorities in what is actually needed on farm, in factory and on building site. Exporters are needed to provide a view of what markets are demanding. Operational government departments, local government and Māori will also offer insights into research needs.



Figure 2: Balanced approach to developing research priorities and strategies

Balanced portfolio of risk

There is a need to strike a balance between research focused on improving the areas that New Zealand has strength in already and investigating areas of potential future growth. The present shift towards prioritising 'transformational' research needs to be viewed through a risk-reward lens. Investing in new 'transformational' research of course has a higher potential reward, but also brings with it increased risk of not being successfully commercialised.

If New Zealand does not continue to invest in research for those industries for which we already have established and competitive domestic producers, there is a risk we slide backwards compared to overseas counterparts. Equally, we need to continue to invest in core areas such as biosecurity, biodiversity and so on.

DairyNZ believes the bulk of New Zealand's science research needs to be on areas where we already have established and proven capability to compete on a world stage. Investment in

‘transformational’ research should be an important and significant minority of our research spend.

Proposals for ‘transformational’ research need to be adequately tested for feasibility in a New Zealand context before significant research spend is committed. For example, large scale conversion to alternative land use can face constraints due to:

- Labour: New Zealand is already hitting capacity limits in some regions for seasonal workforces.
- Market: Some products may experience a ‘glut’ if done at scale.
- Capital: Land use conversions often require large amounts of capital investment.

Framing of research priorities

The Green Paper considers if research priorities should focus on a problem (e.g., pollution), an opportunity (e.g., alternative proteins), a technology (e.g., CRISPR), a mission (e.g., space) or a field of research (e.g., soil science).

In our view priorities should focus on an identified problems or opportunity. Technologies such as CRISPR are one way of solving a problem or pursuing an opportunity but is not an opportunity unto itself (i.e. priorities should not be framed in a way to ‘pick winners’).

Not all research priorities should operate over the same time horizon. Research into inter-generational social issues for example may require decades to complete. Farm systems research may be required to run over five years. Industrial research may be able to be completed quickly. Strategies for research priorities should be able to reflect varied time horizons for different areas of work.

Design of research strategies

Research strategies should use mechanisms such as Programme Logic Model or Theory of Change model to ensure priorities have clear problems / opportunities they are aiming to address, clear activities, and clear short, medium and long-term goals.

By their nature not all strategies will be successful. Some of our research programmes will pursue novel objectives such as methanogen or nitrification inhibitors with no guarantee of success. We need to avoid finding ourselves locked into programmes for decades where success has become less likely over time. Strategies need to have built-in ‘off-ramps’ that demand re-evaluation or redesign if outcomes are not achieved by specified dates.

Competition issues

A balanced approach to competition

The Green Paper discusses some of the ways competition impacts negatively on CRIs and other research providers. These include the time researchers spend preparing bids for competitive tender processes and the uncertainty organisations face in future cashflows when they must compete for their revenue streams.

Of course, competition has positive elements too. New Zealand government policy has for many years aimed to create a competitive market-based economy because this is known to create

efficient and responsive organisations / sectors. The dairy sector is one of the biggest beneficiaries of operating in a highly competitive domestic and international market.

We agree with sentiment in the Green Paper that, in some places, New Zealand's system is geared too far towards a competitive model. However, we think it is important that this question is viewed as one of balance rather than absolutes.

A research system that does not include adequate elements of competition between organisation faces its own risks and inefficiencies, yet these are not discussed in the Green Paper. For instance, in a low competition model CRIs may become inefficient in their delivery of work and / or may become internally rather than externally focused.

The challenge for MBIE in designing a research system is striking the right balance between competition and control. Future work by MBIE needs to take a balanced approach in how it critiques both highly competitive models and highly planned models. We suggest that MBIE consider the role of other investors (government, sector, philanthropic) in providing some of the competitive or reward signals to balance a core-funded model.

There is also risk that a shift away from the competitive process will not remove competition between CRIs completely. In any system there will always be a process of determining who and what gets funded. A competitive process has the benefit of being open and transparent: all competitors can bid, and the decision-making process is based on clear and transparent criteria. There is a risk that a system of grant funding simply shifts the nature of competition: away from an open and transparent system and towards a system where political connections are more important in the securing of funding.

Base grant funding proposal

The Green Paper discusses the idea of providing CRIs with "base grant" funding to pay for non-attributable costs such as corporate overheads (Section 3.3.2). Under this model, as we understand it, each CRI would receive an allocation of funding to cover overhead costs such as HR, facilities, IT, management and so on. When undertaking research CRIs would then be able charge out scientist time at a much lower than market rate.

