Submission | **Te Ara Paerangi – Future Pathways Green Paper**

23 March 2022

About the McGuinness Institute

The McGuinness Institute was founded in 2004 as a non-partisan think tank working towards a sustainable future for Aotearoa New Zealand. Project 2058 is the Institute's flagship project focusing on Aotearoa New Zealand's long-term future. Because of our observation that foresight drives strategy, strategy requires reporting, and reporting shapes foresight, the Institute developed three interlinking policy projects: *ForesightNZ*, *StrategyNZ* and *ReportingNZ*. Each of these tools must align if we want New Zealand to develop durable, robust and forward-looking public policies. The policy projects frame and feed into our research projects, which address a range of significant issues facing Aotearoa New Zealand. The six research projects are: *CivicsNZ*, *ClimateChangeNZ*, *OneOceanNZ, PublicScienceNZ*, *TacklingPovertyNZ* and *TalentNZ*.

About the cover

To support this submission, the Institute has put together a strategy map to help communicate and highlight the key points made in this submission. The proposed strategy map can be found in Figure 4 of the submission. The front over is a high-level summary.

PREFACE

> "Science is the flexible and revolutionary approach. *So you have faith in science, then?* I don't have faith in science at all. My experience of a lifetime tells me that the methodology of science has great power and great value. That is nothing to do with faith. Faith is completely separate from science." – Sir Paul Callaghan (2014, p. 46)

The above quote from Sir Paul Callaghan's book *Luminous Moments* emphasises the importance of trusting the scientific approach through using a methodology to deliver evidence. Sir Paul Callaghan advocated that strategy should not be based on fluff, fantasy or myths, but on trusted data, reliable information and well-considered knowledge.

Sir Paul pondered and often discussed whether or not it would be better to invest directly in scientists themselves (by providing public funds to co-create research that they believe is important), rather than providing funds/grants to institutions where public funded scientists work. As far as we are aware, Sir Paul never reached a solid conclusion on this matter. However his observation reinforces the fact that there is no proven system in place that ensures public good science is optimised and/or that topics for research are easy to identify.

The Institute has been aware of how rare it is for public funds to be appropriated to long-term investments. Government-funded science is one of those areas. For this reason, the Institute published a major report and background papers in 2012 on the topic: *Report 9 – Science Embraced: Government-funded science under the microscope,* alongside; *Report 9a - A History of Government-funded Science from 1865-2009,* and Report 9b - *A History of Government-funded Science from 2009-2011* (for more information, see here). The aim was to assess the effectiveness of the government-funded RSI system, as well as identifying how the system might be improved to achieve better long-term outcomes for the public good. The Foreword to *Report 9* was written by Sir Paul Callaghan and is attached, as well as the Institute's proposed Strategy Map for Government-funded science and the Report's set of recommended actions and (see Appendix 2).[1]

Later this year, the Institute hopes to public *Report 18: Climate Change Strategy for Aotearoa New Zealand (in progress).* The overall aim of *Report 18* is to explore what an actionable and inclusive climate strategy would look like for Aotearoa New Zealand. There are countless parallels between insights raised in this submission and *Report 18*.

The Institute is increasingly concerned that we are yet to pivot and invest in research systems to collect and report climate change data. This submission, therefore, has a key focus on how reform to the RSI system can better position Aotearoa New Zealand's capability of delivering on climate opportunities and challenges. We find that, in the climate space, not enough effort is put into examining and differentiating between the different types of research that are needed. No one seems to be maintaining the public good datasets that currently exist, identifying new datasets that are needed or developing a taxonomy for the 21st century. It is crucial to consistently review and repeat research over time to improve data and identify progress (i.e. what works and what does not).

Public purpose becomes stronger and more dynamic when put in terms of building creative and durable relationships, learning lessons by doing, and being of service to others (including those you may never meet). Such an approach not only unites us but also sets us free to explore, fail fast and try again.

Thank you again for undertaking this important work.

Wendy McGuinness
Chief Executive

EXECUTIVE SUMMARY

The Institute welcomes the opportunity to offer feedback on *Te Ara Paerangi – Future Pathways Green Paper*. This consultation provides an opportunity to reshape the development and provision of research to better align with demands not only from the Research, Science and Innovation (RSI) system, but across all stakeholders and users of data, information and knowledge.

The submission has been broken down into the following four parts:

Part One: The Institute's approach and overarching concerns
Part Two: Historical context
Part Three: Necessary considerations prior to the development of a new RSI system
Part Four: Answers to the 17 questions

Whilst undertaking work across a range of topics, the Institute consistently observes the poor state of research data. This observation simply reinforces the need for a stronger, better funded and more connected research community focused on delivering data, which can be turned into information and ultimately provide knowledge for all research stakeholders. Aotearoa New Zealand needs robust, holistic and timely data to develop information to better shape public and private investment, manage expectations and build innovative solutions that deliver big upsides and remove risk in response to climate change.

Findings

1. The RSI system is fragmented, siloed, and complex. Resulting in a research ecosystem where funding is not stable, a lack of role clarity exists, there are high-levels of precarity, and ultimately, through a lack of integration, knowledge is not being shared at the rate that is needed.
2. The RSI system is largely unresponsive to, and exclusive of, minority groups.
3. There is weak connectivity between researchers across organisations both domestically, and internationally. Furthermore, there is a general failure of the translation of science into policy.
4. There is a concerning lack of strategic capability and direction with the public sector.

Recommendations

1. **A clear and concise vision is required**
   Reform must be underpinned by a robust and aligned RSI strategy that lays out how to better embed foresight into the operations and design of Aotearoa New Zealand's public research institutions. In doing so, we will be better positioned to build a stronger research ecosystem that is responsive, anti-fragile, accessible, future-focused, and better equipped to meet the climate opportunities and challenges Aotearoa New Zealand faces.

2. **Build strong relationships with Māori**
   Develop actionable pathways for a co-created RSI system to occur. Reform needs to be inclusive of te ao Māori and a te-Tiriti led approach, namely, through the recognition of mātauranga Māori and kaupapa Māori frameworks alongside the Western Science model.

3. **Prepare an updated timeline on the history of public good funded science**
   Research the researchers. Develop a shared understanding of lessons learned from the past to navigate the future.

4. **Consider alternative investment models**
   Prioritise the development of funding models that are more targeted, dedicated and accessible to increased stability, reduce precarity and provide equal opportunity across different types of research organisations.

5. **Build in an independent review of the system that is implemented.**

Part One: The Institute's approach and overarching concerns

This section outlines the Institute's approach and views on the wider research system – our underlying assumptions, overarching concerns and general thinking that this submission is built upon.

1.1 The Institute's approach

The distinction between research, science and innovation
Only through the holistic observation of the components of the RSI system can you identify and understand what is working and what is not working in that system. Generally speaking, the process that is RSI can be defined as generating new ideas, developing emerging ideas and leveraging proven ideas. However, more specifically and practically, in our view, *research* is the systematic generation, gathering or organisation of data/information; *innovation* is the process of delivering new/better-value creation in relation to a particular factor (e.g. business, community, individuals, society, etc); and *science* is the 'boundary' that research and innovation must fit within.

The role of data, information and knowledge
We can observe the RSI system compartmentally, in the same way we observe data, information and knowledge. *Data* on its own does not create information; data becomes information only when it forms patterns (or not). In addition, *information* on its own does not create knowledge; information only becomes knowledge when there is enough of it to illustrate how the system works. Hence *knowledge* is not simply dependent on quality and timely data or relevant information – true knowledge evolves from understanding how a system operates dynamically (e.g. how it responds to new stimuli). Knowledge often comes from observing a system over a long period of time and is passed on from one generation to another. Climate change is relatively new and we are still very much at the data stage. We need to focus on the quality and timeliness of the data we have and to collect, sort and chronicle data for current and future generations – so that we can benchmark progress or what does not work.

The difference between 'types of research'
Being clear about the different types of research available for the country to invest in will be important not just from an input perspective but also in terms of gaps or opportunities that require further research. The Institute defines six different types of research below:

- **Primary versus secondary research**.
  Primary research is gathering new data rather than relying on already existing data. Secondary research relies on the work of others to build knowledge. The Institute, for example, does a mixture of primary and secondary research.
- **Targeted versus non-targeted (broad) research**.
  The targeted approach, requires you to decide what you want to know, set up the method and perform your analysis. In contrast, a non-targeted approach analyses everything, then you decide what you want to know.
- **Basic versus applied research**.
  Basic research (also called pure research or fundamental research) is driven by curiosity or interest in a scientific question. It aims to improve scientific theories and prediction of phenomena. It is a major means of generating new ideas, principles and theories and is often academic in nature. In contrast, applied research is designed to solve a specific practical problem, and is often commercial in nature rather than aiming to acquire knowledge for knowledge's sake.

The difference between 'strategy' and 'foresight'
Strategy deals with the means to an end; it is hard work. It focuses on 'how' and the 'goal' – in particular how to reach the goal. Foresight is creative, playful and explorative and focuses on 'what if'. The Institute finds that, in the climate space, not enough effort is put into foresight.

The three I's
The Institute often analyses systems using the three I's: Institutions, Instruments and Information. This ensures questions are asked not only about each of the three components or the effectiveness of the linkages between them, but whether there are gaps, conflicts or even double-ups in the system. There is often a mismatch between policy design and implementation (e.g. KiwiBuild). Policy agencies and teams often lack the tools, skills or mandate to effectively administer complex and expensive programmes, particularly those requiring collaboration with the private sector. Being aware of these relationships raises the question of what new institutions, instruments and information are required and what are no longer needed.

1.2 Overarching concerns

While the Institute appreciates that the purpose of this submission is to reshape the RSI system, the Instituter wishes to raise various concerns associated with the existing RSI system, as well as wider instrumental and institutional concerns). The Institute raises these concerns with the hope that they will be alleviated through the introduction of a reformed RSI system.

Concerns over the current state of research data
Whilst undertaking work across a range of topics, the Institute consistently observes the poor state of research data. This observation simply reinforces the need for a stronger, better funded and more connected research community focused on delivering data that can be turned into information and ultimately provide knowledge for decision-makers making investment decisions (e.g. away from stranded assets to new and emerging industry) and/or public analysts making recommendations to Ministers.

To illustrate this, the Institute has been involved in the aquaculture space relating to the New Zealand King Salmon (NZKS) applications to farm salmon. Throughout this work, the Institute identified many inconsistencies associated with the term 'temperature'. Temperature is commonly understood to have a universal (and therefore comparable) meaning across a range of consent applications. However, the Institute has recently learned that this is not the case. To learn more about this topic, see *Working paper 2021/14 – The Role of Ocean Water Temperature in Climate Change Policy – A New Zealand King Salmon Case Study* and *Working Paper 2021/15 – Looking for a taxonomy for Aotearoa New Zealand's oceans* (both working papers can be found here.

Sea water temperature is dependent on the inclusion of multiple characteristics to ensure accuracy, independence and comparability. In this case, comparing water temperature over time or between farms requires reporting on the (i) location, (ii) time of day, (iii) day of the year, (iv) tide and (v) depth, as well as specifying who undertook the research. Climate change, as NZKS is discovering, is happening very fast. NZKS is now seeking cooler water to farm salmon. Investors, bankers, insurance companies, and those undertaking resource management decisions should expect that they can access and be provided with useful data that is reliable and can be compared. Work is urgently required in this space.

(i) Pace and scale of funding options
The Institute advocates for faster upfront investment to support the development of RSI system reform. The budget cycle, with its emphasis on short-term expenditure and lengthy annual vetting process, is not well suited to delivering long-term investment certainty. The timely development of a mechanism to guarantee long-term funding certainty is crucial.

