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Report 9b

2058

A History of Government-funded Science 2009–2011

Background report to Report 9: Government-funded Science Under the Microscope

MCGUINNESS INSTITUTE

Project 2058: Report 9b

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About the Institute The McGuinness Institute is an independently funded non-partisan think tank. The main work programme of the Institute is *Project 2058.* The strategic aim of this project is to promote integrated long-term thinking, leadership and capacity-building so that New Zealand can effectively seek and create opportunities and explore and manage risks over the next 50 years. It is hoped that *Project 2058* will help develop dialogue among government ministers, policy analysts and members of the public about alternative strategies for the future of New Zealand.

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Preface

The game of science is, in principle, without end. He who decides one day that scientific statements do not call for any further test, and that they can be regarded as finally verified, retires from the game.

Karl Popper, 1959

In 1959 the philosopher Karl Popper published the English-language version of his influential book *The Logic of Scientific Discovery*, which had appeared in German in 1934. In it he argued the case for science based on falsifiability. Although born in Vienna, Popper had exiled himself to New Zealand in 1937, and he remained in this country until 1946. Fifty years on from the publication of *The Logic of Scientific Discovery*, science – in New Zealand as in other countries – relies on an often complex system of support from both the public and private sectors. As with the 'game of science' itself, the way in which we support it also requires testing.

As this report shows, the New Zealand science system has undergone substantial change over the last two years. On the whole, most of the changes appear to be in the right direction, but it is too soon to tell what effects they will have on the science that is undertaken here, or the outcomes that will result.

In order to understand the broader sweep of changes that publicly funded science in New Zealand has experienced, this report should be read alongside Report 9: *Government-funded Science Under the Microscope: Working towards a National Sustainable Development Strategy* (SFI, in press). The following background report and working papers are also intended as supporting publications to Report 9:

- Report 9a: *A History of Government-funded Science from 1865–2009* (SFI, 2009a);
- 2009/05: *Exploring New Zealand and International Government-funded Science Goals* (SFI, 2009b);
- 2010/01: *Exploring Long-term Policy Drivers in Science: A scan of international think tanks* (SFI, 2010);
- 2011/14: *MSI Innovation Investment Board: Legislation, operation and board membership* (SFI, 2011a);
- 2011/15: *MSI Science Investment Board: Legislation, operation and board membership* (SFI, 2011b);
- 2011/17 *New Zealand Universities: Research activities, commercialisation and international benchmarking* (SFI, 2011c);
- 2011/18 *New Zealand Crown Research Institutes: Legislation, operation, and governance* (SFI, 2011d).

Given the changing nature of science, and the society that supports it, no science system can be regarded as definitive. As Popper also observed, '... no matter how many instances of white swans we may have observed, this does not justify the conclusion that all swans are white.' This report describes the science system as it is at present, so that we may consider the future science we will need and, to enable this, the system we will require. The future is discussed in Report 9, *Government-funded Science under the Microscope* (SFI, in press).

During the preparation of this package of reports a number of eminent thinkers have generously offered their time, thoughts and opinions as peer reviewers. In particular, we offer our sincere thanks to Dr Caroline Saunders, Professor Harlene Hayne, Professor Jack Heinemann, Dr Jacqueline Rowarth, James Palmer, Professor Jeff Tallon, John Lancashire, Dr Morgan Williams, Dr Steve Thompson and Sophie Howard. It is important to note, however, that all errors, omissions and matters of opinion remain those of the authors. Further, this report does not necessarily reflect every idea or view raised by the external reviewers, nor would they necessarily agree with every recommendation contained in the report. This being said, the report would not be the document it is today without their input. Lastly, I wish to acknowledge and thank my co-author Dr Robert Hickson, and the research team of Joe McCarter, Mark Newton, Chris Aitken and Diane White, without whom this report could not have been written.

Wendy McGuinness
Chief Executive

Executive Summary

The aim of this report is to provide an overview of the changes that have occurred in New Zealand's government-funded science system between 2009 and 2011, so to inform the content of a National Sustainable Development Strategy.[1]

The methodology is discussed in Section 2, which includes a discussion on terminology and a brief statement on the limitations and boundaries of the research. The principle method adopted during the researching of this report was a literature review, which was supplemented by feedback from external reviewers.

Section 3 presents a review of the major changes to the government-funded science system between 2009 and 2011. The recommendations made in 2008 by the Royal Society's National Science Panel are noted and subsequent changes to the science system by the National-led government are described. The changes to the system in the last two years have been described as the biggest changes since the creation of the Crown Research Institutes (CRIs) in 1992. The major changes include the creation of a Ministry of Science and Innovation (combining previously separated policy and funding roles), reducing contestability in the science system, providing clearer goals and accountability for the CRIs, a greater focus on economic outcomes and the creation of the role of the Prime Minister's Chief Science Advisor.

We end the review by noting the extent to which the National Science Panel's recommendations have been implemented. It is too soon to conclude whether the recent changes to the science system will have the desired effect of enhancing the quality and relevance of publicly funded science in New Zealand. The government's 2010 report *Igniting Potential: New Zealand's science and innovation pathway* (MoRST, 2010a) describes the changes and future direction of the science system. However, while the principles described in *Igniting Potential* provide a good foundation upon which to build a better-performing science system, the report does not go the extra step in establishing a formal science and innovation strategy.