Overhead multipliers vary between industries, but it is common for professional consultancies to operate on a multiplier of between 2.5 and 3.0. This means that if an employee's take-home pay was \$50 an hour, their charge-out rate would be between \$125 and \$150.

Private consultancies of course must recover overhead costs through their charge-out rates. They do not have the option of receiving base grant funding from the government. Government funding CRI overhead costs has the potential to open a large gulf between what a CRI can charge a person out for and what a private organisation can afford to charge.

Private sector providers could become uncompetitive

It is unclear from the Green Paper if it is expected that CRIs would charge out their time to private sector clients at market rates or subsidised rates. If CRIs can charge out their time to private sector clients at subsidised rates, this raises issues for private sector research service providers and universities.

Private sector providers, including DairyNZ, risk being unable to compete with government funded CRIs. The proposal risks eroding New Zealand's private sector research, science and innovation capability.

Recognising key, privately held capability with a 'core' funded model (as is currently done with Cawthron Institute) is one of a range of solutions.

CRI activities are broader than just science, research and innovation

One of the successes of the CRI model is that CRIs have been able to diversify beyond pure science and research and offer broader services to government and private sector clients. CRIs currently perform many functions including services related to carbon footprint analysis, sustainability advice, economic analysis and farm systems analysis. These services are often done for private sector clients and have private sector competitors.

One example is Toitu Envirocare. Toitu is a wholly owned subsidiary of Manaaki Whenua Landcare Research that specialises in environmental certification, carbon footprint analysis and sustainability advice. Toitu has over 500 clients who are spread throughout the world.

It is unclear from the proposal if the overhead costs of these business advisory services would be covered by the base grant funding proposal.

In the event they are not, issues may arise as it is not always clear-cut what is science, research and innovation and what is business advisory.

If the base grant funding proposal was to cover the overhead costs of business advisory services, private sector economics, sustainability and farm systems consultancies, just to name a few, would find themselves competing with organisations whose overhead costs are covered through government grant funding. New Zealand would risk losing this private sector capability as it would struggle to compete with subsidised CRIs.

Cumulative issues – loss of independent research

DairyNZ believes that New Zealand needs to maintain its access to independent science and research.

Much of the government science spend will always be driven by political commitments and priorities. In some cases, commitments to double exports, to grow regional incomes, or in other cases to make every river swimmable, achieve carbon neutrality and achieve a just transformation to a low carbon future.

Science and research need to, at times, challenge political commitments. Scientists will sometimes discover their research findings are at odds with the political zeitgeist.

Sometimes the best science takes place when issues are contentious. Government will always need to invest in research that supports government / political priorities, but the national good requires researchers who are willing to test these priorities and challenge the status quo. Quality science needs both collaboration between scientists and robust debate and challenge (competition) between scientists – we need a funding system and a range of institutional diversity that encourages both.

In the event that the priorities, strategy and funding are set by government, that CRIs are bulk funded by government, and we potentially lose private sector capability (all issues raised above), there is a risk that independent research currently undertaken both within CRIs and by private sector science institutions is lost or diminished. This may see New Zealand's research system prone to groupthink and less able to challenge the status quo.

Workforce issues

We note that research projects which have longer than three-year funding commitments enable practitioners to support PhD programmes within the research project. Workforce issues we believe will benefit from having a greater proportion of research funded as multi-year commitments.

Commitment to open science and open data

We do agree more needs to be done to promote and use the research we have done.

One negative consequence of the competitive landscape between CRIs is that CRIs will carefully guard their intellectual property often to the detriment of publicising and using the research done. In our view, where the government has fully funded research, there should be a commitment to open data. Research findings should be freely available. This is something the government can make a condition of engagement.

New Zealand does not do a good job of cataloguing and maintaining government research done in past decades. As ministries change their corporate structure and update websites much of the work funded just twenty years ago is lost from the public domain. Even within ministries research is often lost. This is unacceptable when taxpayers have paid for this work.

One simple option is to establish a central government website that houses all government-funded research and is maintained by MBIE.

International linkages

New Zealand national research spend represents a very small portion of the over \$2 trillion invested in research each year globally.

Where possible, we should seek to collaborate with international counterparts on research priorities, strategies and in research projects:

- This can mean our research spend can go further (as we leverage additional funds)
- It can produce research that has global rather than national applicability
- Enhancing the international linkages our research community can expose researchers to new methods and systems

International models and structure of CRIs

DairyNZ researchers have experience working in a number of systems overseas. These include Teagasc in Ireland, Wageningen University & Research in the Netherlands and INRAE in France.