(ii) Underfunding of key scientific organisations
It is widely known that public research institutions and key scientific organisations are largely underfunded across Aotearoa New Zealand. These institutions simply are not receiving the amount of funding that they require, and thus are restricted in the work they can do – especially in a time where said services are of an extremely high demand. Reform to funding mechanisms is critical to ensuring universities, Crown research institutes (CRIs), government agencies and the private sector can deploy domestic research and innovation to tackle climate change, while creating new opportunities in emerging industries.

(iii) An outdated CRI operating model

When CRIs were developed in 1990, they were done so to operate in the fields of strategic importance to Aotearoa New Zealand (as mentioned in the *Green Paper*). At the time, this objective represented a completely different economic and societal structure. Such aspirations have dramatically shifted since then. The fields of strategic importance are now much wider and require more adaptive organisations that are dynamic, more closely connected and able to respond quickly. Furthermore, following the disestablishment of two prominent foresight institutions; the Commission for the Future (1982) and New Zealand Planning Council (1991), CRIs were expected by the Prime Minister at the time, the Rt Hon Jim Bolger to assume this responsibility.

(iv) How Māori aspirations will be realised

Currently, Māori are under-represented in the CRIs and in the RSI system generally. The small pool of Māori researchers and other staff in the CRIs are additionally stretched because they are often implicitly expected to assist with cultural labour. There is a risk that for Māori, CRIs will become an unattractive place to work. In some areas, engagement with CRIs by iwi and other Māori organisations can be complicated where they are unsure about which CRI to approach. Stakeholders noted that CRIs run on a Western management science model, which can inhibit responsiveness to kaupapa Māori frameworks.

(v) Discrimination

Minority groups are consistently under-represented in the RSI system. Diversity and inclusivity are key components of a resilient, accessible and future-focused RSI system, and they must be prioritised as part of reform. Professor Bronwyn Hayward emphasised that the design and implementation of a robust RSI system will require diversity across all aspects.[2] Diverse thought, life experience and values are crucially necessary for developing solutions to complex issues.

(vi) Strategic capability regarding climate change

The Institute is concerned with the strategic capability across government departments concerning climate change. Our analysis of government department strategies (GDSs) found low levels of climate change action articulated within existing strategies. There is very little discourse on trade-offs between generations or possible impacts on current or future New Zealanders, or indeed an understanding that the economy needs to pivot in order to reach the 2050 target. This is an example of the lack of holistic strategic consideration that has occurred in the past; in the context of an RSI strategy, this should not be the case.

(vii) Lack of relevant data to inform policy

In many areas of the RSI system, policy itself won't be enough to reach solutions – greater data, information and knowledge is needed. Uncertain and unquantified research proposals arise from a lack of data/information that ultimately reduces potential to achieve research priorities and meet commitments.

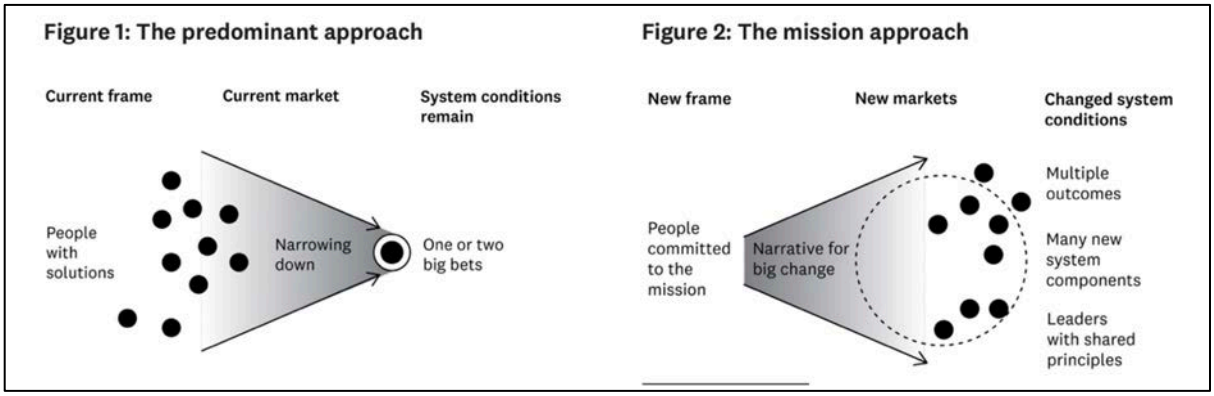
(viii) Failure to translate science data into policy

The Institute is concerned that the level of information sharing and enquiry between the science and policy sectors is lower than it needs to be. During such times of high uncertainty, large-scaled and fast-paced rate of change, it is crucial that political decisions are based on the latest and most accurate evidence. We cannot afford for key decision makers (especially MPs and Representatives of the House) to be uninformed . To this end, the Institute would like to acknowledge the systems that historically existed to alleviate such an issue. There used to be frequent 'Science Briefings' run by the President of the Royal Society, where scientists would gather with MPs and Representatives of the House to share their ideas, explain their perspectives, and ultimately educate. These science events may help the House to engage early with challenging issues (like the Three Waters reform), which may not have been so disruptive, and ideally led to more evidence based solutions.

(ix) Aotearoa New Zealand is yet to achieve widespread systems thinking and deliver systems change solutions

In the Institute's view, Aotearoa New Zealand is yet to achieve widespread systems thinking and deliver systems change solutions. Furthermore, the existing policy-making frameworks and current decision-making processes are likely to deliver additional inequality and risk to future generations. The need to bring innovation, public policy, iwi/Māori, private sectors and local communities together to identify missions is something that the Institute feels strongly about. The opportunity of reform could lead an efficient, adaptive and anti-fragile RSI system in this direction. To address the grand challenges, the government would need to (a) acknowledge the magnitude of the grand challenges we face and the urgency for change; (b) exercise leadership by showing a willingness to make courageous decisions and to accept the concept of learning by doing (such as experimentation and fast-fails); and (c) have a vision about what we want to achieve and clarity over the values that will get us there. This will not be easy, but it will be exciting, dynamic and energising.

Figure 1: A mission approach[3]



Part Two: Historical context

This section is a survey of existing documents that may be useful when considering the design of the RSI system. Through doing so, the Institute aims to share lessons learned and the importance of looking backwards to learn lessons and to help reduce the risk of work duplication – saving resources and time.

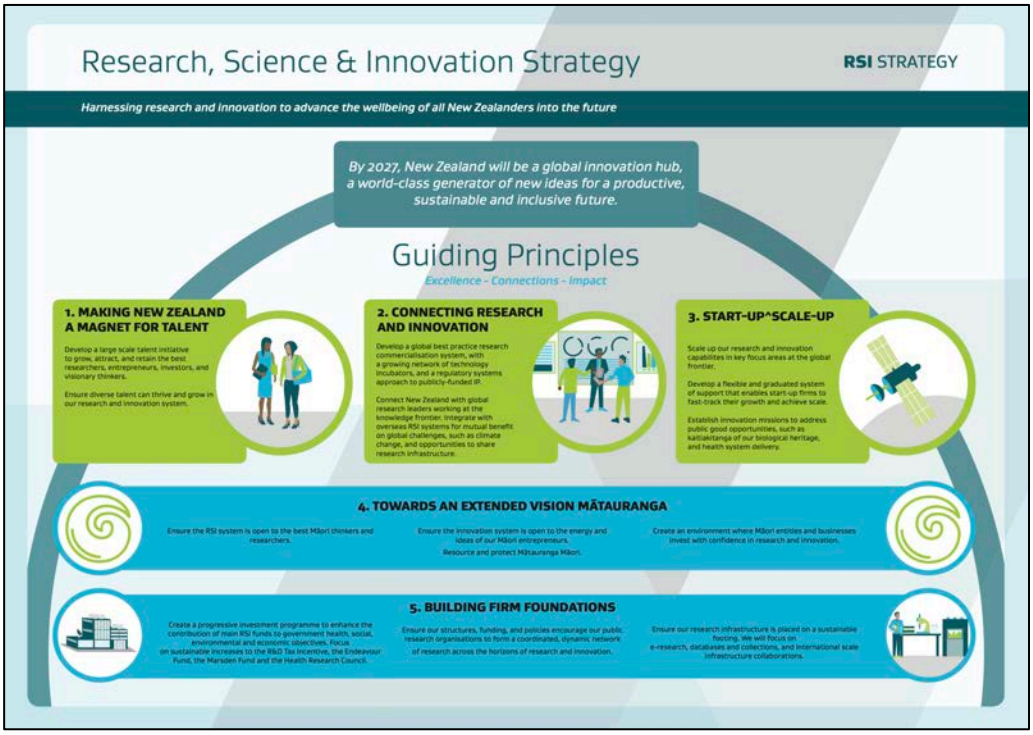
2.1 Timeline of Climate-related Policy (Institutions, Legislation, International Commitments, Instruments, and Conference of Parties) (2021)

As mentioned above, we need to identify where Aotearoa New Zealand has come from in order to develop inclusive and actionable ways forward. The working paper, *Timeline of Climate-related Policy (Institutions, Legislation, International Commitments, Instruments, and Conference of Parties)* (2021), aimed to better understand the different eras associated with climate change and how this history has impacted on Aotearoa New Zealand's climate-related policy since 1980.[4] In order to do so, the Institute developed a timeline mapping the history of climate-related policy in Aotearoa New Zealand. This paper will contribute to an evidence base that the Institute will use to develop core assumptions that will influence and develop the narrative underpinning future *ClimateChangeNZ* research – namely *Report 18: Climate Change Strategy for Aotearoa New Zealand*. Insights from this paper could help illustrate how the components of a system (both individually and collectively) are constantly shifting in response to challenges and opportunities. See the timeline in Appendix 3.

2.2 New Zealand's Research, Science & Innovation Strategy (2019 draft)

The Government's draft strategy set out how the RSI system will play a central role (and how the government plans to act to support it) to 'tackle the big challenges of our time' – namely, the transition to a zero-carbon economy by 2050, supporting our regions to grow, preserving and protecting our environment, creating fulfilling and high-value jobs, and increasing our wellbeing. Alongside these objectives, the proposed strategy's overall aim is that 'by 2027, New Zealand will be a global innovation hub, a world-class generator of new ideas for a productive, sustainable, and inclusive future'.[5] Illustrated and communicated by a strategy map (see Figure 2), the draft strategy proposed a programme of principles and resulting actions to improve the efficacy of the RSI system.[6]

Figure 2: New Zealand's Research, Science & Innovation Strategy – Draft Strategy Map (2019)



The Institute is interested to see if, as part of the reform, an updated strategy map will be made, and how it may differ to that presented in Figure 2. Between 2019 and today a lot has changed, and an updated strategy map would probably look and feel a lot different. This point aims to reinforce the importance of reviewing strategies as they progress.

Alongside a wider inquiry into maximising the economic contribution of Aotearoa New Zealand's most productive frontier firms, a response to the draft strategy was briefly included in the New Zealand Productivity Commission's (NZPC) *New Zealand Firms: Reaching for the frontier* inquiry (April 2021). The NZPC observed that 'the strategy lacks a clear fit with the Government's industry strategy and the relatively small allocation of resources to the industry strategy risks undermining the industry strategy's effectiveness'.[7] The NZPC made several recommendations regarding the development of a new RSI system:

- The Government should update and confirm its research, science and innovation (RSI) strategy to signal its intended innovation effort and direction over the next five to ten years.
- The RSI strategy (and a significant quantum of associated funding) should be clearly aligned with the Government's industry strategy.
- The Government should develop and put in place transparent arrangements for the governance, implementation and monitoring of its RSI strategy.
- Governance and oversight of the implementation of the Government's RSI strategy should include high-level representation from Government, Māori, industry (firms and workers), researchers and educators.
- The Government should engage with other stakeholders (researchers, educators, industry (firms and workers) and Māori) to develop a transparent implementation plan for its research, science and innovation (RSI) strategy. After initial engagement, the Government should publish a consultation draft and invite submissions from stakeholders. The implementation plan should cover (among other things):
  - how the areas for action under the RSI strategy will be resourced and over what timeline;
  - how a significant quantum of resource under the RSI strategy will be aligned with the Government's industry strategy;
  - proposed changes to policies and practices (including funding criteria) that will better achieve the objectives of the RSI strategy;
  - which agencies will take the lead on the actions; and
  - arrangements to monitor and evaluate initiatives and the overall success of the RSI strategy.[8]

2.2 Te Pae Kahurangi: Positioning Crown Research Institutes to collectively and respectively meet New Zealand's current and future needs (July 2020)

Commissioned by the Ministry of Business, Innovation and Employment (MBIE) in 2019, *Te Pae Kahurangi* reviewed the ways in which the current system caters to the requirements of public research institutions.[9] High-level findings from *Te Pae Kahurangi* (as mentioned in the *Green Paper*) were that (i) a lack of role clarity exists for institutions; (ii) unproductive competition occurs between institutions; (iii) integration is lacking between universities, CRIs and other parts of the research system; (iv) there is weak responsiveness to Māori; and (v) the RSI system generally suffers from weak connectivity. The Institute was pleased to see that these issues were acknowledged and elaborated on in the *Green Paper*.