The next report in this series – Report 9, *Government-funded Science Under the Microscope* – describes what additional improvements to the publicly funded science system the Sustainable Future Institute considers necessary to meet the challenges and opportunities New Zealand will face in the coming decades.

1 For an explanation of what a National Sustainable Development Strategy is, see SFI, 2007: 8–9.

1. Purpose

The purpose of this background report is to provide information on the changes that have occurred within the government-funded science system between 2009 and 2011, then to explore the institutions and methods set up to increase the effectiveness of the system, so as to inform the content of the Institute's Report 9, *Government-funded Science under the Microscope: Working towards a National Sustainable Development Strategy* (SFI, in press). The history of the government-funded science system up to 2009 is covered in Report 9a, *A History of Government-funded Science from 1865-2009* (SFI , 2009a). These reports all form part of the Institute's work programme *Project 2058*.

1.1 Project 2058

The strategic aim of *Project 2058* is to promote integrated long-term thinking, leadership and capacity-building so that New Zealand can effectively seek and create opportunities, and explore and manage risks, over the next 50 years. In order to achieve this aim, the *Project 2058* team are working to:

1. Develop a detailed understanding of the current national planning landscape, and in particular the government's ability to deliver long-term strategic thinking;
2. Develop a good working relationship with all parties that are working for and thinking about the 'long-term view';
3. Recognise the goals of iwi and hapū, and acknowledge te Tiriti o Waitangi;
4. Assess key aspects of New Zealand's society, asset base and economy in order to understand how they may shape the country's long-term future, such as government-funded science, natural and human-generated resources, the state sector and infrastructure;
5. Develop a set of four scenarios to explore and map possible futures;
6. Identify and analyse both New Zealand's future strengths and weaknesses, and potential international opportunities and threats;
7. Develop and describe a desirable sustainable future in detail, and
8. Prepare a *Project 2058* National Sustainable Development Strategy. (SFI, 2009c: 3)

This report is designed to help progress the fourth point above.

1.2 The Sustainable Future Institute

Earlier work by the Institute has indicated that New Zealand is well behind on its international obligations to develop and implement a National Sustainable Development Strategy (NSDS) (SFI, 2007: 2). The creation of an NSDS requires consideration of where New Zealanders would like to be as a country and what challenges lie ahead. Dealing with these challenges is often complex and requires large-scale change, much of which may be beyond our control. It involves planning for a desired future, while acknowledging our weaknesses and looking for solutions to the problems we envisage will be encountered along the way. With this in mind, this report is a step towards the Sustainable Future Institute's goal of creating an NSDS for New Zealand and an integral component of *Project 2058*.

2. Methodology

The methodology for this report sits within the wider methodological framework that is discussed in *Project 2058 Methodology: Version 3* (SFI, 2009c). Thus, the general methodology of *Project 2058* informs the methodology of Report 9, *Government-funded Science under the Microscope: Working towards a National Sustainable Development Strategy* (SFI, in press), which in turn informs the methodology underlying this background report, Report 9b.

This report looks at the changes to the government-funded science system that have been introduced by the National-led government since 2009. These changes are still being implemented and we recognise that a detailed analysis of their implications is premature. The purpose of this report is to describe how the focus and management of publicly funded science in New Zealand has changed over the last three years.

2.1 Terminology

For the purposes of this report, 'government-funded science' refers to science for which financial support is provided directly by the government. No highly specific definition can be made due to the great changes in the mechanisms by which government support has been delivered over the history of science in New Zealand. These mechanisms have ranged from grants made to individual science organisations in the 1860s to the complex Vote Science & Innovation (Vote S&I) arrangement in existence today. While Vote S&I currently forms the bulk of government funding for science in New Zealand, smaller amounts also come from other appropriations, such as Vote Tertiary Education, Vote Agriculture and Forestry, and Vote Health.

Government legislation also enables five industry research levies for heavy engineering, building, dairy, meat and wheat (MSI, 2011b). Although overseen by the Ministry of Science & Innovation (MSI), each levy is collected and utilised separately by the relevant industry association. The focus of this report is on government funding of MSI (and its predecessors, the Ministry of Research, Science and Technology [MoRST] and the Foundation for Research, Science & Technology [FRST]), Crown Research Institutes (CRIs), and other spending through Vote S&I, therefore research levies are not examined further.

The following definition of research and development (R&D) has been taken from Statistics New Zealand (2008) and is based on international best practice:

> Research and experimental development comprises creative work undertaken on a systematic basis in order to increase the stock of knowledge. Any activity classified as R&D is characterised by originality. Investigation is a primary objective. (Statistics New Zealand, 2008: 2)

For the purposes of this report, the meanings of 'research', 'science' and 'technology' are those used in the Crown Research Institutes Act 1992, as set out at s 2:

> *research* means scientific research; and includes scientific development and related services
>
> *science* includes the physical sciences, the biological sciences, and the social sciences; and also includes *technology*; and scientific has a corresponding meaning.