The most common system overseas is a single agricultural research centre closely connected to a government agriculture ministry. Most research is funded by the agricultural ministry, through the agricultural research centre.

New Zealand appears unique as a small country with multiple government agricultural research institutes. There is merit in considering if a more consolidated approach is appropriate in the agricultural sector CRIs, granted there are both pros and cons to consolidation of our existing CRIs. This is of course an issue that will impact DairyNZ significantly. In this respect we would be interested in engaging with you further on potential consolidation models and pros and cons of each.

Wageningen University and Research in the Netherlands is a system that produces a good collaboration between researchers, industry and corporates. The Wageningen model has an emphasis on commercialising of research. This is a model we could look to investigate further to see what lessons can be incorporated into the New Zealand system to improve our ability to focus our research on commercial opportunities.

Our scientists are eager to sit down with you discuss our experiences in overseas systems as you work through the Te Ara Paerangi – Future Pathways review.

CONTACT

Thank you once again for the opportunity to comment on the Te Ara Paerangi – Future Pathways Green Paper.

Please do not hesitate to contact DairyNZ if you have any queries regarding this submission or require any further information by emailing Bruce.Thorrold@dairynz.co.nz.

I, along with members of my Senior Leadership Team, are eager to meet with the team at MBIE to discuss this submission and the path forward from here.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'Tim Mackle', written over a large, light-colored circular mark.

Tim Mackle
Chief Executive

Appendix – Detailed question answers

Key Question 1. What principles could be used to determine the scope and focus of research priorities?

Selective: Research priorities should provide a level of focus to our research spend. Too often when government, organisational or industry priorities are defined they are written in a way that means effectively everything can be interpreted to be included under one of the priorities. Rather, priorities need to be explicit. For priorities to truly set a direction, some things must be left out.

Based on evidence: Research priorities need to avoid the tendency to be based on perceived rather than actual wisdom. For example, any such claims that customers are demanding product traits, alternative proteins, etc, need to be demonstrated with appropriate evidence.

Balanced portfolio of risk and impact: It is unwise and risky to weight research priorities too heavily towards new industries or transformational technologies. If impact is the end goal, a smaller proportional change can have a large impact if the sector is large, and can often be delivered with more confidence. Therefore, it is likely, *a priori*, that a majority of research spend will be on existing industries and nearer term technologies.

Bipartisan: If research priorities are to provide a long-term strategic direction, they need to have bipartisan support. Long-term strategic priorities need to have meaningful consultation with the Leader of the Opposition.

2. What principles should guide a national research priority-setting process and how can the process best give effect to Te Tiriti?

Balanced approach to priority setting: It is important the research priority setting process is strongly influenced by those who will use the research, namely, producers and exporters. In the primary sector this means heavy involvement from farmer and grower organisations such as DairyNZ, Beef+LambNZ, Zespri, Federated Farmers, Federation of Māori Authorities (FOMA), as well as exporters such as Fonterra and the Meat Industry Association.

CRIs should be involved and bring to the table a knowledge of what is feasible and what investment is needed to achieve outcomes.

Giving effect to Te Tiriti in this context means working in partnership with Māori on common areas of interest, continued support and further acceleration of Māori researchers, scientists, and the like, as well as guidance / frameworks on knowledge sharing and protection.

3. How should the strategy for each research priority be set and how do we operationalise them?

Research strategies should use mechanisms such as Programme Logic Model or Theory of Change model to ensure priorities have clear problems / opportunities they are aiming to address, clear activities and clear short, medium and long-term goals.

By their nature not all strategies will be successful. Some of our research programmes will (or at least should) pursue novel objectives such as methanogen or nitrification inhibitors with no guarantee of success. We need to avoid finding ourselves locked into programmes for decades where success has become less likely over time. Strategies need to have built-in 'off-ramps' that demand re-evaluation or redesign if outcomes are not achieved by specified dates.

Flexibility needs to be built into strategies so that objectives and projects can change when new information is obtained. Strategies need to be able to 'fail fast', i.e. avoid prolonged spending on objectives after it has become apparent that they are either unachievable or unlikely to be achievable by building 'off-ramps' into research programmes.

Strategies should accept some appropriate level of risk in the portfolio of research work, as some promising avenues may not lead to success. Indeed, if all projects meet their desired outcomes in full, it is unlikely that the boundaries were pushed far enough.

Research strategies need to have a focus on international collaboration. New Zealand must identify problems that have international relevance and co-develop solutions that have international applicability. We then address these problems by partnering with research institutes around the world.

It is vital that end users are engaged in strategy development.