Te Pae Kahurangi's objective is to encourage thinking around the development of 'a strategy-led pan-CRI operating model underpinned by a set of incentives that, to the greatest extent possible, harness the intrinsic motivation of researchers to contribute to improved outcomes for New Zealand through excellence, impact and purposeful collaboration and moderate unproductive competition for scarce resources'.[10] Below are some high-level suggestions made in *Te Pae Kahurangi* about how to achieve a fit-for-purpose operating model for public research institutions:

- being strategy led, determining pan-CRI research priorities that drive the building of research teams across organisational boundaries and the developing of new capabilities
- being customer-centric – responsive and easy to navigate for all customers and stakeholders
- working together to support Māori and iwi aspirations in a Te Tiriti-based partnership model
- putting national benefit ahead of organisational interest in purposeful collaboration across CRIs and with science system partners
- acting as a magnet for scientific and associated talent supported by contemporary research facilities
- utilising scarce resources efficiently and effectively: optimising capital spend, sharing facilities, leveraging collective scale and capabilities
- enabling a resilient system. The ability of CRIs to deliver on the future state is, in part, dependent on the design of funding and ownership elements of the system within which they operate. The Panel has also developed options for changes to these elements of the operating model.[11]

2.3 A review of the funding and prioritisation of environmental research in New Zealand (December 2020)

Again, in response more specifically to the funding and prioritisation of environmental research, this review by the Parliamentary Commissioner for the Environment includes considerations and suggestions for the direction of a new RSI system. The commissioner, in a previous review of environmental reporting, found a 'lack of consistency in the way we monitor the state of things, and in many important domains, an outright absence of data'.[12] In response to finding gaps in the monitoring and reporting of information (and knowledge) the commissioner 'recommended that the Minister for the Environment and the Minister of Research, Science and Innovation ask their officials to advise on how to better link New Zealand's environmental reporting system with the science system'.[13] The commissioner then questions whether or not society is able to fill these gaps, noting 'I am not confident that there is a coherent basis for our national investment in environmental science. I am particularly concerned that there is no mechanism that links the ongoing demand environmental reporting makes for an understanding of complex ecological processes that evolve over decades, and a science funding system that is constantly searching for innovation, impact and linkages to the ever-changing demands of business and society.'[14]

With this in mind, he recommended that environmental research funding should be ring fenced and explicitly linked to an environmental research strategy.[15] Regarding practical steps, the commissioner provides two models of action:

> To provide a sense of how these attributes might be realised in practice, I outline below two models. They are effectively variations on the same theme, the difference being principally institutional. The first proposes no new entities and seeks to promote change through altering the roles of key government agencies and the skills available to them. The second (and preferred option) embeds the necessary expert skills within a dedicated funding agency. Under both options it is proposed that all institutions with relevant expertise should be able to access the available funds, whether they are negotiated or contestable. In both cases the emphasis should be on collaboration, thereby providing a strong incentive for research institutions independent of central government, such as tertiary institutions and IROs, to align their work with the proposed environmental research strategy.[16]

2.4 McGuinness Institute Research (2012)

In 2012, the Institute published a major 2058 report and background papers regarding the topic of consultation: *Report 9 – Science Embraced: Government-funded science under the microscope,* alongside; *Report 9a - A*

History of Government-funded Science from 1865-2009, and *Report 9b - A History of Government-funded Science from 2009-2011.*[17] See Appendix 2.

2.5 McEwen, M; Charles Fleming, Environmental Patriot: A Biography (2005)

This publication, while not containing any outwardly explicit recommendations, offers insight into navigating contentious (often political) issues, and also provides an example where not enough weight had been placed on gathering evidence to inform public policy. The publication recounts the efforts of Charles Fleming of advocating and catalysing change in the 1980s. During this time, there were multiple government departments that had overlapping functions regarding environmental management. This led to a scattered, fragmented and complex approach process when addressing challenges. Under these arrangements, it was found that passionate public servants were spread out and essentially lost and powerless within large bureaucratic departments.[18] At consequence of the conservation and environmental movement during the 1980s, the environmental management system was overhauled. This saw the inception of three new agencies; the Ministry for the Environment, Department of Conservation and the Parliamentary Commissioner for the Environment.[19]

It is important to acknowledge and understand lessons of the past to better navigate the future. Unfortunately, there still exists a lack of priority on gathering evidence to best inform and direct public policy. An example of this is the Three Waters Reform. In our view, the analytical approach behind reform is not as strong as it must be – which, again, stems from a lack of gathered evidence. Detailed assessments are vital to identifying what the issues are, where they occur and how to fix them.

Part Three: Necessary considerations prior to the development of a new RSI system

The Institute believes that the design of an efficient, adaptive and anti-fragile RSI system must include a solid foundation – which considers the roles and relationships that institutions, instruments and information play. The Institute advocates that an anti-fragile, accessible and future-focused research system should be designed and delivered through a RSI strategy, which should be developed in accordance with current and future data requirements of the public and private sectors. In this regard (and in order to overcome the challenges of the coming decades), the Institute has identified a potential area that could provide improved awareness, connection and stability for the RSI system – the development of a data research dashboard.

There is currently no central publicly available register of research infrastructure or resource assets for the RSI industry, which means it is not possible to debate a strategy for significant public investment in RSI. One result is that scientists may not know what other assets exist in the public domain, meaning assets are not necessarily well utilised and maintained. The development of a central register would encourage key players in the industry to work together to create a more valuable and utilised resource base for the future. An inaccessible and unconnected research database makes decision making even more difficult during times of uncertainty. In our view, a bottom-up approach toward data retrieval and sharing would shape an underlying RSI strategy and help future-proof the RSI system. A data research dashboard would ideally contain an extensive array of data relating to the components of the RSI system, which would then be used to identify what decisions require what information. The dashboard should be co-designed by a wide group of research stakeholders across industry, government, iwi (as well as mātauranga experts) and the community. It is crucial to ensure that the dashboard is compatible with alternative knowledge bases (such as mātauranga Māori and kaupapa Māori) to enable accessibility and connectivity for all stakeholders across the RSI system.

3.1 Which decisions require which information?

Good planning needs good information, which is why accessible and relevant research is essential when managing rapid and uncertain change. The public's interest is best served by reducing information disparity between actors. Good information takes time and money to find and collate. As mentioned above, it is crucial to develop a system with its demands and expectations built in. Moving forward, it is crucial to have access to a range of information to shape public and private investment, manage expectations and build innovative solutions that deliver big upsides and remove risk (across a range of opportunities and challenges). Hence, a centralised, publicly available register of timely, accurate and connected information would be invaluable for decision making.

The dashboard could be designed and curated in a way that could be tailored to best suit the user – through the application of filters to arrange and present data relating to a specific topic(s) of interest. For example, in the context of climate change, the dashboard could be filtered to identify the types of data that society will require in order to overcome the challenges and realise opportunities of climate change. Once types of data are identified and consolidated, we are then able to accurately determine which research areas require more attention. This would instantly provide structure and direction for the RSI strategy (while future proofing the RSI system). It could roughly take the shape of the table in Appendix 4.

3.2 RSI strategy

Effective policy and system design requires equal focus on foresight, strategy and reporting. Foresight drives strategy but is shaped by reporting. Strategy drives reporting but is shaped by foresight. Lastly, reporting drives foresight but is shaped by strategy. Thus, as strategy is a common theme across the Institute's work, the Institute is interested in identifying, observing and assessing the state of strategic capacity and capability across the public and private sectors. As previously mentioned, the Institute regularly reviews and asses government department strategies (GDSs) against a criterion. Generally, the observed state of strategic capability and direction from government departments (regarding solutions to challenges and/or plans to realise opportunities) is poor. See our GDS work here.

Uncertainty can be managed. Long-term investments in skills, innovation and strategic planning can, to an extent, mitigate risks associated with imperfect knowledge of future events. Therefore, the Institute advocates any reform to the RSI system being preceded and directed by a specific RSI strategy. To this end, it is essential to explore a diverse range of different strategies before developing the optimal strategy. Our understanding is that the principles (set out in question one, Part Four) should first drive the choice of strategy, and then determine the scope and focus of the national research priorities. This means that a number of strategies should firstly be identified, then assessed against the principles and only then a final strategy is selected and tested (often to be further find-tuned). Aotearoa New Zealand is at risk of spending too much time on aspects of strategy design, and not enough time on testing, adjusting and implementing a comprehensive integrated strategy.