2.2 Limitations and Boundaries

The issues addressed in this report are significant in their complexity and scale, and as such provide a starting point for much deeper analysis and discussion. Government-funded science can take many forms, so while this report focuses on New Zealand's major milestones in a developing science sector, other forms of scientific research and advancement have occurred within specific commercial and educational settings. The report does not attempt to discuss or take into consideration privately funded science; that is, research undertaken by public or private organisations that is funded by the private sector. We do recognise that privately funded science and research is also an important component of the country's science system. Therefore, while we have restricted ourselves to the publicly funded component, we note the need for privately funded science and research to be studied and taken into account.

3. Government-funded Science from 2009 to 2011

The basis for the development of this new era in the government-funded science system began in 2007 with the publication of the OECD's review of New Zealand's innovation policy (OECD, 2007). While the report noted strengths in New Zealand's innovation system, it also described areas for improvement (see Table 1). The need for changes to be made to the science system to improve its effectiveness was further reinforced the following year when the New Zealand Royal Society's National Science Panel released *A Science Manifesto* (described as 'a plan for the recovery of New Zealand science').[2] The panel identified the following 10 initiatives as central to renewing New Zealand's national science system:

1. Develop a national science strategy;
2. Establish an office of the chief scientist;
3. Enhance innovation policy;
4. Ensure that government policy processes are evidence-based;
5. Reduce transaction and compliance costs;
6. Continue to increase both public and private RS&T investment;
7. Improve the path to commercialisation;
8. Promote science across the entire education system;
9. Build national recognition of the public value of science; and
10. Trust science, scientists and scientific institutions. (National Science Panel, 2008: 5–9)

The government of the day did not formally respond to the National Science Panel's *Manifesto*. However, the National-led government elected in November 2008 introduced a range of science reforms that addressed issues raised by both the OECD and the National Science Panel. These are briefly noted in the following sections, and progress toward implementing each recommendation (as at October 2011) is described in Section 3.5.

Table 1: Strengths and Weaknesses in New Zealand's Innovation System Identified by the OECD
Source: OECD, 2007: 11–14

Note: Table 1 is not an exhaustive list of all the strengths and weaknesses identified by the OECD

Strengths	Weaknesses
Basic conditions for entrepreneurship and innovation are good	Shortcomings in physical and virtual infrastructure (such as land transport and broadband connections)
Most aspects of framework conditions are conducive to innovation	Lack of investment in business R&D
Government is aware of the importance of science and technology	Barriers to business growth, such as cost to access international markets and the prevalence of 'lifestyle businesses' which are interested in limited growth
New Zealand has a predictable policy environment and a competent public administration	Shortcomings in the process of technology diffusion and adoption
Good skills and capabilities in CRIs and universities	Lack of management, marketing and distribution skills
Competitive natural resource-based sectors	Fragmented system of government support for R&D
Pockets of excellence in emerging industries, such as software and other creative industries	Inadequate incentives for public sector research organisations
	Excessive reliance on a few policy principles

2 The members of the National Science Panel were Dr Jim Watson (Chair), Dr Mike Boland, Professor Carolyn Burns, Professor Marston Conder, Professor Sally Davenport, Professor Peter Gluckman, Professor Stephen Goldson, Professor Harlene Hayne, John Lancashire, Professor Caroline Saunders and Professor Jeff Tallon (National Science Panel, 2008: 2).

3.1 Appointment of the Prime Minister's Chief Science Advisor, May 2009

The 2009 appointment of the Prime Minister's Chief Science Advisor has proven to be an important development for the New Zealand science system. Professor Sir Peter Gluckman, who currently holds the position, has stated that in this role he is '[not] a lobbyist for the scientific community or for scientists or for universities or CRIs. I can only be a lobbyist for New Zealand; I am in this role to help the PM and his advisors use science best to advance New Zealand' (Gluckman, 2009a: 2). Based on these comments, the stated purpose of the role is in line with the intent of an NSDS and will aid in the recognition of science as an important part of any future government strategies.

Since taking up this role, Professor Gluckman has made multiple public statements and speeches regarding the need to change the management structure, philosophy and approach to undertaking science in New Zealand (see Gluckman, 2009a; 2009b; 2009c; 2009d; 2010a; 2010b). These statements in general provide independent support for the proposals put forward in this report, and if followed should aid the implementation of an effective NSDS. Of particular note is Professor Gluckman's work with the Prime Minister, the Minister of Research, Science and Technology and the science sector to develop the New Zealand science strategy document *Igniting Potential* (MoRST, 2010a).

3.2 Crown Research Institute Taskforce

In October 2009, the government initiated a CRI Taskforce to 'examine how CRIs can best deliver on the Government's economic priorities and respond to the needs of research users, particularly industry and business' (Mapp, 2010). The Taskforce came back in February 2010 with what was described as 'the most comprehensive review of the value of CRIs in our near 20-year history' (Morgan, 2010). The Taskforce's report, *How to Enhance the Value of New Zealand's Investment in Crown Research Institutes*, made 27 recommendations to the government and proposed a number of specific actions to address the members' concerns about the existing system. An underlying theme of the recommendations was the need to strengthen and improve the effectiveness of the linkages between CRIs and stakeholders (CRIT, 2010: 9), which would enable the CRIs to make a greater contribution both to the economy and to the wider science sector. Broadly, the recommendations focused on: providing greater certainty of purpose for CRIs; reducing contestability within the system and encouraging collaboration; increased accountability for non-contestable funding; improved governance of CRIs, and greater collaboration between CRIs and the wider science and research system (ibid.: 11–13).