4. How would you like to be engaged throughout the Future Pathways programme?

Our submission highlights our initial reflections on the Green Paper. DairyNZ would like to work with you throughout the process to develop a White Paper and then implement policy decisions.

Our CEO Tim Mackle frequently visits Wellington and would like to meet with you to gain a broader understanding of the proposals MBIE is considering.

During the Climate Change Commission process to provide advice on New Zealand's first carbon budgets and first emissions reduction plan, DairyNZ held an all-day workshop with the Climate Change Commission at our Newstead (Hamilton) head office. This allowed several DairyNZ scientists and senior leaders to engage with the Climate Change Commission in a more meaningful way than that which can be achieved via a written submission.

DairyNZ is a significant user and investor in science, innovation and research. Our scientists have extensive experience working in the New Zealand research system and many model systems abroad. We suggest a workshop is held with MBIE and primary sector participants including DairyNZ.

5. What are your thoughts on how to enable and protect mātauranga Māori in the research system?

DairyNZ is committed to understanding, identifying, and enabling incorporation of mātauranga Māori in the research we do. We continue to learn and evolve as we aim to achieve genuine engagement and incorporation of mātauranga Māori in our research work.

We are conscious of avoiding a superficial exercise where mātauranga is something that is simply 'ticked off' during a project or strategy. On that note, more guidance is needed to understand what best practice would look like in this area including sharing of case studies that highlight both the successes and failures of embedding and protecting mātauranga Māori.

More capability is needed in this area – mātauranga experts are in high demand, but are in short supply and / or are significantly under-resourced.

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

DairyNZ is supportive of further work on the establishment of regional Māori knowledge hubs.

New Zealand is already in an environment where organisations and projects engagement needs are exceeding the capacity for iwi representatives to adequately engage.

Knowledge hubs can improve the efficiency and effectiveness of Māori engagement. Capacity building to improve the resourcing of marae, hapu and iwi may also be needed. Knowledge hubs can also support Māori engagement in government research priority and strategy setting processes.

DairyNZ is at the early stages of building our internal capability so that our scientists understand mātauranga Māori and how to best engage with Māori. Building such capability does take time and resourcing. Knowledge hubs could serve to accelerate this process, remove current barriers, and improve the process of engaging with Māori.

7. How should we determine what constitutes a core function and how do we fund them?

The Green Paper describes core functions as areas that may act as critical services and require dedicated funding.

Some principles that come to mind are therefore areas where:

- Have a general public good for New Zealand's safe and efficient running as a country, such as seismic monitoring, forensic labs or national collections (as opposed to discrete and private applications such as improved animal genetics)
- Are a natural monopoly.
- Are not easily transferred from one organisation to another and therefore require long-term stable funding.

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

We think there is little doubt that providing base funding to CRIs will improve the stability and resilience of organisations. However, long term effectiveness is a more complex issue than improving stability and resilience.

Providing base funding could be done in a way that brings with it many disbenefits - these are discussed in our submission. We have serious questions on how providing CRIs with base funding would impact private providers of science, research and innovation. Issues also arise from CRI business advisory activities and how base funding would impact the competitive landscape for these broader services.

9. How do we design collaborative, adaptive and agile research institutions that will serve our current and future needs?

Our experience is that collaboration can and does occur under the existing model although not to its potential. Collaboration is more of a personal attribute than an organisational attribute, though can be hampered by poor organisational support of collaboration, and funding incentives / disincentives.

One issue we have experienced is a strong focus on protecting intellectual property. This has the impact of both being a barrier to collaboration and reducing agility (as work is slowed down while legal teams assess intellectual property clauses of contracts).

Government funders could also place a stronger priority on requiring public ownership of intellectual property that arises from government funded work.

Regarding collaboration with Māori, the proposed regional knowledge hubs could play a key role here as well as more financial support for under-graduate and post-graduate Māori Science students. As further discussed in question 12, funding relationship building would also help.

10. How can institutions be designed or incentivised to better support capability, skills and workforce development?

Funding research over longer durations (e.g 5-7 years) may allow greater development of capability, skills and workforce such as building postgraduate students into research programmes. Funding for post-graduate students needs to increase so that it is an attractive option. Current funding is well below minimum wage, and we have seen some would-be post-graduate students delay their studies in order to work for a year or two, to better position themselves financially to undertake further studies.

Recognition and encouragement of portable skills (e.g. capability in modern science workflows and data science) would enable flexible career pathways while simultaneously enabling more agile organisations. Where possible, clarity on these desirable sets of skills makes it easier for tertiary institutions to provide graduates and postgraduates the requisite training.

