National Statement of Science Investment

2015–2025

OCTOBER 2015

MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT
HĪKINA WHAKATUTUKI

newzealand.govt.nz

Contents

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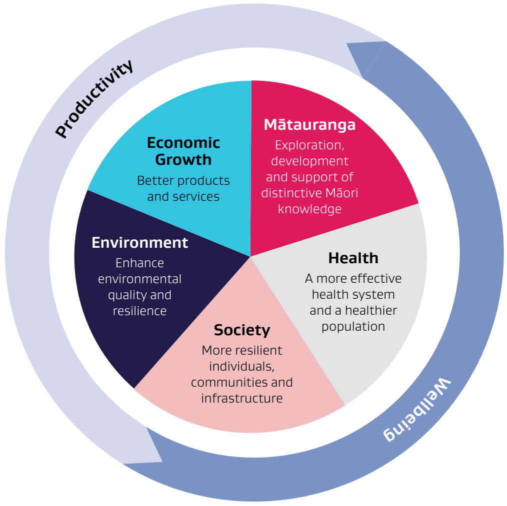
Minister's foreword

I am pleased to release this National Statement of Science Investment. The Government believes excellent, high impact science is fundamental to our ability to achieve excellent economic, environmental, social, and cultural outcomes for New Zealand. The National Statement of Science Investment sets out the Government's long-term vision for the science system, and a strategic direction to guide future investment.

New Zealand has a unique environment and biodiversity, fast-growing knowledge-intensive sectors, a distinctive and inventive culture, including mātauranga Māori, and world-leading concentrations of scientific expertise. New Zealanders typically embrace opportunities to connect internationally through trade and investment, to absorb new ideas from around the world and to contribute to the global pool of knowledge. Our international connections help us generate commercial gain from these strengths and spur innovative change here.



New Zealand is also a geographically isolated country with a small population. We face challenges in accessing markets offshore and in the depth of financial and human resources available domestically. Over the last few decades New Zealand's productivity growth has been slower than in many other advanced economies. The result is that the incomes of New Zealanders have lagged our comparator countries – although we have shrunk the gap in recent years.

Our current livelihoods are also particularly vulnerable to environmental shocks (eg biosecurity breaches, geological events, changes in climate), as well as economic shocks.

Science plays a central role in creating opportunities and solving problems. Our wellbeing, economy and environment will all benefit from greater application of new scientific knowledge by businesses, government agencies, communities and other end-users. As well as uncovering new opportunities, science is central in brokering the balance between the use of our rich, but finite natural resources for the benefit of New Zealanders today, and kaitiakitanga of this inheritance for the future.

Innovation will be the main mechanism through which we lift New Zealanders' productivity, prosperity and wellbeing. It will drive the generation of new ideas, approaches and ways of producing products or delivering services, and their subsequent application and diffusion. We must lift productivity by intensifying knowledge production and ensuring effective and widespread up-take.

New Zealand is experiencing significant demographic changes, including a growing and ageing population and increased diversity. This has implications for resource allocation and intergenerational equity. We must rise to the challenge of continuously improving health and living standards for all New Zealanders in the midst of these changes. Informing and supporting our decision-making with excellent, relevant research will be critical to making an impact.

For us to overcome our economic and geographic obstacles, capitalise on our unique assets and characteristics, and deliver a prosperous future for all New Zealanders, this Government recognises that our science system needs to be not just good, but better than comparable countries.

The National Statement of Science Investment sets out the Government's ten-year strategic direction for the science system. This Statement is the important first step in communicating and focusing our efforts on achieving these crucial outcomes for New Zealand. I encourage you to engage with the opportunity it presents.

Hon Steven Joyce
Minister of Science and Innovation

October 2015

Introduction

In May 2014, the Minister of Science and Innovation released a draft National Statement of Science Investment (NSSI) for public feedback. Much of the feedback received on the draft NSSI welcomed it as a description of the current science and innovation system, but consultees also asked for a document that was more focused on the future, and that contained a more comprehensive plan for science and innovation in New Zealand.

This final NSSI responds to that feedback. It is more forward looking and presents Government's vision for the future in a more specific way. It also presents a revised structure for this vision. Where the draft contained seven objectives, the final document contains a clearer description of what Government expects the growing science system to achieve, and a simpler vision statement for science and innovation funding in New Zealand. It relies mostly on two main 'pillars' as the means to achieve that vision: excellence and impact. Evidence for strong performance under these two pillars will be a prerequisite for further public investment.

The vision for 2025 is set out in **section 1** of the Statement.

Section 2 contains high-level analysis of the performance of the New Zealand science system.

Section 3 discusses the function of different parts of the system, that is, why the system is structured the way it is or, in some cases, how Government wants it to work in the future. These frameworks will inform how Government will think about and act in partnership with the science sector over the next 10 years.

Section 4 sets out future investment direction in some key areas, as well as the general future investment pathway. It also discusses investment in the people who work as part of the science system.

Section 5 describes how the many policy actions that are planned or already underway will contribute to delivering the vision for 2025, and sets out the guiding principles behind them.

Section 6 provides a timeline of the key actions and expected outcomes from our science investments.

One of the actions announced in **section 4** is Government's intention to publish an annual *Science and Innovation System Performance Report*. This will be a compendium that describes the science and innovation system and its performance in some depth. It will begin to provide the comprehensive evidence base needed by researchers, investors and other stakeholders. Given this planned investment, much of the descriptive information contained in the draft NSSI has not been repeated in section 2 and 3 of the NSSI but will be published and updated annually in the system performance report.

Many of those who responded to the consultation on the draft NSSI requested that the final document focus more on priorities and objectives, and on Government's plans to achieve them. The majority view was that a long-term national science strategy would create a more stable and predictable environment, even as further necessary change is implemented to raise and evaluate performance in the science system. It is with this view in mind that we have prepared the first NSSI.

GLOSSARY OF TERMS

BERD – Business expenditure on R&D; the total amount of R&D performed by business. This is a measure of R&D performed by business, rather than R&D funded by business. Business may receive this money from elsewhere, eg government grants administered by Callaghan Innovation.

Bibliometrics – the statistical analysis of publications. We use bibliometrics to provide quantitative analysis of academic literature, eg comparison of citation rates.

Comparative advantage – an economics term; comparative advantage exists where a producer can produce a good at a lower relative marginal cost compared to their competitors.

Connectivity – the science system builds and engages in wide networks with domestic and international research communities and with end-users, and uses these connections to raise public engagement and strengthen its research, skills development, knowledge exchange and influence.

CRI – Crown research institute.

Excellence – well-designed, well-performed, well-reported research, recognised as such, eg through peer review.

FWCI – Field-Weighted Citation Impact is one measure of research quality; it indicates how the number of citations received by an entity's publications compares with the average number of citations received by all other similar publications. It is expressed as an index, where the world average for all publications is 1.