In March 2010, the government responded to the Taskforce's recommendations through the Cabinet Economic Growth and Infrastructure Committee. In its *Crown Research Institute Taskforce Report: Government response*, it endorsed the overall intent of the recommendations (CEGIC, 2010: 1) and agreed that the government should provide greater clarity on the role and purpose of each CRI. It also agreed that government should provide greater certainty of funding for CRIs, reflecting a wider move away from purely contestable funding in the RS&T system. It supported the push to strengthen CRI board accountability and agreed to put in place balanced performance indicators to help measure the success and national benefit of the CRIs (ibid.: 25–28).

With a view to increasing collaboration and reducing contestability within the system, the government identified the need for 'a significant behavioural shift in the CRIs, in particular a reduction in the use of competition to drive performance, and a shift of responsibility to the CRIs' boards to lead and be held accountable for their results' (Mapp, 2010).

The recommendation the government viewed as 'most contentious' was to combine science policy, long-term funding, some contestable funding, infrastructure funding and CRI ownership monitoring into one entity (CEGIC, 2010: 28). While the government supported reducing the fragmentation in science policy, its response to the Taskforce's recommendations stated: 'Ministers may have concerns about the ability of agencies to effectively manage this change' (ibid.). The government also expressed concern about some of the recommendations relating to technology transfer and infrastructure, noting that actively discouraging CRIs from investing in commercialisation could in some instances limit legitimate options for transferring knowledge (ibid.: 26).

In June 2010, MoRST released a plan for implementation of the recommendations of the Taskforce that were supported by the government. The implementation will be complete in time to allow CRIs to operate under new settings in the 2011/2012 financial year (MoRST, 2010c: 2). Further, under the new system it is envisaged that by 2012:

- CRIs will be responsive to end-users and stakeholders;
- CRIs will be agile and innovative;
- CRIs will collaborate to ensure New Zealand has the best teams working on New Zealand's big science problems;
- CRIs will focus on New Zealand rather than the institution's bottom line;
- New Zealand's CRIs will be recognised both nationally and internationally as experts at the forefront of their field;
- CRIs will proactively connect knowledge and technology for the benefit of New Zealand;
- CRIs will provide open and accessible infrastructure for New Zealand; and
- There will be evidence of performance improving across the whole organisation. (MoRST, 2010d)

3.3 Creation of a New Science and Innovation System, May 2010

The creation of a new science and innovation system, documented in *Igniting Potential: New Zealand's science and innovation pathway* (MoRST, 2010a), is an important change to New Zealand's government-funded science system. *Igniting Potential* lays out a cohesive vision of what is expected from science in New Zealand and describes, in broad terms, how to achieve these goals. Some of the key aspects of the strategy are summarised below.

The strategy outlined in *Igniting Potential* sets out three principles to guide investment in science: (i) general principles; (ii) priority-setting principles, and (iii) operational principles.[3]

Igniting Potential sets out *general* principles for funding science as follows: a science system based on scientific excellence and impact; investment in research to enhance economic growth, society and environmental health; recognition of the particular interests of New Zealand; development of a full scientific value chain from discovery to exploitation; flexibility to respond to unexpected results, and discontinuation of funding where science does not show results or promise (MoRST, 2010a: 10).

To determine the allocation of scarce resources the government decided that funding for science should be *prioritised* as follows: investments that ensure scientific talent is retained and able to operate to their fullest potential; investment in areas where New Zealand has competitive advantages; investments that ensure a balanced programme, and investment that builds international partnerships (ibid.).

To guide the operation of the science system *Igniting Potential* sets out three *operational* principles: a transparent, responsive science system with minimal compliance costs and effective accountability; a mix of competitive and strategic funding tools for basic, applied and translational research, and efficiency encouraged and duplication discouraged (ibid.).

Together these general, priority-setting and operational principles will be relied upon to guide the development and operation of New Zealand's science system.

Within *Igniting Potential* the following *research priority areas* were identified following a consultation process:

- high-value manufacturing and services
- biological industries
- energy and minerals

3 In addition to the general guidance provided by *Igniting Potential*, there are several central government documents specific to particular areas of scientific research in New Zealand. According to MoRST (2007a) public investment in certain areas of science had been guided, where relevant, by the following MoRST strategies, which form the *Roadmaps for Science* series of documents: the Energy Research Roadmap; Nanoscience and Nanotechnologies Roadmap; Biotechnology Research Roadmap and Environment Research Roadmap. Under the 2011 merger of MoRST and FRST these responsibilities are currently being transferred to the MSI and information is not yet available as to their degree of continuity under the new scheme.