11. How can we make decisions on large property and capital investments under a more coordinated approach?

This is a significant question given the risks of poor decisions on capital investments on future research performance. At one level the answer is relatively straight forward; investments must be made based on strong alignment with the goals and priorities of the strategy, and on needs

and gaps. That must be coupled with clear deliverables and KPIs for success of that investment, which in turn must be measured and monitored. Too often investments are made in infrastructure without proper measurement and analysis against the original goals.

On the other hand, the answer on how and where infrastructure investments are made becomes very complex when political and social considerations are made. The government has a difficult job and balancing expectations of voters and ratepayers as well as staff of various government owned or supported institutions such as CRIs and universities. A case study where these competing imperatives presented real challenge in decision making on infrastructure might be the AgResearch campus consolidation project intersecting with the Lincoln rebuild.

12. How do we design Te Tiriti enabled institutions?

We have limited expertise to advise appropriately on designing Tiriti-enabled institutions and would be interested to hear what feedback others provide.

13. How do we better support knowledge exchange and impact generation? What should be the role of research institutions in transferring knowledge into operational environments and technologies?

We do agree more needs to be done to promote and use research after it is completed.

One negative consequence of the competitive landscape between CRIs is that CRIs will carefully guard their intellectual property often to the detriment of publicising and further use of the research, commercially, or publicly. In our view, where the government has fully funded research, there should be a commitment to open science and open data. Research findings should be freely available. This is something the government can make a condition of engagement.

New Zealand does not do a good job of cataloguing and maintaining research done in past decades. As ministries change their corporate structure and update websites much of the work funded just twenty years ago is lost from the public domain (or very hard to find). Even within ministries, research is often lost. This is unacceptable when taxpayers have paid for this work. Simple options exist, such as establishing a central government website that houses all government funded research deliverables.

Regulatory pathways for some innovations need to be established. For example, these pathways are being addressed for some issues such as the Biological Emissions Science Accelerator for regulations regarding inhibitor technology. However, a more comprehensive plan to ensure good ideas can be rapidly exploited is warranted.

To achieve best practice research commercialisation, knowledge management and transfer to end-users requires, in our view, early engagement and co-development with end-users to be carried out, and evidence of this in any impact assessment. Historically, DairyNZ has been approached as a representative of end-users very late in the preparation of proposals submitted for funding, which limits the ability to ensure engagement and tailoring of research plans to be most effective.

14. How should we include workforce considerations in the design of research Priorities?

In our view the research priorities should come first based on what is needed for New Zealand's long-term future. Then it becomes possible to identify the relevant workforce considerations, shaping it, to the degree possible, around these priorities (rather than vice-versa).

15. What impact would a base grant have on the research workforce?

Questions remain on how a base grant model would be designed. If a base grant model did impact private sector organisations, a base grant model could have a negative impact on workforce as there would be less career mobility.

The base grant funding model raises issues for CRIs that have diversified beyond pure science, research and innovation. Uncertainty surrounding organisational structures may lead to short term losses as valued employees may choose to take up more secure opportunities in the face of organisational uncertainty.

16. How do we design new funding mechanisms that strongly focus on workforce outcomes?

In our opinion one of the key workforce considerations is providing funding grants on a multi-year basis. This better allows for the creation of postgraduate opportunities within research programmes.

Regardless of the organisational structures, research priorities or funding mechanism, there should be opportunities for leading scientists to deliver impact through their science in roles reflecting their seniority, with people whose skills relate more to resource and workforce management having senior roles that take advantage of their skills in a complementary way.

17. How do we support sustainable, efficient and enabling investment in research infrastructure?

Infrastructure can come in several forms, whether physical (hard) or digital (soft) In either case, these assets can depreciate rapidly with new technology, and yet holding off investment is unlikely to be optimal, so accepting this reality seems paramount.

In the digital infrastructure space, data management according to the principles of open science and open (FAIR) data should be integrated into any planning. The direction towards cloud computing and paying for servers on an as needs basis is likely to be cheaper in the long run for many applications, though turns infrastructure spend into operational costs, which needs to be reflected in project funding.

Infrastructure purchases should match (as far as possible) with open science principles in terms of accessibility and ownership of the data generated from experimental work, and support best practice science workflows (e.g. API's to link data generation to data warehousing).

Additionally, open science becomes more reliant on open-source tools, and so mechanisms to encourage researchers and research bodies to contribute financially or intellectually to this infrastructure is worthy of formal consideration.

Infrastructure must be matched with appropriate skills to use the infrastructure, and so a strategic plan that integrates the appropriate amount of learning into the university sector is a key part of effective infrastructure investment.