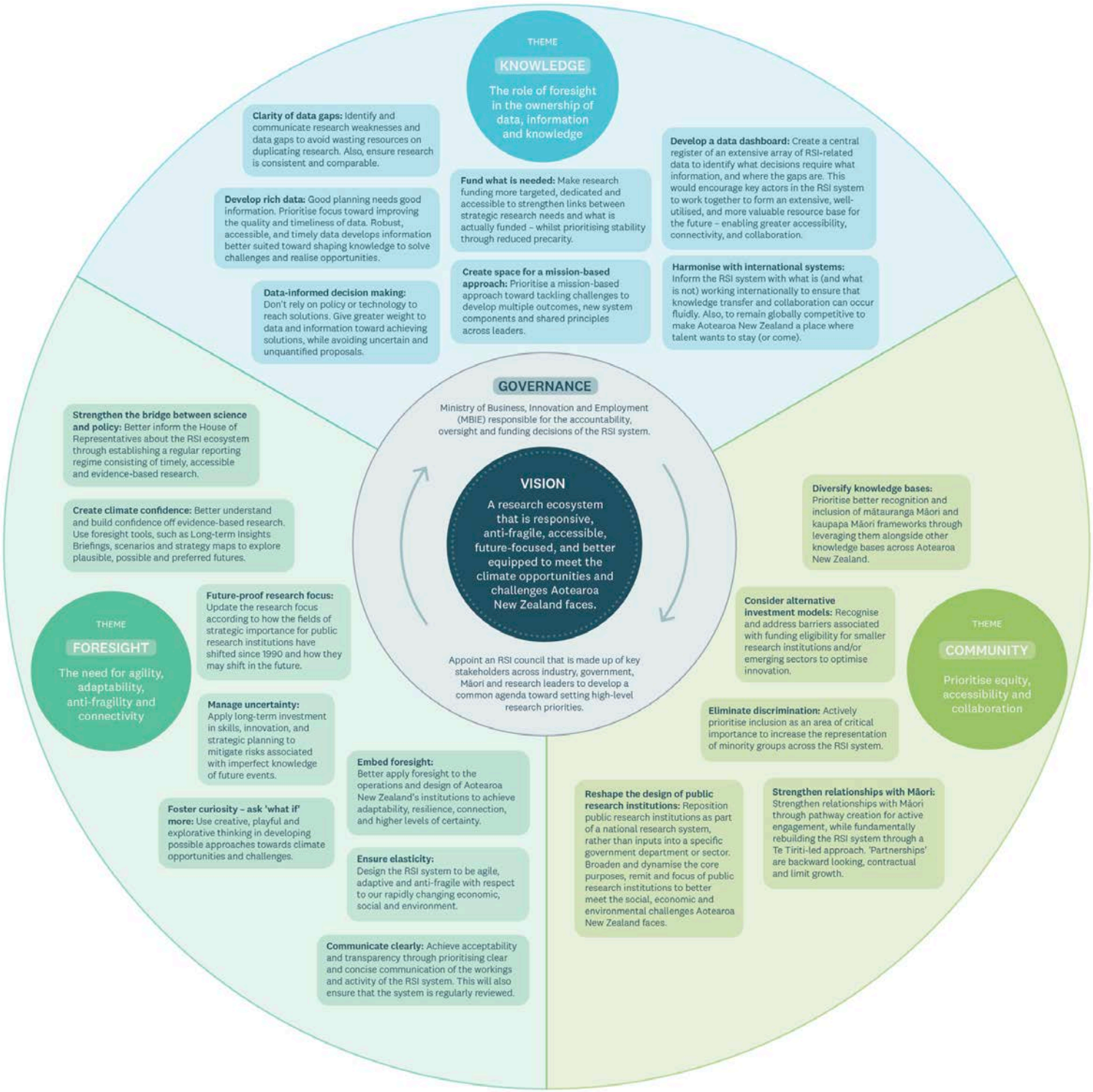
3.2.1 Strategy map

To aid this process, strategies can be tested quickly and effectively using strategy mapping. The Institute strongly advocates using strategy maps; due to their visual nature, quick turnaround and endless repeatability, they are ideally suited to the task of guiding complex, long-term transitions. The Institute was pleased to see the use of a strategy map to illustrate and communicate the 2019 draft *Research, Science & Innovation Strategy* (see Figure 2). The Institute advocates the development of an updated strategy map to accompany an RSI strategy underpinning reform to the RSI system. Figure 3 showcases an example from the Ministry of Primary Industries (MPI) of strong visual communication. The figure illustrates a collective view of the RSI needs of Aotearoa New Zealand's primary sector – a useful design style that could be considered.

Figure 3: Overview of Aotearoa New Zealand science funding and organisations informed by the Primary Sector Science Roadmap (2017)[20]

To support this submission, and to provide an example, the Institute put together a strategy map to visually communicate and highlight the key points made within this submission. The proposed strategy map aims to communicate quickly what needs to happen in order to achieve a research ecosystem that is responsive, anti-fragile, accessible, future-focused and better equipped to meet the climate opportunities and challenges Aotearoa New Zealand faces. The proposed strategy map (seen in summary on the front cover), is illustrated in Figure 4 below.

Figure 4: Proposed strategy for the Aotearoa New Zealand Research, Science and Innovation sector



3.2.2 Strategy maps in government department strategies

The Institute has also seen government departments using more strategy maps. In the most recent iteration of GDS analysis (yet to be published), roughly 40% of GDSs (91 out of 228) included at least one strategy map. The Institute believes that such a map could be a useful way to communicate the government's approach to all stakeholders.

The Institute has developed the following list of key features and strengths of strategy maps:

- **Identification of goals and how they will be achieved**
  Effective strategy maps succinctly state the key goal or vision of the strategy. This is often at the top of the map, communicating the overarching position of the goal, under which key priorities, objectives and action areas sit.
- **Communication of the relationship between ends and means**
  A key function of strategy maps is to communicate the strategy ends, and the means to that end.
- **Illustration of strategic direction**
  Often, strategy maps use arrows or other similar graphics to depict the strategy direction: between the current state and the desired future state.
- **Communication of strategic priorities**
  This information is particularly effective in enabling a member of the public, or someone new to the strategy content area, to quickly identify what the strategic priorities are, and how they relate to the goals and objectives of the strategy.
- **Identification of action areas**
  It is important to identify where attention and resources will be focused in achieving the strategy goals.
- **Communicating information succinctly and clearly**
  As with strategies themselves, clarity and concision are important components of a good strategy map. Overly wordy or 'busy' maps can pose a barrier to identifying or understanding key information.
- **Identification of intangible factors and department capabilities**
  Discussion of intangible factors or assets available to a department in implementing a strategy is particularly effective in strategic analysis.
- **Focus on future-facing objectives**
  The best-practice strategy maps focus on future-facing objectives, rather than outcomes which are specifically measurable.

Emissions Reduction Plan strategy mapping workshop (May 2021)

The Institute previously ran a strategy mapping workshop, which connected a group of highly motivated and informed parties to explore the creation of an emissions reduction plan strategy map. The workshop helped the participants learn more about the strategy mapping tool, and tested whether a strategy mapping exercise (worksheet 1) followed by an assumption mapping exercise (worksheet 2) could contribute to improving the design and communication of a strategy. The overall aim of the workshop was not to deliver an operational strategy map but instead to instil in participants the knowledge and experience of the process. See the worksheets in Appendix 5. For more information on strategy mapping, read *Discussion Paper 2021/02 – Need for speed: strategy mapping and adaptive management*, found here.

Part Four: Answers to the 17 questions

The following section contains our answers to the 17 questions found in the Invitation to comment.

Research priorities (Questions 1–3)

Question 1. Priorities design
What principles could be used to determine the scope and focus of national research Priorities (NRPs)?

As previously mentioned, any reform to the RSI system should be preceded and directed by a RSI strategy. There are many characteristics that can drive the choice of strategy. It is essential, then, to explore a diverse range of different strategies before deciding on the optimal strategy. Our understanding is that the principles should first drive the choice of strategy, which then would determine the scope and focus of the NRPs. This means that a number of strategies should initially be identified, then assessed against the principles; only then, a final strategy is selected and tested (often to be further fine-tuned). Aotearoa New Zealand is at risk of spending too much time on aspects of strategy design, and not enough time on testing, adjusting and implementing a comprehensive integrated strategy.

The Institute agrees that, when applied, the NRPs are likely to have different scopes, sizes and direction. It is crucial, then, that the overarching principles that underpin the strategy can consistently align with, and encapsulate, the national research priorities. The process for setting national science priorities needs to be agile, dynamic, respected and mandated.

Proposed principles:

1. **Uphold Te Tiriti**
   The RSI system currently fails Māori. By acknowledging this, priortising stronger relationships with Māori and fundamentally rebuilding the RSI system through a Te Tiriti-led approach, the bridge between mātauranga Māori and Western science (as well as other knowledge bases) could be strengthened. This would ultimately benefit the RSI system in many ways (see answer to question 5 for more detail). Furthermore, the Institute would like to comment on the use of the term 'partnerships' in the *Green Paper*. The Institute believes that the term 'partnership' is backward looking and constraining. Instead, this should be replaced by the term 'relationship' as it is forward looking in nature and allows room for growth. See presentation by the late Dr Apirana Mahuika on why we need relationships rather than partnerships (see our YouTube Channel here).

2. **Be elastic**
   The RSI system must be elastic (meaning adaptable, anti-fragile and connected). We live in a rapidly changing economic, social and natural environment and the RSI system must be developed to be able to adjust with agility and speed. Select the best strategy, then action (test, watch, monitor, learn, reflect and recalibrate).

3. **Embed foresight**
   The application of foresight across the operations and design of Aotearoa New Zealand's institutions is weak. Appropriate use of foresight in this regard is crucial to achieving adaptability, resilience and connection. Embedding foresight will also alleviate potential operating costs and deliver higher levels of certainty through long-term investments in skills, infrastructure, innovation and strategic planning. Alignment with a mission approach is also important (see Figure 1).

4. **Ensure equity**
   The Institute advocates the active prioritisation of gender and cultural diversity to increase the representation of minority groups across the RSI system. This offers countless benefits, and should be recognised as an area of critical importance.

5. **Governance split**
   Decisions regarding the (i) design and development of high-level research priorities; and (ii) accountability, oversight and funding decisions of the RSI system, in our view, should be made by separate entities. Regarding the former, the Institute recommends that a council consisting of representatives across industry, government and Māori is appointed to govern the process of priority decision-making and design. The latter should ideally be governed by MBIE.

Question 2. Priority-setting process
What principles should guide a national research Priority-setting process? How can the process best give effect to Te Tiriti?

The Institute believes that this question adds an unnecessary layer of complexity to the consultation process – there should only be one group of principles that underpin the RSI strategy used to direct reform. In our view, the RSI strategy should, in itself, be the NRP setting process, instead of another layer of attributes and principles – as mentioned in the *Green Paper*. However, one point that does lend itself more specifically toward the priority setting process is the frequency of review. The Institute agrees that NRPs will need to be reviewed and in some cases changed as we navigate through areas of uncertainty – where foresight can't be solely relied upon. However, the Institute believes that more planning and resource should be put into future proofing (i) the principles underpinning the overall strategy and (ii) the subsequent NRPs. Ultimately, this would reduce costs and time associated with reassessing the efficacy of priorities every so often. The Institute does not deny that there is purpose in such review, but want to reinforce that this may not need to be the case if more attention is given to robustly embedding foresight and flexibility into the priorities in the first place.

Overall, our view is that a successful science system is dependent on how well it is designed to achieve the following: (i) science that supports the needs of society and industry; (ii) a system that puts the right drivers in place to facilitate this; (iii) education that supports the needs of the science system, and (iv) a public that understands the logic of the alignment and is informed of the outcomes. All four success factors need to be measured and reported on over time to indicate whether or not performance is improving and goals are being achieved.

Question 3. Operationalising Priorities
How should the strategy for each national research Priority be set and how do we operationalise them?

The Institute suggests that an independent council should be established and appointed to set the NRPs. The council will ideally consist of representatives from industry, government and Māori (iwi and mātauranga experts) and research stakeholders. The inclusion of Māori representatives would ensure that NRPs (and the setting process) will be inclusive of Te Tiriti and te ao Māori. In light of an existing proposed approach toward setting and achieving NRPs, the Institute wishes to reiterate the recommendation made in the 2021 paper *Pathways to the Future*:

> We propose that the Strategy Team for each Mission is limited to 4–8 people. Team members should each be leaders of key stakeholder organisations needed to implement a plan that will deliver the strategy. They should be capable of committing their organisation to the plan agreed by the Team. Each mission will have (1) A clear measurable impact target, e.g., get a man to the moon and back safely; (2) A timeframe within which the target needs to be achieved, e.g., by the end of the decade.[21]

Regardless of the decided approach, setting and operationalising the NRPs will require attention to strategy, governance and leadership. More specifically, determining resourcing choices and objectives (strategy), providing a point of accountability and decision making and oversight (governance) and enabling day-to-day (and intellectual) direction and setting the culture and working environment for each NRP (leadership). The weight of attention and resource that each component requires will, however, need to be determined – especially the role and mandate that research leaders have. As noted in the *Green Paper,* the Institute agrees that strong leadership in research roles is a better success factor than system design and governance. There will also need to be consideration of safeguards against short-term operational functionality of particular stakeholder groups as well as dedicated funding as part of strategy design.

Te Tiriti, mātauranga Māori and Māori aspirations (Questions 4–6)

Question 4. Engagement
How would you like to be engaged?