GBAORD – Government Budget Appropriations and Outlays on R&D. This is Government's total budget for R&D, and includes the money Government provides to higher education institutions, CRIs and business.

GERD – Gross expenditure on R&D; the total amount spent on R&D in any country.

GOVERD – Government expenditure on R&D; the total amount of R&D performed by Government. This is a measure of R&D performed by Government directly on science. In New Zealand, GOVERD mostly comprises research undertaken by Government-owned CRIs. CRIs and Callaghan Innovation receive some funding from business which they spend on research; this counts as GOVERD.

Gross Domestic Product (GDP) – an aggregate measure of production equal to the sum of the gross values added of all resident, institutional units engaged in production (plus any taxes, and minus any subsidies, on products not included in the value of their outputs.

HERD – Higher education expenditure on R&D; the total amount of R&D performed by universities. Tertiary education institutions in New Zealand receive the bulk of their R&D funding from government.

Impact – the direct and indirect 'influence' of research or its effect on an individual, a community, or society as a whole, including benefits to our economic, social, human and natural capital.

Kaitiakitanga – an emerging approach to environmental management based on traditional Māori principles, concepts, values and views of the environment.

Marsden Fund – established by the government in 1994; a contestable fund administered by the Royal Society of New Zealand that funds excellent investigator-led research.

Mātauranga Māori – is a body of knowledge first brought to New Zealand by Polynesian ancestors of present-day Māori. Mātauranga Māori can exist, and be understood and applied, at various levels, including: broadly by Māori across New Zealand; or at regional, tribal, and whānau levels. Mātauranga Māori can also include the processes for acquiring, managing, applying and transferring that body of knowledge.

NSC(s) – National Science Challenge(s).

PBRF – the Performance-Based Research Fund, which allocates funding to tertiary education organisations based on their past research performance.

Relevance – science focuses on areas of strategic importance to New Zealand and is relevant to the economic, social and environmental needs (both current and future) of domestic and international stakeholders. It contributes to the development of skills to adopt and adapt new knowledge.

Small Advanced Economies (SAE) – six of the world's small advanced economies: New Zealand, Singapore, Israel, Denmark, Finland and Ireland. Also refers to a working group from these countries.

STEM – the academic disciplines of science, technology, engineering and mathematics.

Vision Mātauranga – an MBIE policy framework whose mission is to unlock the science and innovation potential of Māori knowledge, resources and people to assist New Zealanders to create a better future.

National Statement of Science Investment

THE VISION

"A highly dynamic science system that enriches New Zealand, making a more visible, measurable contribution to our productivity and wellbeing through excellent science."

IN 2025, WE WANT TO SEE...

- a better-performing science system that is larger, more agile and more responsive, investing effectively for long-term impact on our health, economy, environment and society
- growth in BERD to well above 1 per cent of GDP, driving a thriving independent research sector that is a major pillar of the New Zealand science system
- reduced complexity and increased transparency in the public science system
- continuous improvement in New Zealand's international standing as a high-quality R&D destination, resulting in the attraction, development and retention of talented scientists, and direct investment by multinational organisations.
- comprehensive evaluation and monitoring of performance, underpinned by easily available, reliable data on the science system, to measure our progress towards these goals.

THE FUTURE

We want to see a society fully engaged with, and benefiting from, a larger, more engaged and more responsive science and innovation system that leverages strong international connections.

Creating a more productive New Zealand economy will require a restructuring towards knowledge-intensive sectors, such as high-technology manufacturing, as well as an increase in productivity across all sectors of the economy.

SECTORS OF INVESTMENT

Government expenditure is responsible for a significant proportion of R&D in the **primary sector**. We will seek to incentivise further industry investment, and reduce our high rate of co-funding over time, while focusing Government funding on high-quality discovery research.

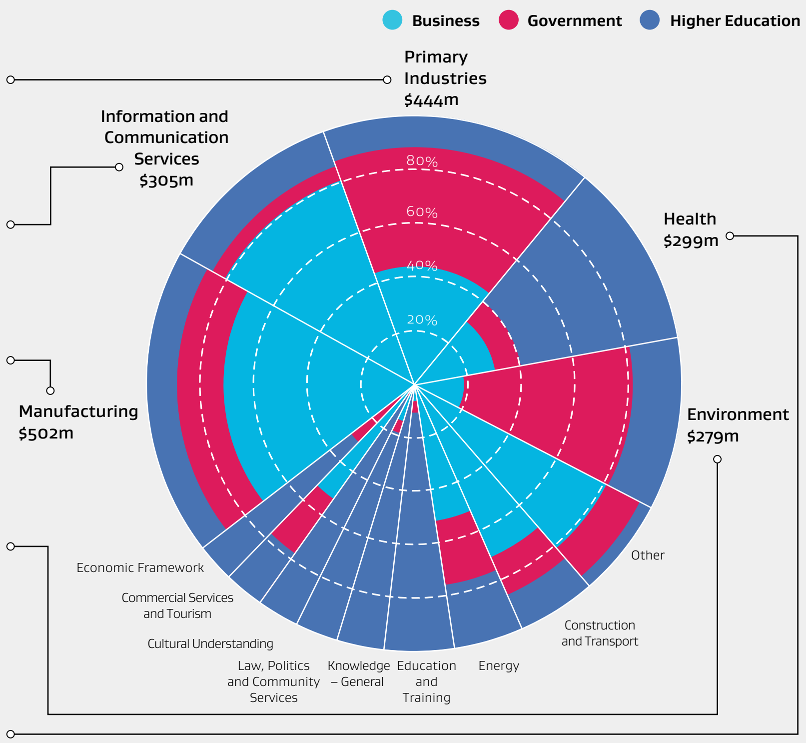
ICT is a sector where the vast majority of R&D takes place in industry. It is also an area where our academic research strength could usefully increase over time. We will seek to support this sector by strengthening our public base of far-from-market discovery research.

Government's main focus in the **manufacturing** sector will be to encourage business R&D to grow more quickly, through incentives such as growth grants. We will also continue to invest and increase our investment in far-from-market discovery research, to support the long term growth of the sector.

Government is the main investor in **environment** research. Significant continuing investment is justified where the public is the primary beneficiary, such as understanding the environment, its inherent processes, and threats and mitigations.

New Zealand has significant strengths in **health** research. We will seek to increase funding to this sector over time, while also considering how to leverage the results for greater economic benefit, in addition to the social and health benefits that already accrue.

EXPENDITURE ON R&D BY PURPOSE OF RESEARCH AND SECTOR OF EXPENDITURE 2014



Source: Statistics NZ R&D Survey 2014

PILLARS [AREAS OF FOCUS FOR SUCCESS]

EXCELLENCE

The quality of the science system and of the people who work within it is the key determinant of impact.

Investment should be subject to a rigorous test for the quality of the science undertaken.