- hazards and infrastructure
- environment
- health and society. (ibid.: 16–17)

3.4 Ministry of Science and Innovation, February 2011

The single most significant change to the science system was the merger of MoRST and FRST into a single agency, the Ministry of Science and Innovation (MSI), responsible for both science policy and science purchase. This change was based on recommendations from both the CRI Taskforce (CRIT, 2010) and the report of the State Services Commission (SSC, 2010). Interestingly, at this time, a merger between MoRST and the Ministry of Economic Development was also considered and a number of points in favour of this merger were noted. However, this option was not adopted, but also not discounted as a future further change (SSC, 2010: 1).

The new Ministry is part of a broader government focus on increasing the research, science and technology sector's contribution to growth. The Minister notes that the goal is to support innovative thinking, and to connect that thinking with businesses in order to develop new products and services for global markets. This would enable MSI to act as a far more effective bridge between science and industry (Mapp, 2011).

The Ministry of Science and Innovation officially came into existence on 1 November 2010, and it took over the full responsibilities of MoRST and FRST on 1 February 2011 following the passing of the State Sector Management Bill on 11 December 2010. The merger also required amendments to the Foundation for Research, Science, and Technology Act 1990 to transfer FRST's powers to the new Ministry. The establishment of the Innovation Board and the Science Board and other related notices, including the investment criteria, are set out in the *New Zealand Gazette* (the *Gazette*) (DIA, 2011).

As we go to print, the MSI website does not set out a clear strategic goal for the new entity, although it does indirectly refer to its role as transferring knowledge and technology from the science to the business sector:

> MSI is the lead agency charged with driving the science and innovation sector. It is also tasked with directing knowledge and technology transfer from the science and innovation sector to businesses and other research users.
>
> MSI was created from merging two other agencies – the Foundation for Research, Science and Technology and the Ministry of Research, Science and Technology. It is responsible for the policy and investment functions of both those agencies.
>
> MSI has some key roles and functions such as advising the Government on New Zealand's science and innovation system, overseeing science and innovation investment and supporting infrastructure and fostering commercialisation, enhancing productivity and achieving wider benefits for New Zealand through the application of research results. (MSI, 2011a)

A new era in government-funded science is now established, and it is timely to reflect on the checks and balances that need to be added to the system to ensure optimal outcomes. For more on this issue, see the discussion in Section 4 of Report 9 (SFI, in press).

3.5 Current Status of the National Science Panel Recommendations and addressing OECD review

In 2010 and 2011, the government-funded science system was a system in transition. The 10 initiatives of the National Science Panel (2008: 5–9) have, in principle, been adopted, or progress has been advanced where the outcome has a long-term outlook. The following table documents the progress to date of the 10 recommendations. Further, some of the broader issues identified by the OECD innovation review (OECD, 2007) are also being addressed – such as improving infrastructure. A review of the high-value manufacturing sector in New Zealand has been undertaken, but not yet released,[4] and this may identify ways of improving technology transfer. Other barriers noted by the OECD, such as the cost of accessing international markets, attitudes of businesses to growth, and lack of coordination in other areas of policy (such as encouraging foreign direct investment) still require attention.

4 See MSI (2011b), *Improving R&D Support to the High-tech Sector*.

Table 2: Progress in Implementing the Recommendations of the National Science Panel as at October 2011
Source: (National Science Panel, 2008: 5–9)

Recommendation	Implementation of Recommendation
Development of a national science strategy	Partially addressed in the release of *Igniting Potential* (MoRST, 2010a), which describes recent changes and identifies the next steps in improving the science system.
Appointment of a chief scientist	Implemented May 2009.[5]
Enhance innovation policy	A new Ministry of Science and Innovation was established in November 2010, and became operational from 1 February 2011.
Ensure that government policy processes are evidence-based	In making this recommendation, the National Science Panel noted: 'To ensure that government initiatives are not misdirected and resources wasted, New Zealand must have its best researchers involved in government's wider policy processes, providing input to policy and legislation' (National Science Panel, 2008: 6). An example of this approach is the report *Improving the Transition: Reducing social and psychological morbidity during adolescence* (OPMCSAC, 2011).
Reduce transaction and compliance costs	The creation of the Ministry of Science and Innovation and the allocation of more core funding to CRIs addresses this in part.
Increase both public and private investment in RS&T	Budget 2009 increased funding to the Marsden Fund, the Health Research Council, and the CRI capability Fund,[6] while in Budget 2010 $234 million (over four years) – a mixture of new and reprioritised funding – was allocated to support business research and development.[7] In the 2011 Budget no new funding was allocated to science, but $24 million (over four years) was reprioritised to support business R&D.[8] The government disestablished the R&D tax credit scheme introduced by the previous Labour government and replaced it with Technology Transfer Vouchers and Technology Grants as a means to incentivise private sector R&D.
Improve the path to commercialisation	In a speech on 'Research, Science and Technology Priorities' in August 2009, the Research, Science and Technology Minister, Dr Wayne Mapp, spoke of the government's intention to 'improve the ability of businesses to connect with scientists and to pull science through to realise commercial opportunities' (Mapp, 2009). Science budget (re)allocations in 2010 and 2011 focused on technology transfer and commercialisation. One of the roles of MSI is to foster commercialisation, and this is evident in the establishment of a National Network of Commercialisation Centres (see discussion in Section 4 of Report 9 (SFI, in press).
Promote science across the entire education system	*Igniting Potential* recognises the need to promote science more broadly. Further, the appointment of the Chief Science Advisor in part addresses this recommendation (MoRST, 2010a).
Build national recognition of the value of science	As above, *Igniting Potential* recognises and partly addresses this need (MoRST, 2010a).
Trust science, scientists and scientific institutions	The introduction of core funding for CRIs, through which they are able to decide what research to undertake to meet national objectives, also reflects this recommendation.