The Institute is not in a position to directly represent Māori engagement in reform on behalf of Te Tiriti obligations and opportunities, Māori research aspirations and the enabling of mātauranga Māori. However, the Institute advocates reform prioritising the above. This should take shape through active engagement, and meaningful and genuine relationships that jointly set priorities, co-develop and co-deliver NRPs. To this end, the Institute wishes to reiterate the following points posed in the *2019 RSI Draft Strategy*:

- ensure the RSI system is open to the best Māori thinkers and researchers, and allow them to thrive in the broadest range of endeavours;
- create pathways for Māori engagement with RSI, and support RSI projects of local and national significance to Māori
- ensure innovation supports are open to the energy and ideas of our Māori entrepreneurs to develop innovative businesses
- create an environment where Māori entities and businesses are able to invest with confidence in research and innovative businesses
- resource and protect Mātauranga Māori while acting appropriately within the framework of the Treaty of Waitangi.[22]

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

The 2019 MBIE-commissioned *Te Pae Kahurangi* (an independent review of CRI capacity and ability to respond to future challenges and needs) identified that there has not been a 'large-scale, long-term, Māori-led science programme in any CRI in 27 years'.[23] Māori are under-represented in CRIs and the wider RSI system – and are 'additionally stretched because they are often implicitly expected to assist with cultural labour'.[24] Furthermore, due to the exclusion of diverse knowledge bases (such as mātauranga Māori and kaupapa Māori), CRIs may be a potentially unattractive place for Māori researchers to work.[25]

There is a lot of value in wisdom, narratives, and reflection. Mātauranga is a case in point; Aotearoa New Zealand benefits from the wisdom passed on by generations, but some may argue that is not evidence. Our view is that there are different types of evidence and therefore different types of information sources. The independence and verification of information sources are also important requirements to consider when publishing data and/or using data as evidence to make decisions. Leveraging mātauranga Māori alongside other knowledge systems could deliver a range of benefits specifically to the RSI system, but also to society more generally. Enabling and protecting mātauranga Māori provides a unique opportunity to redefine science-policy expertise and capability to realise the inherent strengths in indigenous-led innovation.[26] In realising this opportunity, mātauranga Māori would be better recognised in funding criteria, to allow Māori researchers to access funding opportunities – thus accelerating and amplifying Māori involvement and, in turn, enabling the RSI system to become more equitable. As per reform, enabling and protecting mātauranga Māori could initially be achieved through the appointment of mātauranga experts across key research institutions and agencies as well as leaders of advisory groups.

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

The Institute supports regionally based Māori knowledge hubs. Firstly, the Institute agrees with the notion of deploying research resources where Māori knowledge is practised. Secondly, hubs would better identify the research priorities and needs of whānau, iwi and hapū across regional communities and the identification of regional priorities would then further encourage and enable the co-design (and co-benefits) of Te Tiriti/te ao Māori-aligned research. Thirdly, through more efficient and equitable resourcing measures, these regional communities would be better equipped to develop medium- and

long-term strategic outlook (foresight), which would reduce the gap between Māori researchers and policy makers.[27]

Funding (Questions 7–8)

Question 7. Core functions
How should we decide what constitutes a core function and how do we fund them?

The Institute believes that the RSI funding regime should provide equal opportunity and accessibility across different types of research organisations. The Institute agrees that the overall funding regime should not fund research differently because it is done by different types of organisations – albeit that different types of research will require different types (and levels) of funding. In this regard, the Institute agrees that a funding regime that deliberately funds research on the basis of the type of organisation will exacerbate barriers between organisations, increase fragmentation and be complex and confusing to operate.

In our opinion, weak links exist between Aotearoa New Zealand's strategic research needs and what is actually funded (which could potentially be explained by the current funding criteria). Thus, as part of reform, new criteria should be developed to make funding more targeted, dedicated and accessible. The Institute agrees with the proposed funding changes in the *Green Paper*: the setting of new priorities; the explicit and direct funding of those priorities; and aligning priorities with the RSI strategy (which should be first set out in the strategy). The Institute also agrees with the idea of dedicating funding for critical research functions, high priority services emergency responses and database development (see Part Two regarding a data research dashboard).

Across our climate-related work, issues with funding have become increasingly (and alarmingly) apparent. The Institute strongly advocates faster upfront investment to support the (urgently needed) development of large-scale climate-related interventions. The investment mechanisms required to finance such developments (namely decarbonisation and long-term resilience) must be set up in the short-term. The Institute holds concerns over the lack of certainty and clarity about when these funding decisions will be made, considering the budget cycle, with its emphasis on short-term expenditure and lengthy annual vetting process, is not well suited to delivering long-term investment certainty (as mentioned in Part One). The timely development of a mechanism to guarantee long-term funding certainty is crucial. Similar long-term fiscal challenges, such as infrastructure spending, have mechanisms to provide a clear pipeline of projects and funding, such as the National Land Transport Programme.

Funding for the research agenda is the primary vehicle for change; it must be robustly debated, signed off by Cabinet, transparent, and reported against annually. Further, The Institute considers the research agenda should be reassessed annually; this does not necessarily mean work programmes need to change, but they could be modified or fine-tuned to meet new and emerging needs and opportunities. There is a feeling in the literature that once a research investment is approved, it is a sunk cost. In business, it is about squeezing the best outcome out of an investment; hence an annual review of the research investment portfolio should be a matter of good practice, particularly in these challenging and changing times.

Question 8. Establishing a base grant and base grant design
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?

Yes. The Institute agrees with the scope of the three preliminary questions posed to assess the value of a base grant scheme. To this end, the Institute suggests that all of these decisions are stress-tested in a strategy mapping exercise. The Institute provides thoughts on each question below:

1. **Who gets a base grant?**
   The Institute agrees that universities and CRIs should represent the largest proportion of recipients. However, the Institute suggests that robust analysis should be undertaken to assess the

impact of what would occur if other potential recipients (DHBs, museums and certain businesses) were not to receive base grant funding – both in terms of the impacts on the recipients, as well as the wider community in which they operate.

2. **What would be paid for?**
The introduction of a base grant scheme should provide more weight towards stable funding than contestable funding. By prioritising a base grant scheme to increase stable funding, it is likely research organisations will be better placed to embed foresight, whilst reducing uncertainty and transaction costs. In alignment with suggestions made in *Te Pae Kahurangi,* the Institute agrees that this funding should be allocated toward 'explicit and stable funding of fit-for-purpose core and high-priority research and science service capabilities and functions, including prioritised databases and collections (as determined at a pan-CRI level), as well as emergency response'.[28] The Institute believes that a base grant regime should cover a greater proportion of research costs, potentially even including salaries. While this option does reduce the amount of funding available (for other priorities and contestable funding, etc), it would strengthen the research workforce through skills training, attraction and retention of talent and high levels of stability and resilience.

3. **How would the sum awarded change over time, and can organisations enter and leave the scheme?**
The Institute agrees that funding allocations will need to vary over time and support enabling research organisations to enter and leave the scheme, as it could potentially alleviate any problems with the base scheme design around 'who gets a base grant'. The Institute believes that the most equitable and accurate way to allocate funding would be through a combination of (i) a negotiated system and (ii) an activity-based system. This would mean that the funding organisations would receive is adjusted periodically to match the quantified level of activity while supported by the periodic investment judgment calls made by the Government. In our view, this regime would provide a secure level of stability, while also enabling funding to be responsive, agile and robust.

Institutions (Questions 9–13)

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

The Institute agrees with the high-level objectives and purpose behind reform to institutional design and supports the notion to reposition public research institutions as part of a national research system rather than inputs into a specific government department or sector.

The Institute believes that re-examining how best to design Aotearoa New Zealand's public research institutions is a key component to the success of the RSI reforms. Unfortunately, largely due to constraints associated with the current funding regime, public research institutes are operating far less efficiently and productively than they could be.

Although the New Zealand Crown Research Institutes paper *Pathways To The Future* believe that: '[f]or Public Research Institutes to be genuinely at the table with Government, Industry and Māori, They need to be able make and deliver on commitments' [sic].[29] However they also note that: 'the current funding system the CRIs have limited ability to make such commitments. The majority of CRI funding comes from a mix of contestable MBIE funding and commercial contracts. These tend to be piecemeal and sporadic, rather than strategic and consistent. There is only limited institutional funding and hence only limited empowerment.[30]

This, again, reinforces the notion that institutional design reform (as well as all RSI reform) needs to be carefully considered, tried and tested and underpinned by strategy. Regarding operational form and model, the Institute offers a perspective as to how institutions could be better designed below:

1. **Broadening and dynamising the core purposes, remit and statement of intent of public research institutions**.
   As briefly discussed in the *Green Paper*, we agree that this would enable more effective collaboration, and ability to respond to broad and complex challenges that require a connected and multidisciplinary approach.

2. **Size and number of institutions.**
   Rethinking the size and number of institutions provides a fresh perspective toward institutional design; however, trade-offs will occur. Larger and fewer institutions seem to be the way international funding models and global trends are moving (successfully too). On the beneficial side, larger institutions are likely to be more stable; enable greater connectivity through the development of interdisciplinary research; and create capability hubs across sectors, which enables further effective collaboration to tackle research missions. There is also evidence that larger institutions enable greater financial agility and the ability to meet (and commit to) government priorities and industry demands. However, forgoing the option of smaller institutions could impede the agility of research institutions.

3. **Research focus.**
   This is a key feature of institution design that must be considered in reform. The research focus (as discussed in the *Green Paper* on p. 59) of public research institutions was to 'operate in the fields of strategic importance to New Zealand', which, despite being set in 1990, still determines the focus and remit today. In the process of reshaping how research focus should be decided to enable interdisciplinary collaboration against complex challenges, the Institute suggests that a council (involving industry, government, Māori and research stakeholders) is appointed to set the scope, and to review it when needed. In this regard, a good starting place would be to consider how the 'fields of strategic importance to New Zealand' have shifted in the last 30 years and probe foresight into how they may shift in another 30 years. Another key point is how to better enable the flow of knowledge from research to end users.

4. **Harmonisation with international research systems.**
   Following international models will ensure that knowledge transfer and collaboration can occur easily and organically.

Question 10. Role of institutions in workforce development
How can institutions be designed to better support capability, skills and workforce development?

The Institute agrees that there should be a strong approach toward organisational incentives – talent development, resourcing, attraction and retention with an internationally aligned mindset, as well as providing flexible and diverse career pathways. This could be achieved by prioritising the development and implementation of better investment mechanisms that support more fluid career pathways, increased diversity, increased stability, increased coordination and reduced precarity. Through improved coordination across the RSI system, barriers of knowledge transfer could be reduced (or removed) to support the flow of scarce resources and talent – making sure that they are mobile and thus able to deliver the highest value where it is needed most.

Question 11. Better coordinated property and capital investment
How should we make decisions on large property and capital investments under a more coordinated approach?

The Institute agrees that a coordinated approach toward decision making on large property and capital investments is necessary; however, the Institute expresses caution on picking the right balance between institutional autonomy and system benefits. The Institute suggests that the development of a centralised infrastructure programme and council could be helpful to inform and direct decisions in this area. Ideally this will help establish a coordinated and strategic approach. Aotearoa New Zealand has a limited pool of resources, so it is essential that it looks to where it can most effectively develop large-scale infrastructure. The Institute agrees with prioritising co-location as a key factor in better-coordinated decision making –

specifically between universities and public research institutes. As mentioned in the *Green Paper*, the benefits of co-locating research institutions are many.

Question 12. Institution design and Te Tiriti
How do we design Tiriti-enabled institutions?

See answers to Questions 1, 4–6.

Question 13. Knowledge exchange
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?

The Institute believes that knowledge exchange and impact generation could be strengthened through encouraging more integration between CRIs and universities – specifically, this could be achieved through interactions between research students and CRIs, on top of realising the benefits of co-location.[31] The Institute also supports prioritising the development of stronger international research connections. As mentioned in the *Green Paper*, the Institute agrees that creating new (and strengthening existing) links between international and domestic research institutions directly supports the exchange of knowledge.

Research workforce (Questions 14–16)

Question 14. Workforce and research Priorities
How should we include workforce considerations in the design of national research Priorities?

The Institute suggests that research workforce issues need to be considered as part of any reform of the design of national research Priorities. The following suggestions could be included in workforce considerations:

- Provide adequate support for researchers early in (and throughout) their careers, and incentivise researchers to stay in Aotearoa New Zealand, which is essential to maintaining a strong and stable scientific workforce.
- Empower stronger and easier collaboration between researchers across the domestic and international system.
- Establish solid research leaders that encourage and inspire early to mid-career researchers, and ensure that succession planning is well supported.