IMPACT

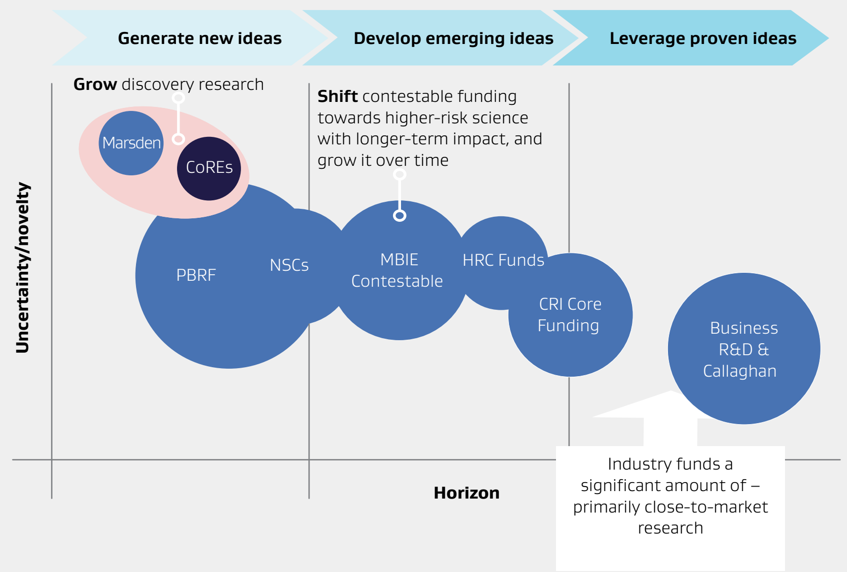
All of our science should have a strong line of sight to the eventual benefits for individuals, businesses or society.

This does not mean focusing purely on industry-led, close-to-market research. Science has an important role in challenging, as well as supporting, existing industries, products, practices, approaches and frameworks.

ALIGNING GOVERNMENT'S INVESTMENT

Over time, we will seek to grow Government's investment in more ideas-led, discovery research, which is likely to have more long term transformative impacts on New Zealand, and where the role for Government intervention is most clear.

As a country, we need to balance our strong and growing investment in applied science with more future-focused research that will challenge existing approaches and grow new, knowledge-intensive enterprises.



Government's commitment to grow investment in science to 0.8 per cent of GDP will entail substantial additional investment in high-value science.

The NSSI signals priorities for future investment including sectors of specific interest as described above, ideas-led discovery research and BERD.

National Statement of Science Investment

DESIGN PRINCIPLES

THE PLAN

CONTESTABLE FUNDING

ENSURE AN APPROPRIATE ROLE FOR GOVERNMENT

This means making sure that where the benefits accrue to individual firms or other end-users they are meeting an appropriate proportion of the cost, and the benefits of publicly funded research are understood and distributed broadly across New Zealand and the world.

ENSURE THE SCIENCE SYSTEM IS TRANSPARENT AND HIGH PERFORMING

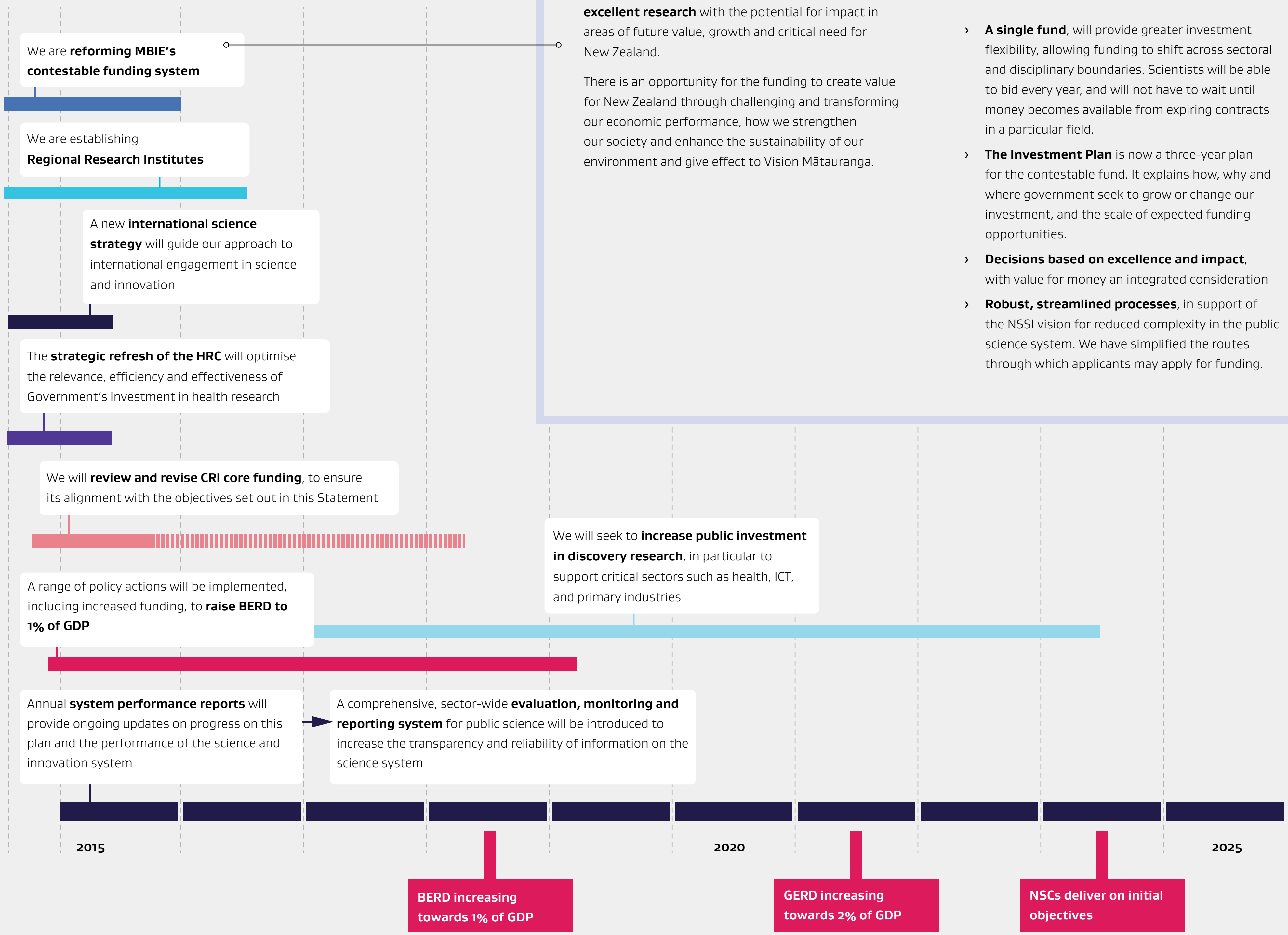
This means strong, easily accessible information on our science, and the people, institutions and funding that support it. Government will use this evidence to guide future investment and drive performance.