5 See Appendix 4 for the terms of reference of the Prime Minister's Chief Science Advisor, and the Advisor's website, www.pmcsa.org.nz, for more information.

6 See the 2009/10 Budget for Vote Research, Science & Technology, at http://www.morst.govt.nz/publications/a-z/b/budget/Budget-2009

7 See Budget 2010, Science and Innovation, at http://www.beehive.govt.nz/sites/all/files/Science_Innovation_onepager.pdf

8 See Budget 2011, Q&A, at http://www.msi.govt.nz/budget2011/QA

4 Conclusion

The government-funded science system has undergone significant reform between 2009 and 2011. The 2007 OECD review of New Zealand's innovation policy, together with the release of *A Science Manifesto* by the Royal Society's National Science Panel, provided a catalyst for the introduction of major changes to the structure, scope and functions of many key institutions within the science system. These included the appointment of the Prime Minister's Chief Science Advisor; the creation of a CRI Taskforce and the subsequent implementation of the Taskforce's recommendations; the release of *Igniting Potential*, the government's strategy for science and innovation in New Zealand; and the merger of MoRST and FRST into one body, the Ministry of Science and Innovation (MSI).

This period of substantial institutional change is not yet complete, hence any evaluation of the current system would be premature. As this report goes to print in October 2011, MSI is continuing to release further details of the new system and to implement changes, especially with regard to CRIs. Inevitably, there will be further changes and developments once these new structures and bodies become operational. Therefore, the full scale of the reforms is unlikely to be realised until at least 2012.

In Report 9 the Institute considers the scope for further change and the future of the government-funded science system. The report looks at how performance will be measured; what 'success' will look like for MSI and the wider science system, and which agency will be charged with this assessment. Further, the Institute is interested in whether *Igniting Potential* will be followed by more detailed strategy documents to provide a clear path for implementation. A strategy should include provisions for its review and details on the release of subsequent strategies. *Igniting Potential* identified several specific areas in which successive strategies will be released and the Institute awaits progress in these areas.

The Institute hopes these outstanding questions and concerns will be addressed within the ongoing reforms, so as to ensure the longevity and success of the new structure of New Zealand's science system.

Appendix 1 Policy Institutions

In addition to the newly established Ministry of Science and Innovation (MSI), which is discussed in this report, the following institutions are also involved in developing science policy.

i) Ministry of Economic Development

The Ministry of Economic Development (MED) formulates policy to administer Vote Economic, Industry and Regional Development. The Ministry's 2003 *Growth and Innovation Framework* (MED, n.d.[a]) was followed by the *Economic Transformation Agenda* (MED, n.d.[b]), which guided MoRST's investment policy. Implemented in 2006, the *Economic Transformation Agenda* aimed to lift New Zealand into the top half of economic performers in the OECD, place innovation much more at the core of government economic policy (OECD, 2007: 157), and foster New Zealand's progress 'to a high income, knowledge-based market economy, which is both innovative and creative, and provides a unique quality of life to all New Zealanders' (MED, n.d.[b]). The *Economic Transformation Agenda* has now been superseded by the *Economic Growth Agenda* (MED, 2010), aimed at creating 'an environment that allows businesses to grow, export and create high-value jobs'.

ii) Ministry of Education

The Ministry of Education is the government's lead advisor on the education system. It creates policy that directs the management of research funds (such as the Performance-Based Research Fund, and the Centres of Research Excellence Fund) administered by the Tertiary Education Commission. It also provides support to primary school teachers in their delivery of science in the curriculum, and publishes other reports that discuss the integration of science in our education system.

iii) The Ministry of Agriculture and Forestry

The Ministry of Agriculture and Forestry (MAF) invests in a number of science and research projects through the Sustainable Farming Fund. In 2009, with the introduction of the Primary Growth Partnership worth a total of $190 million over four years, MAF's role as an important policy/purchase agent of public RS&T funds increased greatly. The Primary Growth Partnership is allocated to MAF through Vote Agriculture and Forestry, and will be invested in partnership with business provided it can be matched dollar for dollar.

iv) Other ministries

Other RS&T policy development agencies include the Ministry for the Environment (MfE), the Ministry of Fisheries (MFish; now part of the Ministry of Agriculture and Forestry), the Ministry of Health and the Ministry of Social Development. As well as policy creators for RS&T, these ministries are also purchasers of RS&T. Each government body administers its own fund; for example, MfE oversees the Waste Minimisation Fund and MFish administers the Environmental Certification Fund.