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

The Institute agrees that a base grant regime would benefit the research workforce in terms of reduced precarity, increased diversity, increased stability and high-quality career pathways. Base grant regimes, through stability, also provide the opportunity to shift greater focus and attention toward skills training. The upsides of providing more attractive, flexible and diverse roles are encouraging steps toward making Aotearoa New Zealand a place where talent wants to stay. This also potentially enables better pay for researchers, meaning that they are more likely to stay in Aotearoa New Zealand if they are paid the equivalent or close to what they would receive overseas.

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

Stronger funding mechanisms need to be designed to develop, resource, attract and retain talent. More specifically, we need to develop dedicated schemes that establish multiple pathways to better support

early to mid-career researchers to establish research programmes. In order to realise stronger funding mechanisms, the Institute recommends that critical success factors and performance indicators are first identified (as part of an underlying strategy). This would then aid the design and development of funding mechanisms to better align with the overall goals of the system.

Critical success factors for an optimal model to allocate government investment in science should include the following:

- The funding process is transparent.
- The application process is constant.
- The research agenda is clear and concise.
- The reporting framework is comprehensive, timely, relevant and transparent.
- A register of funds is easily discoverable.
- Funding applications are straightforward and not overly onerous or complex.
- Allocation decisions are transparent and non-partisan, and complaint mechanisms are in place; While the areas in which some CRIs will use their core funding are clear, there is a crossover for some of the Institutes. For example, research conducted by GNS Science may fall under the Environment, Hazards and Infrastructure, or Energy research areas.
- Members of the science community understand the application process.
- Members of the science community recognise the constrained and limited nature of funding and readily invest in frugal science.

The Institute also recommends the consideration of a repayable grant mechanism for emerging sectors, as well as companies/institutions that are researching priority areas which struggle to compete with large, existing and successful players for funding. This approach would enable smaller companies/institutions to secure funding to acquire the technology they need to become globally competitive in the form of a grant, which converts to a loan when milestones are met.[32]

Research infrastructure (Question 17)

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

As mentioned above, it starts with strategy – specifically, investments can most effectively be made through critical success factors and performance indicators. To this end, the Institute suggests establishing investment models that deliver certainty and stability through planned, long-term and dedicated funding of research infrastructure. The Institute agrees that (in alignment with chosen critical success factors and performance indicators) modern and agile working environments need to provide access to the latest equipment and technologies that allow researchers to remain at the global frontier of knowledge production.

Furthermore, in conjunction with insights raised in response to Question 11, the Institute recommends exploring the benefits associated with sharing infrastructure resources. It is likely that, through co-location, institutions could make more efficient use of capital investments and potentially improve the international rankings of Aotearoa New Zealand universities – whilst improving the efficiency of operations.

Appendix 1: Consultation questions

Research Priorities (Questions 1–3)

1. **Priorities design**
   What principles could be used to determine the scope and focus of national research Priorities?

2. **Priority-setting process**
   What principles should guide a national research Priority-setting process? How can the process best give effect to Te Tiriti?

3. **Operationalising Priorities**
   How should the strategy for each national research Priority be set and how do we operationalise them?

Te Tiriti, mātauranga Māori and Māori aspirations (Questions 4–6)

4. **Engagement**
   How would you like to be engaged?

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

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

Funding (Questions 7–8)

7. **Core functions**
   How should we decide what constitutes a core function and how do we fund them?

8. **Establishing a base grant and base grant design**
   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?

Institutions (Questions 9–13)

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

10. **Role of institutions in workforce development**
    How can institutions be designed to better support capability, skills and workforce development?

11. **Better coordinated property and capital investment**
    How should we make decisions on large property and capital investments under a more coordinated approach?

12. **Institution design and Te Tiriti**
    How do we design Tiriti-enabled institutions?

13. **Knowledge exchange**
    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?

Research workforce (Questions 14–16)

14. **Workforce and research Priorities**
How should we include workforce considerations in the design of national research Priorities?

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

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

Research infrastructure (Question 17)

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

Appendix 2: Excerpts from *Report 9: Science Embraced Government-funded Science under the Microscope*

Source: McGuinness Institute, *Report 9: Science Embraced Government-funded Science under the Microscope*[33]

Foreword

If we can embrace its potential, science could be a major game-changer for New Zealand. For too long we have thought of ourselves as a small farming nation making an honest, but simple living; we have believed that our strengths lie in agriculture and tourism and that these areas should be the focus of our economic future. Playing to traditional strengths has merit, but at the same time we must ask ourselves, what is the long-term economic carrying capacity of these sectors? Are these sustainable ways to create long-term wealth for New Zealand?

If we are serious about holding on to our unique culture and way of life, preserving our beautiful country and creating sustainable wealth then we need to raise our eyes above the horizon. I have no doubt that New Zealand has the potential to transform itself into a thriving knowledge economy, taking advantage of the sheer scale of foreign markets to sell high-end technological and creative products, without exhausting the land. That future requires us to aspire. But it is a future that we can create. We are rich in water and energy resources, we have a great education system, world-class science and engineering, a vibrant artistic and creative sector, quality urban environments and a civil society. When we combine all this with our unique landscapes, and our pristine mountains and seas, we have the chance to be 'The place where talent wants to live'.

The gulf between vision and strategy is no small obstacle to navigate. We cannot expect to simply invest more money into scientific endeavour and think that industry will flourish on this alone. What is needed is a national strategy and the resolve to move consciously towards its vision. This is not just a challenge for the science sector; the New Zealand public need to be engaged and inspired, to be involved as stakeholders and investors, and to be willing to take up this challenge alongside the science community. The challenge for the scientists is to articulate and act upon the values that will inspire their fellow citizens.

This report addresses the issue of values and the role of science in contributing to New Zealand as a sustainable nation. It addresses the relationship between science and ethics, the concept of frugal science and the idea of science driving policy. It is not just a review of science; it is an exploration of the conceptual thinking and strategy that drives government investment in science in New Zealand. It addresses the inherent challenge of ensuring top performance by exploring the role of science in New Zealand and questioning how its systems and institutions can be better directed toward a sustainable national strategy. This document provides the basis for a conversation that needs to be happening across New Zealand.

Sir Paul Callaghan GNZM FRS FRSNZ

Figure 36 shows the linkages that need to exist within a strategy to make it effective and efficient. It does not aim to be a full and final strategy, as this would require agreement over the strategic intent and drivers. Only after this agreement has been reached is it possible to add detail over how the enablers will make the strategy happen and how the targets and initiatives will act as instruments to drive change and measure performance. However, it does indicate why a strategy map is useful to both test and communicate strategy.

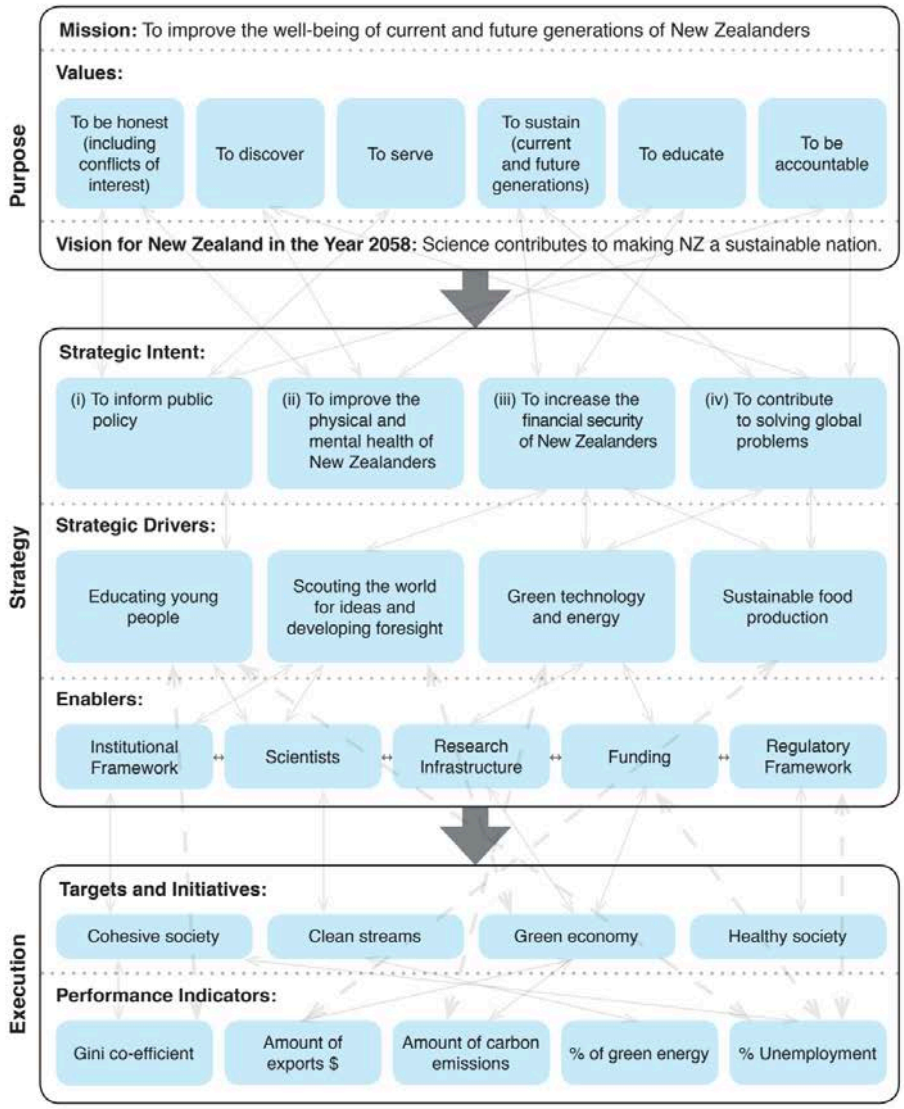
Table 10: The Proposed Strategy of the Government-funded Science System

Strategic Intent	(i) To inform public policy (ii) To improve the physical and mental health of New Zealanders (iii) To increase the financial security of New Zealanders (iv) To contribute to solving global problems
Strategic Drivers	(i) To inform **public policy** Focus on public policy that matters to New Zealanders; examples include health, wellbeing, education, welfare, social equity and diversity; water irrigation and fertiliser management; pest eradication; earthquakes (before, during and after); green energy; marine management, and science infrastructure. (ii) To improve the **physical and mental health** of New Zealanders Focus on managing and resolving child obesity, diabetes, rates of suicide, alcohol abuse and child abuse, which require specific research strategies to inform public investment and measure performance. (iii) To increase the **financial security** of New Zealanders Focus on providing a diverse range of niches that create long-term jobs and secure exports. (iv) To contribute to solving **global problems** Focus on support for Pacific neighbours, including climate science, food and water management, medical care and research. New Zealand could also be a repository for information on climate change, such as sea change and its impact in this part of the world, including Antarctica. Collaboration with Australia and others could lead to significant science infrastructure investments in areas such as telescopes, seed banks, and pandemic research.
Enablers	Institutional framework, scientists, research infrastructure, funding, and regulatory framework

Table 11: The Proposed Strategy Execution of the Government-funded Science System

Targets and Initiatives	Servicing the needs of the public, training scientists in scientific inquiry and ethics, reinforcing sound science, policing junk science, providing open data, open innovation, and foresight.
Performance Indicators	**Input monitoring:** Reporting on the government investment dollar, assessing the utilisation and life of science infrastructure, assessing the quality and quantity of scientists, following business research and development. **Process monitoring:** The cost of the research dollar. **Output monitoring:** The quality and quantity of publications, the quality and quantity of patents, and the commercialisation of science outputs. **Outcome monitoring:** Improvements in trust and improvements in well-being.
Strategy Map	Figure 36 is an example of a strategy map, bringing together the nine pillars mentioned above.