CREATE AS SIMPLE A SYSTEM AS POSSIBLE

An overly complex science system makes it hard for those working within and with the system to navigate and locate the right knowledge, partners, funding and institutions.

CREATE A SYSTEM THAT IS STABLE OVER TIME

Science is, for the most part, a long term endeavour, and stability is necessary to support this. Our aim across the reforms outlined in this section will be to create flexible, responsive systems that will remain stable over time, and will be able to adapt to changing circumstances without the need for major redesign.



We are reforming the MBIE contestable fund to support **excellent research** with the potential for impact in areas of future value, growth and critical need for New Zealand.

There is an opportunity for the funding to create value for New Zealand through challenging and transforming our economic performance, how we strengthen our society and enhance the sustainability of our environment and give effect to Vision Mātauranga.

CRITICAL FEATURES

- **A single fund**, will provide greater investment flexibility, allowing funding to shift across sectoral and disciplinary boundaries. Scientists will be able to bid every year, and will not have to wait until money becomes available from expiring contracts in a particular field.
- **The Investment Plan** is now a three-year plan for the contestable fund. It explains how, why and where government seek to grow or change our investment, and the scale of expected funding opportunities.
- **Decisions based on excellence and impact**, with value for money an integrated consideration
- **Robust, streamlined processes**, in support of the NSSI vision for reduced complexity in the public science system. We have simplified the routes through which applicants may apply for funding.

Section 1:

The Vision for New Zealand's Science System

Our vision for the science system

The New Zealand science system has a number of critical strengths. It is efficient, producing a high volume of good quality academic outputs at comparatively low cost. Elements of the system are tightly focused on science with direct relevance to end-users. Our approaches to some problems – such as biosecurity – are recognised as world leading. We also have internationally recognised strengths in health and biotechnology research, among other areas.

Government's investment in New Zealand's science system has grown by over 70 per cent between 2007/08 and 2015/16[1]. It is imperative that we ensure this and future investments are effective in delivering benefit to New Zealanders. The performance of the system in contributing to the outcomes Government is seeking can and should improve. In order to mitigate New Zealand's isolation and small scale, the way we do science and innovation as a country needs to be world leading, and our science investments need to make a bigger contribution to our economy. Central to this Statement is Government's vision for the shape of the science and innovation system in 10 years' time, and for science and innovation's contribution to New Zealand.

THE VISION FOR 2025

> "A highly dynamic science system that enriches New Zealand, making a more visible, measurable contribution to our productivity and wellbeing through excellent science."

Over the next 10 years, we want to see:

- a better-performing science system that is larger, more agile and more responsive, investing effectively for long term impact on our health, economy, environment and society
- growth in BERD to well above 1 per cent of GDP, driving a thriving independent research sector that is a major pillar of the New Zealand science system
- reduced complexity and increased transparency in the public science system
- continuous improvement in New Zealand's international standing as a high-quality R&D destination, resulting in the attraction, development and retention of talented scientists, and direct investment by multinational organisations
- comprehensive evaluation and monitoring of performance, underpinned by easily available, reliable data on the science system, to measure our progress towards these goals.

Pillars

Our vision for 2025 will be supported by two main pillars or areas of focus where Government will concentrate its activity. These are impact and excellence.

It is vital that all parts of the system continue to strive for greater excellence and impact in the science undertaken, with our science being of the highest quality possible and most public investment having a clear line of sight to eventual impact. A focus on impact does not mean a focus solely on close-to-market or end-user-driven research. Scientific discovery challenges, as well as supports, existing industries and practices, and both roles must be developed in a balanced way.

IMPACT

Impact is a critical concept and a matter of increasing focus in science systems across the world. Investors, and in the publicly funded science system policy-makers and taxpayers, should have a strong understanding of the real-world effects of science, help to shape research questions, and accelerate the use to which knowledge will be put.

Impact encompasses the ways in which scientific research benefits individuals, whānau, communities, organisations, New Zealand, and the world. It encourages researchers and investors to think about the broader implications of research from the outset, as priorities shift, or when research raises unexpected discoveries.

Most science will take years to generate benefits for end-users, and there are many mechanisms by which new knowledge may eventually transform into benefit. Over the next few years, Government will focus on improving our understanding of the potential and measured impacts of research, including impacts resulting from the integration of the Vision Mātauranga policy across the Government's science investments. This is a tenet of the National Science Challenges (NSCs) and will be a prominent feature of the reformed Ministry of Business, Innovation and Employment (MBIE) contestable fund.

Government will do more to identify the value of high-impact research to New Zealand

This Statement includes a significant focus on the commercial impact of research and on industry research activity. This is an area in which New Zealand lags behind most other advanced economies, at a significant cost to our prosperity and wellbeing. Government intends to foster a much more innovative and innovation-led economy: rapidly lifting business R&D is central to this goal. Government has an aspirational goal to increase BERD to 1 per cent of GDP by 2018.

Other research will indirectly deliver financial dividends, for example by mitigating adverse health or environmental impacts or generating better understanding of our resources. Poor health or social outcomes, and environmental contamination or loss, are extremely costly, and science can deliver effective safeguards, treatments and solutions. Effective interventions are generally far more feasible, cheaper and more effective than rehabilitation or restoration.

However, high-impact research cannot always be valued in economic terms alone. For example, the impact of endangered species protection could be considered in terms of economic (tourism revenue), environmental (role in the ecosystem), and cultural or social (as taonga or public amenity) values.

This range of values means it is often inappropriate to trade off the impact of two very different research proposals. Individual competing proposals need to be considered on grounds of excellence, and against relevant dimensions of impact.

The relationship between New Zealand's science system and the world production of knowledge is important now, and that importance will grow in the future. Science is an international endeavour, with knowledge flowing easily across international borders, and international collaboration common. We need to ensure that we are well placed to access the best science from overseas, as well as generate excellent science of our own. Government will continue to give careful consideration to New Zealand's balance between conducting, collaborating in and accessing science, and monitor our investment decisions to make sure they are delivering the greatest overall value in this context.

As part of Government's medium-term objective to improve the information gathered and used to inform the science system, we have developed a framework that considers different dimensions of impact. The table below expands on those concepts of impact to provide a sense of the areas in which we will be seeking to develop better focus and information on the impact of our science. This richer understanding of impact will guide our future investment decisions.

Many of these dimensions of impact are interdependent. A richer understanding of impact will guide our future investment decisions.