Appendix 2 Purchase Institutions

The Tertiary Education Commission

Vote Education funds are allocated on behalf of the government by the Tertiary Education Commission (TEC). Investment is guided by the provisions outlined in the *Tertiary Education Strategy 2007–12* (MoE, 2006: 2). TEC administers the Performance-Based Research Fund, which in 2011/12 will provide $250 million of contestable research funds to Tertiary Education Organisations (TEOs) (Treasury, 2011: 309). TEC also administers funding for Centres of Research Excellence, which provide collaborative research between public and private sector organisations; in 2011/12 these funds will total $33.7 million (ibid.).

The Health Research Council of New Zealand

The main function of the Health Research Council of New Zealand (HRC) is to allocate funding on behalf of the government for the purpose of implementing national health research policy. The HRC is a Crown entity and its operations are governed by the Health Research Council Act 1990. Section 4 of the Act states that the aim of the HRC is to 'improve human health by promoting and funding health research'. The HRC's RS&T investments are primarily funded through Vote S&I (formerly Vote RS&T, and totalling $82.24 million in 2009/10), and to a lesser extent through Vote Health ($0.29 million in 2009/10) and other sources ($1.35 million in 2009/10) (HRC, 2010: 2). Pursuant to s8(3) and s6(g) of the Act the HRC's council has the powers of a board of directors, and is accountable to the Minister of Health, who maintains a close relationship with the Minister of Research, Science and Technology. The boundaries of this relationship are set out in a Memorandum of Understanding. Funding is allocated to a broad range of health-related research areas, including biomedical, clinical, public health, and Māori and Pacific health.

The Royal Society of New Zealand

The Royal Society of New Zealand is an independent national academy of scientists. It has several functions:

> To foster in the New Zealand community a culture that supports science and technology, including (without limitation) the promotion of public awareness, knowledge, and understanding of science and technology; and the advancement of science and technology education;
>
> To encourage, promote, and recognise excellence in science and technology;
>
> To provide an infrastructure and other support for the professional needs and development of scientists and technologists;
>
> To establish and administer for members a code of professional standards and ethics in science and technology;
>
> To provide expert advice on important public issues to the Government and the community;
>
> To do all other lawful things which the Council considers conducive to the advancement and promotion of science and technology in New Zealand. (RSNZ, 2009)

The Royal Society receives funding from government for research contract management and science promotion services.

Other government agencies

A range of government agencies and other government bodies such as regional and local councils invest in RS&T. MoRST's *Our Strategy 2008–2011* stated the total 2006/07 investments as $65 million, comprising RS&T in Agriculture, forestry and fishing ($18m), Environment including local government ($15m), Health ($9m), Social ($8m), Māori knowledge and development ($5m), Defence ($5m), Infrastructure and energy ($3m), and Earth atmosphere ($2m) (MoRST, 2008a: 8).

Appendix 3 Provision Institutions

Crown Research Institutes

Crown Research Institutes (CRIs) were established in 1992 as government-owned businesses with a scientific purpose. Each institute is based around a productive sector of the economy or a grouping of natural resources (MoRST, 2010b).

Universities

New Zealand's eight universities are active providers of research, science and technology. Universities receive public funding from both MSI, through Vote Science and Innovation, and TEC, through the Performance-Based Research Fund. The total expenditure on Higher Education Research and Development (HERD) in New Zealand in 2010 was $802 million (Statistics New Zealand, 2011: 49). This expenditure on HERD represented 33% of all expenditure on Research and Development in New Zealand.

One of the primary functions of universities is to train postgraduate students, so that they are well adapted to provide basic research. It is estimated that 48% of all basic research undertaken in New Zealand is done at universities (MoE, 2011).

Research consortia

There are 14 research consortia funded by MSI, in which private sector partners match the Government's funding dollar-for-dollar. Research consortia provide collaborative, medium- to long-term research between at least two private-sector providers and one Crown Research provider. This pooling of knowledge, resources, skills and administration results in reduced transaction costs while building research capacity (Davis, 2006: 30). 'Consortia are designed to benefit their sector, through the transfer of knowledge and technology from research organisations, and to have a positive impact on the economy' (Templer, 2011).

Centres of Research Excellence

The government established the Centres of Research Excellence Fund to promote and undertake world-class research that contributes to New Zealand's economic development and incorporates knowledge transfer into training. The Centres of Research Excellence (CoREs) are 'all physically hosted within universities, but they have various partnership linkages with other institutions, particularly CRIs and other universities' (MoRST, 2007b: 1).[9] In this way, CoREs are a successful model of collaboration between research organisations. CoREs are funded principally by TEC through Vote Education. They can also receive funding through Vote Science & Innovation (from the Marsden Fund, the Health Research Council, and funds administered by MSI), other government departments (such as MAF) and through private investment. In 2011/12 CoREs will receive $33.7 million in public funds from the Centres of Research Excellence Fund through Vote Education (Treasury, 2011: 309).