Figure 36: An Example of a Strategy Map for Government-funded Science



Note: This strategy map aims to show the internal cohesion within the strategy. The horizontal dotted lines show the horizontal integration between ideas, while the vertical lines indicate the linkages between the purpose and the execution. The dashed lines represent the high-level linkages between strategy and performance indicators. This map is provided for discussion and to show what a useful tool a strategy map can be. However it must also be assessed in terms of external cohesion and how it fits within the probable, possible and preferred futures. See discussion in Section 8.3.

10.4 Recommendations for Science Policy

This report seeks to contribute to a deeper discussion on science in society and the role of government in science. Countries that have significantly improved wellbeing through science have done so, not simply because of the level of funds invested, but because their governments' chose to think strategically. They used their investment as a lever to drive change, precisely and meticulously responding to the events around them. Developing a sound strategy for a dynamic and complex system is not easy, but intelligent countries do so through seeking engagement across government, policy analysts, scientists and researchers, and society. Their pathway to success is to identify feasible strategic options, select the best strategy, communicate that strategy and then implement and monitor progress – all with a view to optimising the public's investment in science. Critical to embracing science is to put sound and robust science at the intersection where scientists and society meet. This section recommends ten actions that we believe together would propel the current system into action.

1. Embed foresight

Embedding foresight into central government has proven to be a critically important tool for shaping the government-funded science research agenda in Singapore. New Zealand would benefit from the establishment of a unit within the DPMC to increase the government's awareness and preparedness for the future. Such foresight will not only indicate where opportunities exist, but will dictate the type of research infrastructure New Zealand should be developing, the type of expertise required to drive this investment and the necessary regulatory frameworks required to manage risks and intellectual property.

2. Instil values and ethics

A set of shared values that are easily discoverable, understandable, and encourage engagement with the general public, are critical to ensure that trust is built on a stable and unifying framework. For this to happen there must be a 'will' by the profession and its employers to uphold and champion these values and to embed these shared values and ethics into their everyday practice. Figure 36 identifies the six values we believe are important. Ethical policies should be designed with the future in mind; too often in the past ethics have been developed after the practice has been developed, when many stakeholders have a vested interest. For example with increasing demands on resources, the Continental Shelf and Antarctica are areas where values and ethical practices need to be developed now for future exploration.

3. Prioritise wellbeing

MSI has stated its intention to contribute to the wellbeing of New Zealanders. Developing a shared understanding of what improvements to wellbeing might look like is a critical component to realising this objective. Wellbeing is an evolutionary concept, one that must be developed by each successive generation in terms of the political, social, economic, environmental and cultural climate at the time. We believe a wellbeing project is necessary along the lines of the Canadian study that aims to redefine progress in terms of wellbeing (Policy Horizons Canada, in press). Such a project is necessary to drive all policy and to make it clear what improvements we are working hard to achieve.

4. Prioritise governance over the research agenda

Strategic intent acts as the key link between the mission, values and vision, and the initiatives that will drive change in the government-funded science system. However, our current focus in the current strategic intent appears to focus on New Zealanders' financial security. While this is a critical factor in achieving the vision of delivering wellbeing to current and future generations, there are three other areas that are equally important: informing public policy, improving health and solving global problems. We recommend that each of the four areas should have a high-level research agenda that describes what the public investment will deliver. This description should make clear how each of the six 'priority investment areas' can be directed to achieve the four areas of strategic intent. This agenda should be signed off by Cabinet annually so that it aligns the public investment with existing and emerging issues. MSI should be required to report annually against the research agenda in detail.

5. Represent the profession

The science community, at a national level, should consider how best to represent the profession. There are at least 20,000 researchers and scientists in New Zealand, but only a small number are represented

directly by a scientific membership organisation. The majority are instead represented through the organisations that employ them. Science, more than most professions, needs a safe place to discuss, debate, peer review, advocate and integrate science. Experts will not always agree, and it is the science community that creates the place for best practice to be agreed, complaints managed, problems defined and resolved, and mysteries explored.

6. Expand and align enablers

The current government-funded science system tends to focus on the middle of the strategy pyramid in Figure 1, rather than aligning the whole pyramid. Further, there seems to be a tendency to respond to problems by changing the institutional framework rather than dealing with the less obvious enablers, such as the profession and the regulatory framework.

7. Standardise terminology

The current language around the government-funded science system, and science generally, is inconsistent. MSI should undertake a project to develop a comprehensive glossary of the language that supports the government-funded science system and place it on their website. This would enhance the ability to effectively discuss, debate and drive science. Such language needs to be precise, articulate and particular so that it can be used to develop a strong mission and vision statement. We consider MSI would benefit from becoming the Ministry of Scientific Inquiry rather than of Science and Innovation

8. Ask and answer outstanding questions

Scientific inquiry is at the heart of sound science, yet the sector is not always good at applying this inquiry to the funding that is the life-blood of science, nor to the research agenda and the research outputs and outcomes. A number of outstanding questions exist, meaning that we need to research the research. Section 9 identifies 30 questions that address gaps in the science strategy, test the assumptions underlying the current institutional framework and examine the system linkages that are purported to deliver the desired outcomes in the future. Policy makers must address and answer these questions in order to develop a robust and flexible government-funded science system capable of engaging with emerging issues.

9. Execute

Delegation of funds and responsibility for how those funds are used will only work if a clear strategic intent is established and a clear measurement framework is put in place to monitor and benchmark progress over time. This would reveal whether performance is improving, goals are being achieved, and further changes are necessary. CRIs in particular need such a framework, as the method by which they are now funded requires greater clarity over the strategic intent and the metrics to assess progress. The metrics also need to be made public so that all stakeholders are able to assess the quality of the investment.

10. Review

As a matter of good practice, any significant change should require a robust one off review to assess whether the promised benefits have been delivered and what lessons are to be learned. The Minister of Science and Innovation should require a full, independent review within five years of the recent restructure, ideally in 2015. The results of this review should be made publicly available. This point was discussed in a recent briefing by the Office of the Auditor General to the Education and Science Committee. Without setting such a milestone, the opportunity to assess and recalibrate the system will be lost. Moving towards a science policy system that rejects myths, embraces values and pursues strategy will require both the engagement of the public and the 'will' of the science community. Now that the recent changes to the institutional framework are largely complete, we hope to see a persuasive strategy developed and communicated. One of the key findings of this report is the need for greater engagement between scientists and the New Zealand public. This research represents our commitment to a wider debate on the contribution that science can make to the wellbeing of New Zealanders, now and in the future.

Appendix 3: Timeline of Climate Change Policy

Source: McGuinness Institute, *Working Paper 2021/01 – Timeline of climate change institutions and instruments since 1980* [34]

Figure 4: Timeline of Climate-related policy

Appendix 4: Data research dashboard (climate example)
Source: McGuinness Institute (in progress)

An inaccessible and unconnected research database makes decision making even more difficult during times of uncertainty. In our view, a data research dashboard would contain an extensive array of data relating to the components of the RSI system, which would then be used to identify what decisions require what information. The dashboard should be co-designed by a wide group of research stakeholders across industry, government, iwi (as well as mātauranga Māori experts) and the community. The table below is an example of they type of data that could be included in the climate-related Dashboard.

Table 1: Suggested data that could be collated to produce a Dashboard

Data category	Specific data needed	Metric(s)	Applied Science?	Water, atmosphere, land?	Adaptation or mitigation?	Organisation	Research or experiment?	Accessible
Emissions (total)	Country emissions	CO2e	yes	Atmosphere	Mitigation	NZ Government	Research	Yes
	City emissions	CO2e	yes	Atmosphere	Mitigation	LGNZ	Research	Yes
	Regional emissions	CO2e	yes	Atmosphere	Mitigation	LGNZ	Research	Yes
	Provincal emissions	CO2e	yes	Atmosphere	Mitigation	LGNZ	Research	Yes
	Vehicle emissions	CO2e	yes	Atmosphere	Mitigation		Research	Yes
	Transport emissions	CO2e	yes	Atmosphere	Mitigation		Research	Yes
Emissions (breakdown)	CO2 emissions	CO2e	yes	Atmosphere	Mitigation	NZ Government	Research	Yes
	Methane emissions	CO2e	yes	Atmosphere	Mitigation	NZ Government	Research	Yes
	Nitrous oxide emissions	CO2e	yes	Atmosphere	Mitigation	NZ Government	Research	Yes
	Fluorinated gases	CO2e	yes	Atmosphere	Mitigation	NZ Government	Research	Yes
Emissions (profile)	Emissions per person	CO2e	yes	Atmosphere	Mitigation		Research	Yes
	Emissions per household	CO2e	yes	Atmosphere	Mitigation		Research	Yes

Data category	Specific data needed	Metric(s)	Applied Science?	Water, atmosphere, land?	Adaptation or mitigation?	Organisation	Research or experiment?	Accessible
	Emissions per livestock animal	CO2e	yes	Atmosphere	Mitigation		Research	Yes
	Emissions per industry	CO2e	yes	Atmosphere	Mitigation		Research	Yes
	Emissions per sector	CO2e	yes	Atmosphere	Mitigation		Research	Yes
Migration	Population data	no.	no	N/A			Research	Yes
	Socioeconomic structures		no	N/A			Research	Yes
	Population predictions	no.	no	N/A			Research	Yes
Agriculture	Landuse/Landcover	area	no	Land			Research	Yes
	Animal/Crop type	no.	no	Land			Research	Yes
	Amount	no. / weight?	no	Land	N/A		Research	Yes
	Productivity		no	Land	N/A		Research	Yes
	Exports	$	no	Land	N/A		Research	Yes
	Imports	$	no	Land	N/A		Research	Yes
	Soil conditions		yes	Land	N/A		Research	Yes

Data category	Specific data needed	Metric(s)	Applied Science?	Water, atmosphere, land?	Adaptation or mitigation?	Organisation	Research or experiment?	Accessible
Weather (usual events)	Rainfall (mm per day, month, year etc)	mm	yes	All	N/A		Research	Yes
	Wind	km	yes	All	N/A		Research	Yes
	Snow	mm	yes	All	N/A		Research	Yes
	Turbulence	km	yes	All	N/A		Research	Yes
	Temperature (c per day, month, year, etc)	c	yes	Atmosphere	N/A		Research	Yes
	Storm (severity and frequency)	barometer?	yes	All	N/A		Research	Yes
Weather (extreme events)	Flood (scale, severity and frequency)		yes	Land	N/A		Research	Yes
	Drought (scale, severity and frequency)		yes	Land	N/A		Research	Yes
	Tornado (scale, severity and frequency)		yes	Land	N/A		Research	Yes
	Rogue waves (scale, severity and frequency)		yes	Water	N/A		Research	Yes

Data category	Specific data needed	Metric(s)	Applied Science?	Water, atmosphere, land?	Adaptation or mitigation?	Organisation	Research or experiment?	Accessible
Maritime weather/condition	Sea temperature	c	yes	Water	N/A		Research	Yes
	Current activity		yes	Water	N/A		Research	Yes
	Eutrophication potential		yes	Water	N/A		Research	Yes
	Seaweed health		yes	Water	N/A		Research	Yes
	Wave activity		yes	Water	N/A		Research	Yes
Sea level rise	Coastal erosion		yes	Land	Adaptation		Research	Yes
	Vulnerable infrastructure ($)	$	no	Land	Adaptation		Research	Yes
	Vulnerable communities		no	Land	Adaptation		Research	Yes
	Mean water level		yes	Water	N/A		Research	Yes
Natural resources	Ground water availability		yes	Water	Adaptation		Research	Yes
	Surface water availability		yes	Water	Adaptation		Research	Yes
	Coal imported	t	no	Land	Mitigation		Research	Yes
	Coal mined	t	yes	Land	Mitigation		Research	Yes
	Coal burned	t	yes	Land	Mitigation		Research	Yes