The following are some of the dimensions of impact that we consider

ECONOMIC	ENVIRONMENTAL	HEALTH & WELLBEING	SOCIAL
New/improved products and services	Reduced or mitigated environmental impact	Improved population health and health status for disadvantaged groups	Increased knowledge of and interest in science
Reduced operating costs or commercial risk	Reduced or mitigated environmental risk	Reduction in health maintenance costs	Understanding of and resilience to real or perceived communal risk
New job opportunities	Improved condition of an environmental asset	Early detection and mitigation of health risks	Stronger social and infrastructure systems and improved techniques for delivery of public services
Improved business and industrial processes	Better understanding of the environment, and characterisation and management of natural capital	Improved wellbeing through development of human and social capital, and removal of institutional barriers	
Value extraction from existing science			
Improvements in public policy advice			
VISION MĀTAURANGA			
Indigenous innovation: economic growth through distinctive R&D	Taiao: sustainability through iwi and hapū relationships with land and sea	Hauora/Oranga: improved health and social wellbeing	
Mātauranga – explore indigenous knowledge for science and innovation			

Through the Vision Mātauranga policy we will encourage appropriate research arising from the interface between Māori knowledge and science to help deliver effective and innovative products, services and outcomes for both Māori and all New Zealand. This will include integrating the policy across government's investments in research, and support building the capability, capacity and networks of Māori and the research community to collaborate and carry out this work. We will also better understand how to implement research in a way that maximises its effectiveness amongst Māori, and other sectors, within our communities. New Zealand can be an international leader in this area.

EXCELLENCE

The quality of the science system and of the people who work within it is the key determinant of impact. Investment should be subject to a rigorous test for the quality of the science undertaken. Investment in poor quality science is not only a poor use of funds; it can be actively harmful.

Government recognises New Zealand's strong history of directly applied science to solve critical issues, and does not propose to consider excellence only through the lens of academic outputs such as published papers, although this remains very important. Ongoing monitoring, evaluation and independent review all have a part to play in pursuing a continuous improvement in the quality of our science.

Excellence in science is not easily identified by one measure. It is a concept as applicable to projects and teams as it is to individuals, and is not static; it grows and changes as science does. Given this, we propose to take the following factors into account when considering excellence.

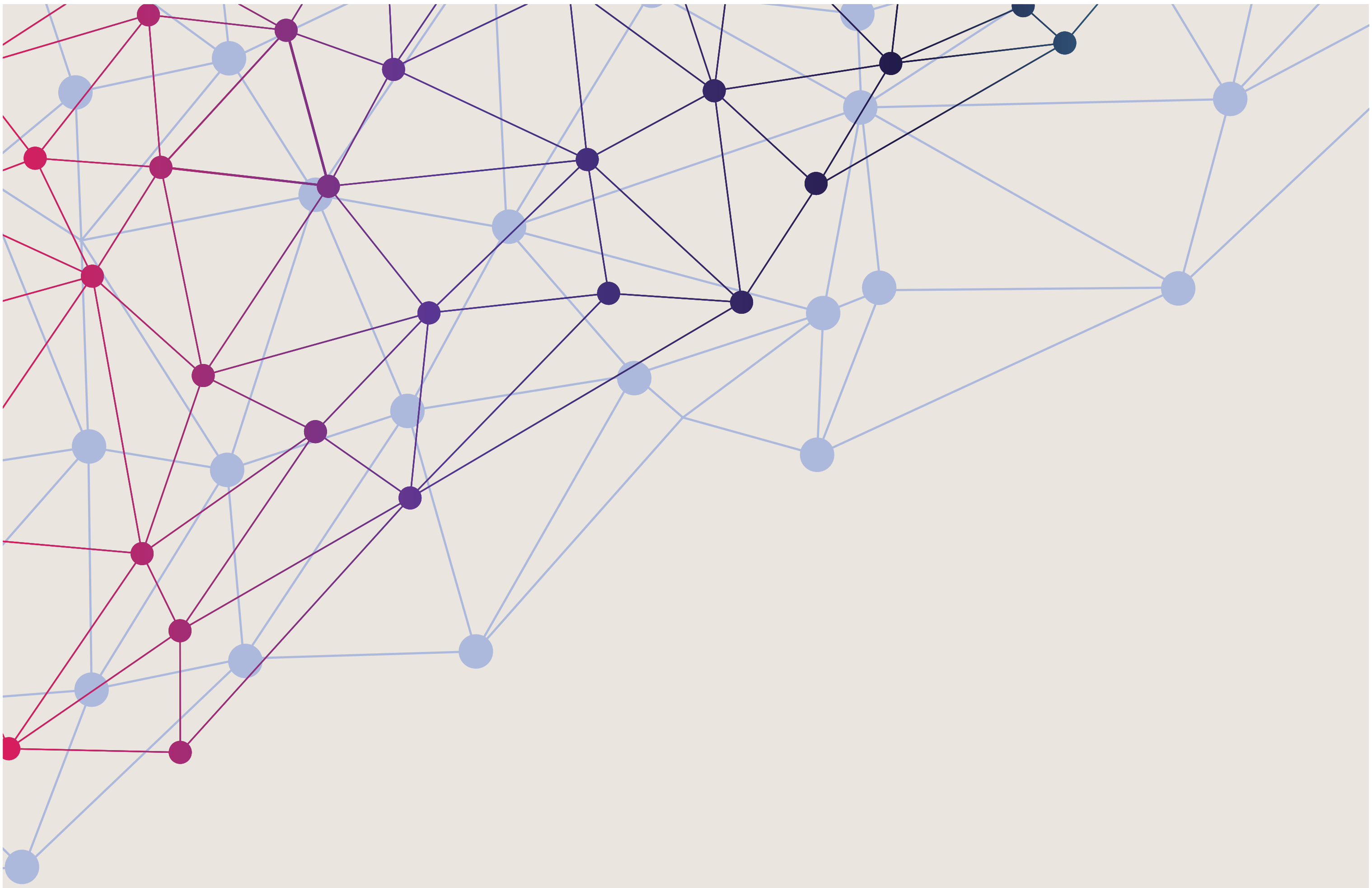
We understand excellent science as...

THE BEST PEOPLE	A RIGOROUS APPROACH	OPTIMUM RESULTS
Individuals, teams and institutions well placed and sufficiently skilled to do the research, who are sought-after practitioners in their field, with reputations for high-quality work, and linked internationally and domestically.	Well-defined, repeatable methodologies and careful implementation. Transparency and stringent peer review. Best-practice approaches. Builds on existing approaches. Risks identified and managed.	Expansion and application of knowledge, wide knowledge dissemination, high reliability and repeatability, strong application. International reputation enhanced.

Good engagement with end-user needs is often a predictor of high-quality science. For example, bibliometric data tell us that, overall, papers co-authored with industry tend to gather many more citations than those produced by a single author, or authors in collaboration with other non-industry scientists.

This relationship also appears to work in the opposite direction. A science system that develops, retains and attracts talented individuals will draw increased investment from industry, including from overseas.

In order to achieve our vision of New Zealand as a high-quality destination for scientists and R&D investment, we need to focus on building scientific excellence and relevant connections with end-users – including industry, public service providers, other research organisations, iwi and communities.