Independent research organisations

Independent research organisations also provide RS&T in New Zealand. These non-government, industry-linked organisations provide research primarily for industry, and have a strong ability to facilitate research and technology transfer. They may receive the majority of their funding through commercial income, industry levies, charitable donations or from public monies via contestable funds (IRANZ, n.d.). Independent research organisations include the Building Research Association of New Zealand (BRANZ), Dairy NZ, the Heavy Engineering Research Association, the Malaghan Institute of Medical Research and the Cawthron Institute.

Whare wānanga

Whare wānanga are government-funded Māori tertiary education institutions. The purpose of the three whare wānanga is to create a significant entrance point for Māori into the tertiary education system. Whare wānanga have close relationships with iwi, hapū and whānau, as well as with research institutions such as universities (MoRST, 2008b).

9 Eight CoREs have been established. They are concerned with: molecular ecology and evolution, at Massey University; molecular biodiscovery, at the University of Auckland; mathematics and its applications, at the University of Auckland (whose funding has not been continued); Māori development and advancement, at the University of Auckland; advanced materials and nanotechnology, at Victoria University of Wellington; human and animal growth and development, at the University of Auckland; advanced bio-protection technologies, at Lincoln University, and creation of new foods targeting health and wellbeing, at Massey University. For further information see http://www.acore.ac.nz/cores

Appendix 4 Terms of Reference of the Chief Science Advisor

The New Zealand government appointed a Chief Science Advisor (CSA) in May 2009. The terms of reference for the Chief Science Advisor's role are reproduced below (Gluckman, n.d.: 1, 2).

INDEPENDENT ADVICE

The CSA is appointed as a Ministerial Advisory Committee of one accountable to the Prime Minister.

The appointment will be subject to the fees framework and all aspects of the arrangement will require APH [Cabinet Appointments and Honours Committee] approval.

Appointment to a Ministerial Advisory Committee would be terminable at the will of the Prime Minister.

The CSA will provide independent advice to the Prime Minister and his Government on such matters as are from time to time included in an agreed work programme determined by the Prime Minister.

The CSA may propose matters for inclusion in the work programme.

Since advice will be subject to the OIA [Official Information Act] it would in most cases be released in due course or proactively published by government.

The OIA also applies to all workings of the Ministerial committee.

PUBLIC STATEMENTS

The CSA will conform to the **no surprises convention** in regard to all public statements on science that may be proposed whether made in the capacity of CSA or as a private citizen.

Public pronouncements on science matters by the incumbent while acting as CSA or in his private capacity will not be made without giving prior formal advice of the intention to release the information and its full content.

This extends to forewarning the Prime Minister as a matter of courtesy, of the intention to make a statement even in the incumbent's acknowledged areas of expertise.

Questions around managing Crown liabilities require that Government and Ministers retain the right to accept, reject or disagree publicly with any advice or public statements as they may see fit.

The CSA may from time to time speak with representatives of other political parties in connection with matters of science and his advice.

PROMOTION OF SCIENCE

The CSA wishes to engage in activities aimed at promoting the role of, the contribution to society from, and career opportunities available in Science. Such promotion of science generally is to be encouraged. Even so the **no surprises convention** would apply to any large scale initiative.

It may be that a systematic programme for promotion of science will be proposed and agreed perhaps in conjunction with other bodies (e.g. The Royal Society, IPENZ, TEC, MoRST, FRST, TVNZ, and NZ on Air etc).

Such an initiative would require Ministerial sponsorship, an Agency home and budgetary support through normal processes.

REPRESENTATION

From time to time the Prime Minister may request the CSA to undertake a representational role. The full terms and conditions of such an engagement will be specified at the time of making the request.

APPOINTMENT OF CSA TO OFFICIAL COMMITTEES

In all cases the potential for conflicts of interest in such appointments must be considered carefully and worked out fully before engagement.

To a considerable extent it is likely the influence of the CSA will be greatest if the incumbent remains outside the formal science system for the duration of incumbency.

The Minister of RS&T may with the prior agreement of DPMC [the Department of the Prime Minister and Cabinet] as the managing agency request one-off pieces of advice on key areas of interest from time to time.

EMPLOYMENT OF SUPPORT STAFF

DPMC will be the managing agency for the CSA role and will enter any relevant contracts since a Ministerial Advisory Committee can not be an employer or enter into contracts.

WORKING ARRANGEMENTS

Financial support for the role will be provided via a transfer from Vote RS&T.

Relevant support from the Ministry of RS&T will be channelled through the Minister of RS&T in the same way as requests for information from other ministers are handled by the Ministry of RS&T.

Budgetary and financial management will be as agreed between DPMC and the CSA.

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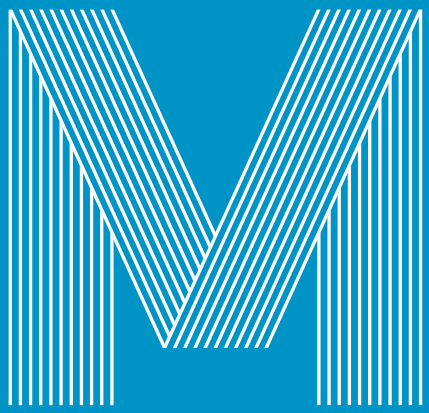

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