Data category	Specific data needed	Metric(s)	Applied Science?	Water, atmosphere, land?	Adaptation or mitigation?	Organisation	Research or experiment?	Accessible
	Oil and gas		yes	Land/Atmosphere	Mitigation		Research	Yes
Land use	Deforestation	area	yes	Land			Research	Yes
	Vegetation	area	yes	Land			Research	Yes
	Urban	area	no	Land	Adaptation		Research	Yes
	Rural	area	no	Land	Adaptation		Research	Yes
	Native tree planting	area / no.	yes	Land	Mitigation		Research	Yes
	Pine tree planting	area / no.	yes	Land	Mitigation		Research	Yes
	Ecosystem impact		yes	Land			Research	Yes
Natural events	Volcanic activity		yes	Land	N/A		Research	Yes
	Earthquakes		yes	Land	N/A		Research	Yes
	Tsunami		yes	Water	N/A		Research	Yes
	Wildfires		yes	Land/Atmosphere	N/A		Research	Yes
	Glacial melt		yes	Land	N/A		Research	Yes
	Landslides		yes	Land	N/A		Research	Yes
Biodiversity	Habitat loss	area	yes	Land			Research	Yes
	Ecosystem change		yes	Land			Research	Yes
	Population density		yes	Land			Research	Yes

Data category	Specific data needed	Metric(s)	Applied Science?	Water, atmosphere, land?	Adaptation or mitigation?	Organisation	Research or experiment?	Accessible
	Endangered species		yes	Land			Research	Yes
	Extinction rates		yes	Land			Research	Yes
Building materials	Concrete imported	t	no	Land	Mitigation		Research	Yes
	Concrete made	t	no	Land	Mitigation		Research	Yes
	Concrete used	t	no	Land	Mitigation		Research	Yes
	Steel imported	t	no	Land	Mitigation		Research	Yes
	Steel made	t	no	Land	Mitigation		Research	Yes
	Steel used	t	no	Land	Mitigation		Research	Yes
	Treated wood imported	t	no	Land	Mitigation		Research	Yes
	Treated wood made	t	no	Land	Mitigation		Research	Yes
	Treated wood use	t	no	Land	Mitigation		Research	Yes
Consumption	Waste	t	no	Land	Adaptation		Research	Yes
	Recycling	t	no	Land	Adaptation		Research	Yes
	Shifting consumer preferences				Adaptation		Research	Yes
Infrastructure	Sewerage			Land	Adaptation		Research	Yes
	Wastewater			Land	Adaptation		Research	Yes

Data category	Specific data needed	Metric(s)	Applied Science?	Water, atmosphere, land?	Adaptation or mitigation?	Organisation	Research or experiment?	Accessible
	Roads			Land	Adaptation		Research	Yes
	Airports			Land	Adaptation		Research	Yes
	Ports			Land	Adaptation		Research	Yes
	Bridges			Land	Adaptation		Research	Yes
	Tunnels			Land	Adaptation		Research	Yes
	Buildings			Land	Adaptation		Research	Yes
	Dams			Land	Adaptation		Research	Yes
	Railway lines			Land	Adaptation		Research	Yes
	EV charging stations			Land	Adaptation		Research	Yes
Shipping	Exports	$	no				Research	Yes
	Imports	$	no				Research	Yes
	Frequency		no				Research	Yes
	Fuel use	L	no				Research	Yes
Vehicles	Electric vehicles (% of total)	%	no		Mitigation		Research	Yes
	Import of electric vehicles		no		Mitigation		Research	Yes
	Combustion vehicles (% of total)		no		Mitigation		Research	Yes

Data category	Specific data needed	Metric(s)	Applied Science?	Water, atmosphere, land?	Adaptation or mitigation?	Organisation	Research or experiment?	Accessible
	Import of combustion vehicles		no		Mitigation		Research	Yes
Climate funding								
Stranded assets	Oil and gas (left in the ground)							
International obligations	ETS credits							

Appendix 5: Worksheets from ERP workshop

Source: McGuinness Institute[35]

Attachment 4 (Draft as at 18 May 10am)

Worksheet 1: Strategy mapping exercise

ERP Emissions Reduction Plan
Strategy Mapping Workshop

Purpose

Step 1: Select one of the budgets below.

- ☐ Emissions budget 1: 2022–2025
- ☐ Emissions budget 2: 2026–2030
- ☐ Emissions budget 3: 2031–2035

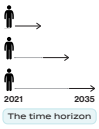


Table ES1: Our proposed emissions budgets. All gases are combined as CO_2 equivalent

	2018	Emissions budget 1 (2022 – 2025)	Emissions budget 2 (2026 – 2030)	Emissions budget 3 (2031 – 2035)
All gases, net (AR4) (Mt CO_2e)		271	286	223
Annual average (Mt CO_2e/year)	69.2	67.7	57.3	44.6
Average reductions on 2018 levels		2%	17%	36%

He Pou a Rangi Climate Change Commission, 2021 Draft Advice for Consultation, p. 17

Values

Step 2: Select the lens you will use for decision making.

- ☐ Māori/Crown relations
- ☐ Productive
- ☐ Resilient
- ☐ Inclusive
- ☐ Sustainable
- ☐ Other

Themes

Step 3: Select themes that will meet the purpose above (ideally 3–6).

Examples could include:

- ☐ Housing & urban reform
- ☐ Energy sector shift
- ☐ Land use adaptation & innovation
- ☐ Circular, low-emmissions economy
- ☐ Other
- ☐ Other
- ☐ Other
- ☐ Other

Goals

Step 4: Select a number of goals that fit logically under each theme (ideally 3–6).

Actions

Step 5: Select what actions are necessary to achieve each goal (ideally 3–6).

Requirements

Step 6: Select what requirements are necessary to ensure each action is achieved (ideally 3–6).

Questions to stress test your strategy

Step 7: Stress test your strategy map.

1. Complete the assumption mapping exercise (Worksheet 2). Does this change your themes, goals, actions or requirements?
2. Check that cause-and-effect relationships exist throughout the strategy map. Do this by going from the bottom of the strategy map to the top, reviewing each relationship along the way.
3. Place your hand over portions of the strategy map and see if alternative (less costly/more effective) themes, goals, actions or requirements exist.
4. Check that words are precise and familiar, and sentences are short and straightforward (apply the Write Plain Language Standard).
5. How would you know whether the strategy is working correctly? Do feedback loops exist?

Creating one integrated strategy map

Step 8: Combine all 3 strategy maps into one map.

Budget 1: 2022–2025 + Budget 2: 2026–2030 + Budget 3: 2031–2035 = Integrated Strategy Map

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Worksheet 2: Assumption mapping exercise

ERP Emissions Reduction Plan
Strategy Mapping Workshop

Explanation

An assumption map helps to test, validate or identify holes in the strategy (an assumption being an unchallenged input that shapes the strategy). It helps identify issues that could prevent the strategy from succeeding.

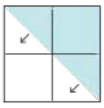
Step 1: Write down a list of assumptions that you think may exist. (e.g., use sticky notes – but not orange ones)

Step 2: Sort similar assumptions and then choose a high-level assumption to reflect the group (e.g., use an orange sticky note).

Step 3: First rank these high-level assumptions from top to bottom on the left of the diagram below by whether they have a high or low impact (magnitude) on the success of the strategy (use the orange sticky notes only on this worksheet).

Step 4: Second move these high-level assumptions across the diagram from left to right to show what is explicit (well recognised) and what is implicit (not well recognised).

Step 5: Now think about how you could move the assumptions from right to left and/or from top to bottom. Note: You will not be able to remove all assumptions, but by making them more explicit/transparent you are ensuring you know when you are taking a calculated risk. This will ensure when the strategy is reviewed or assessed, learnings can be made, and action can be taken early (saving money and time).



High magnitude

If the assumption is incorrect, it will impact the success of the strategy

Explicit ← How well acknowledged is the assumption? → Implicit

Low magnitude

If the assumption is incorrect, it will not impact the success of the strategy

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Endnotes

1 For more information on Report 9, see the McGuinness Institute website. Retrieved 21 March 2022 from https://www.mcguinnessinstitute.org/publications/project-2058

2 See University of Canterbury (UoC). (March 2022). International climate change panel needs more women, says lead author. Retrieved 21 March 2022 from https://www.canterbury.ac.nz/news/2022/international-climate-change-panel-needs-more-women-says-lead-author-.html

3 See McGuinness Institute. (2021). *Discussion Paper 2021/01: Mission Aotearoa Mapping our Future*, p. 8. Retrieved 21 March 2022 from https://www.mcguinnessinstitute.org/publications/discussion-papers

4 See McGuinness Institute. (2021). *Working Paper 2021/01 – Timeline of climate change institutions and instruments since 1980*, p. 2. Retrieved 21 March 2022 from https://www.mcguinnessinstitute.org/publications/working-papers

5 See Ministry of Business, Innovation and Employment (MBIE). (September 2019). *New Zealand's Research, Science & Innovation Strategy: Draft for Consultation*, p.4. Retrieved 8 March 2022 from https://www.mbie.govt.nz/dmsdocument/6935-new-zealands-research-science-and-innovation-strategy-draft-for-consultation

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7 See New Zealand Productivity Commission. (April 2021). *New Zealand firms: Reaching for the frontier. Final report*, p. 145. Retrieved 8 March 2021 from https://www.productivity.govt.nz/assets/Documents/Final-report-Frontier-firms.pdf

8 See Endnote 7.

9 See Ministry of Business, Innovation and Employment (MBIE). (July 2020). *Te Pae Kahurangi: Positioning Crown Research Institutes to collectively and respectively meet New Zealand's current and future needs*, p. 2. Retrieved 8 March 2022 from https://www.mbie.govt.nz/assets/te-pae-kahurangi-report.pdf

10 See Ministry of Business, Innovation and Employment (MBIE). (July 2020). *Te Pae Kahurangi: Positioning Crown Research Institutes to collectively and respectively meet New Zealand's current and future needs*, p. 35. Retrieved 8 March 2022 from https://www.mbie.govt.nz/assets/te-pae-kahurangi-report.pdf

11 See Ministry of Business, Innovation and Employment (MBIE). (July 2020). *Te Pae Kahurangi: Positioning Crown Research Institutes to collectively and respectively meet New Zealand's current and future needs*, p. 25. Retrieved 8 March 2022 from https://www.mbie.govt.nz/assets/te-pae-kahurangi-report.pdf

12 See Parliamentary Commissioner for the Environment. (December 2020). *A review of the funding and prioritisation of environmental research in New Zealand*, p. 3. Retrieved 8 March 2022 from https://www.pce.parliament.nz/media/197111/report-environmental-research-funding-review-pdf-32mb.pdf

13 See Endnote 12.

14 See Endnote 12.

15 See Parliamentary Commissioner for the Environment. (December 2020). *A review of the funding and prioritisation of environmental research in New Zealand*, p. 60. Retrieved 8 March 2022 from https://www.pce.parliament.nz/media/197111/report-environmental-research-funding-review-pdf-32mb.pdf

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24 See Endnote 23.

[25] See Endnote 23.

[26] See T. Kukutai, T. McIntosh, A. Boulton, M. Durie, M. Foster, J. Hutchings, M. Mark-Shadbolt, H. Moewaka Barnes, T. Moko-Mead, S.-J. Paine, S. Pitama and J. Ruru. (2021). *Te Pūtahitanga: A Tiriti-led science-policy approach for Aotearoa New Zealand.* Auckland: Ngā Pae o te Māramatanga, p. 10. Retrieved 8 March 2022 from http://www.maramatanga.co.nz/sites/default/files/CB_TePutahitanga_A4_2021_inner_Digital_final.pdf

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[32] See New Zealand Crown Research Institutes. (1 September 2021). *Pathways to the Future: A strategy to lift the positive impact of science on Aotearoa New Zealand's economy, environment, society and cultures*, p. 26. Retrieved 8 March 2022 from https://niwa.co.nz/sites/niwa.co.nz/files/Pathways_to_the_future_of_NZ_Science.pdf

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