The vision for 2025

"A highly dynamic science system that enriches New Zealand, making a more visible, measurable contribution to our productivity and wellbeing through excellent science."

Section 2:

The Performance of the New Zealand Science System

> "The Government's vision is to deliver a highly dynamic science system that enriches New Zealand, making a more visible, measurable contribution to our productivity and wellbeing through excellent science."

In order to realise this vision, we will monitor and evaluate impact and excellence, and use the knowledge gained to inform our strategic direction, investment priorities and funding decisions.

Most of the data we currently have on the performance of the science system are focused on academic excellence – the quality of our institutions, people and publications. This is a crucial component of the performance story. But as we shift towards a greater focus on impact, our immediate priority is to complement this with a much richer understanding of how our science produces tangible benefits for New Zealanders.

Our current understanding of impact across the system is largely limited to proxy indicators that tell us about the likelihood of impact – such as the quality of connections between researchers and end-users. This section discusses some of the key proxy indicators we use to examine performance in the science system, and looks forward to how we will assess the performance of the science system in the future as our data improve.

New Zealand's knowledge production

NEW ZEALAND HAS A SMALL BUT GROWING SCIENCE SYSTEM

Our science system is efficient in producing a high volume of good quality academic outputs at comparatively low cost

New Zealand researchers publish more papers per capita than in comparator countries.

Our relatively large – by international standards – CRIs mean we also have a reputation for strong applied science with direct relevance to end-users.

Universities produce the largest proportion of research, but CRIs and universities have approximately equal output per research employee.

With 0.14 per cent of global spending, 0.06 per cent of global population and 0.18 per cent of the world's researchers, New Zealand produces:

› 0.60 per cent of publications
› 0.71 per cent of citations
› 0.68 per cent of highly cited articles

As Government has increased science funding, output has grown across most research areas.

However, New Zealand still has relatively few scientists, and a high proportion of them work in the government and higher education sector.

ACADEMIC COLLABORATION

Consultation submissions suggested individuals, projects and institutions in New Zealand were not well connected.

Only 3.2 per cent of New Zealand publications have academic and corporate affiliations, suggesting scope for more collaboration.

Better partnerships between domestic research partners and end-users will increase the quality and impact of our science.

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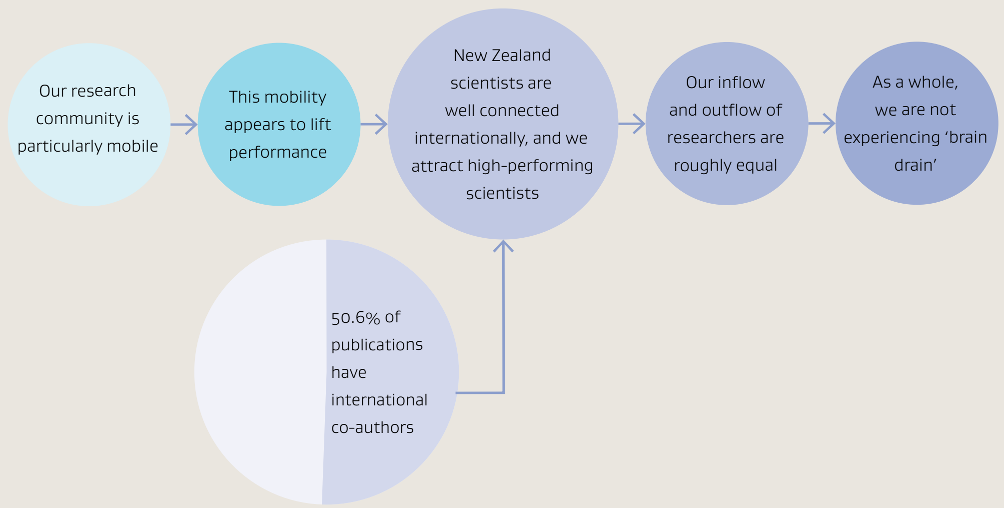
NEW ZEALAND SCIENTISTS ARE WELL CONNECTED INTERNATIONALLY



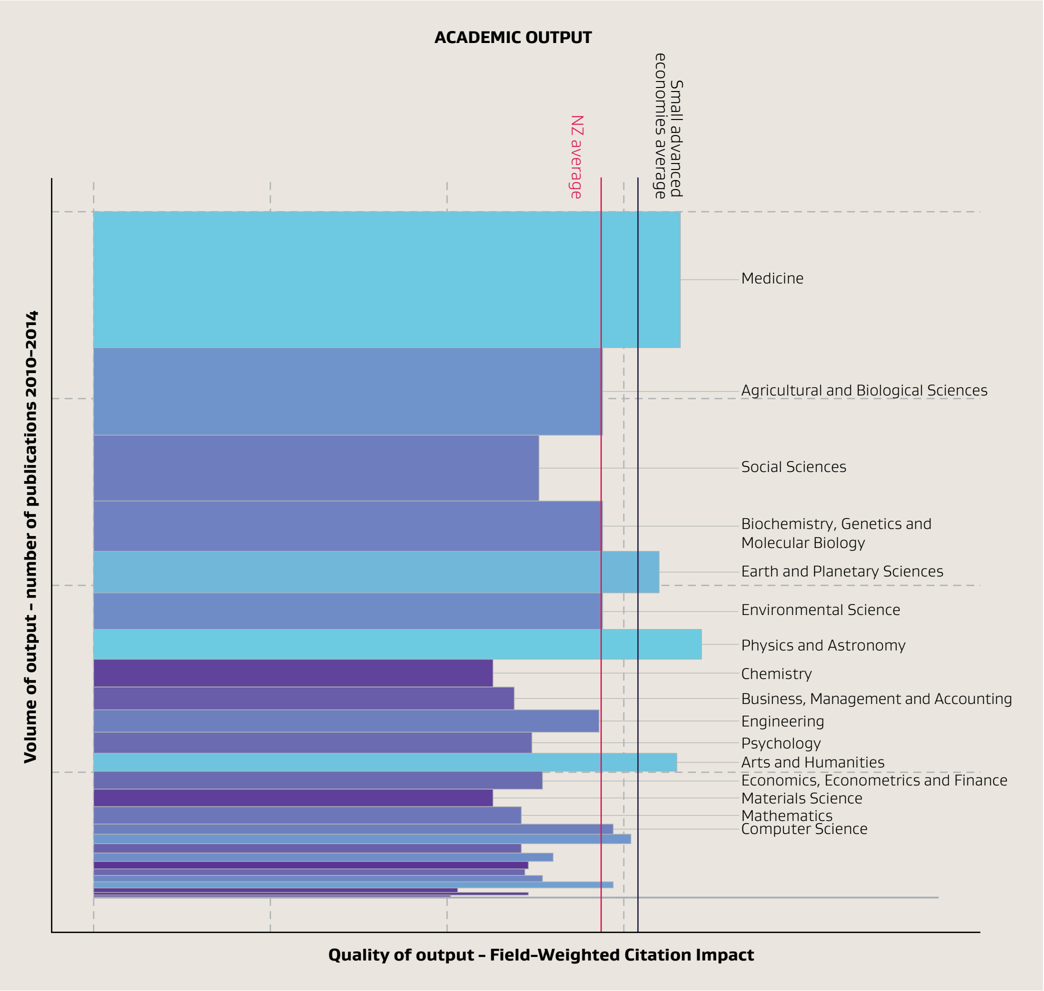
PUBLICATIONS

One way to look at the amount and quality of science in New Zealand is to consider the academic papers published.

These data tell us, for example, that we have significant strengths in both the volume and quality of our health research.

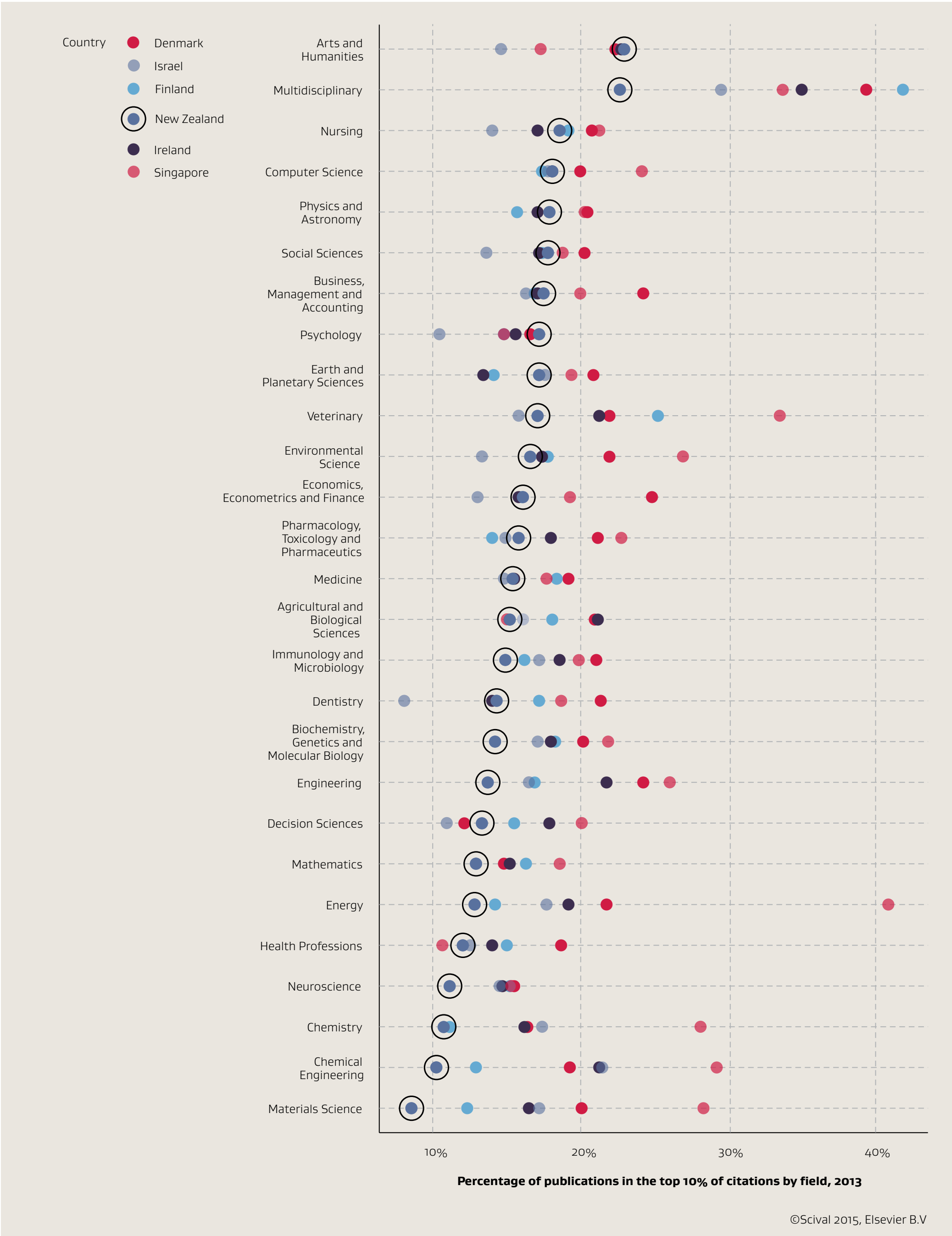
Although our CRIs are closely focused on applied science for end-users, scientists in CRIs do publish papers and, where they do, they produce on average just as many as, and of similar quality to, scientists in universities.

However, although our system has notable strengths, and compares reasonably well internationally, we need it to be excellent.



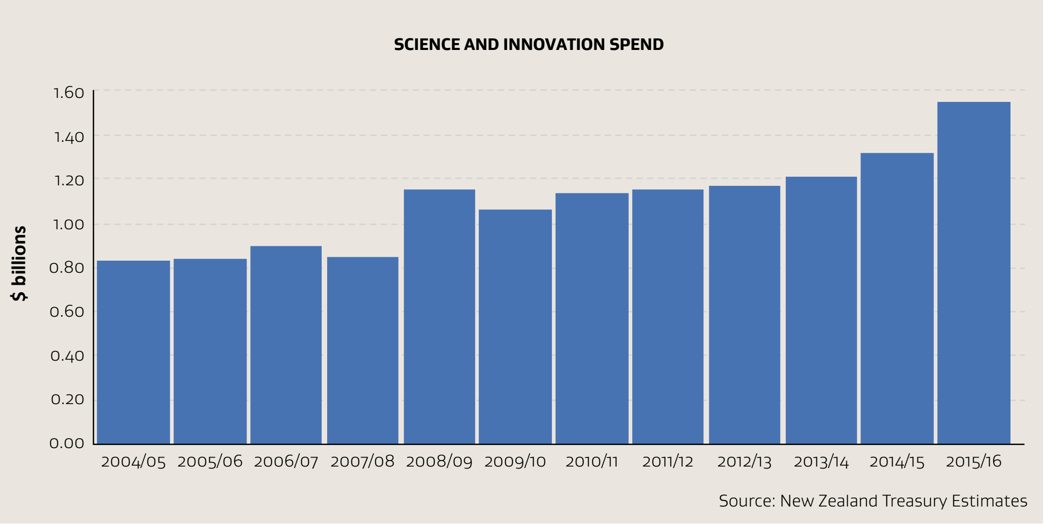
HIGH-QUALITY ACADEMIC OUTPUTS IN THE SMALL ADVANCED ECONOMIES

The chart below shows one measure of how 'excellent' our science is, compared to other SAE countries. **It shows the percentage of domestic science papers that appear in the top 10 per cent of papers by number of citations in the world.** This measure of the 'top end' of our outputs is probably more important than the average. Some evidence suggests that it is science, and particularly scientists, of the highest quality that attract industry partners domestically and globally, lead quality improvements across the science system, and generate the most useful new knowledge. On these measures of 'standout' rather than average quality we could perform better.



Government investment is delivering results

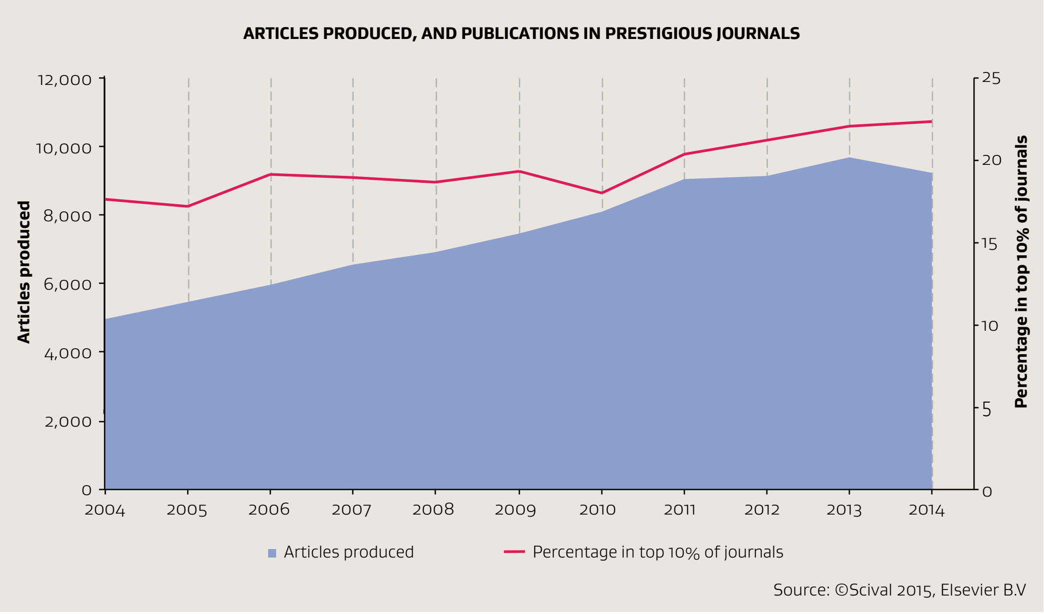
GOVERNMENT SCIENCE AND INNOVATION EXPENDITURE HAS INCREASED BY OVER 70 PER CENT SINCE 2007/08



OUR SCIENCE HAS IMPROVED IN RESPONSE

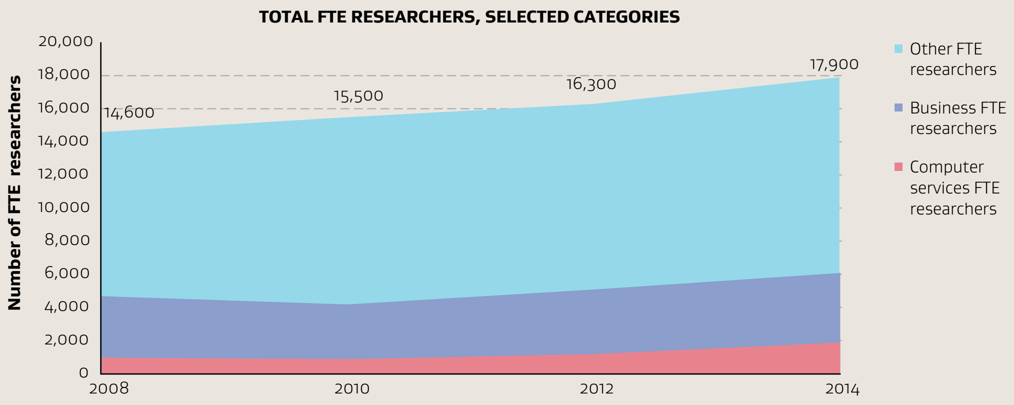
New Zealand is producing more excellent research

Our scholarly output has increased substantially since 2008, and the proportion of articles in the top 10 per cent of publications has increased by 20 per cent.



The research workforce is growing

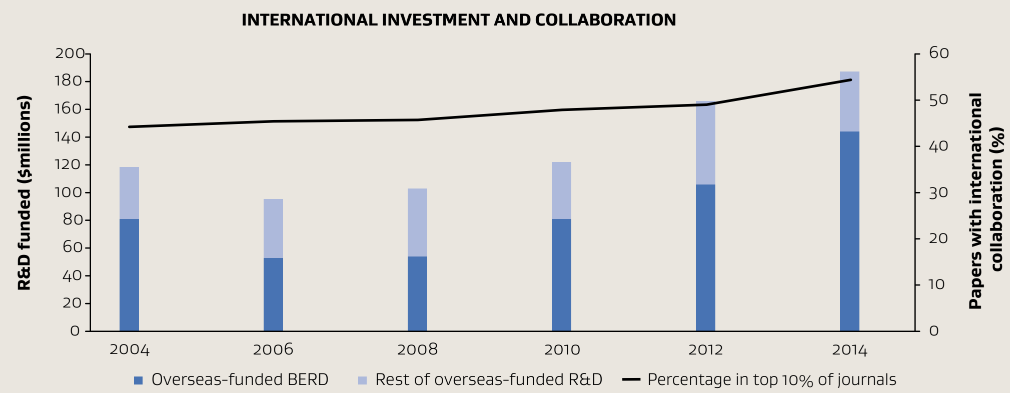
The number of highly skilled researchers in New Zealand is increasing, reaching 17,900 in 2014. The business sector has accounted for half of this increase, with the majority of that growth coming from computer services firms.



Source: OECD MSTI indicators and Statistics NZ R&D Survey 2014

International collaboration and investment are increasing

New Zealand scientists are collaborating more with international partners and our science is attracting greater levels of overseas investment.



Source: Statistics NZ R&D Survey 2014

...OVER TIME, WE EXPECT TO SEE BROADER IMPACTS RESULTING FROM THIS INVESTMENT

SCIENCE INVESTMENTS WILL MAKE A DIFFERENCE TO ISSUES AFFECTING NEW ZEALANDERS

Over time, we expect to see significant benefits for New Zealand through investments in investigator-led, mission-led and industry-led research.

These benefits will accrue through policy and practice, and in social and environmental spheres, as well as through commercially viable outputs.

For example, the National Science Challenges are a major new collaborative mechanism, funding research addressing complex, long term, national-scale issues.

For example, we expect National Science Challenges to:

› Research climate-related risks and opportunities

› Reduce and moderate age-related conditions

› Improve the safety of communities along coastlines and rivers

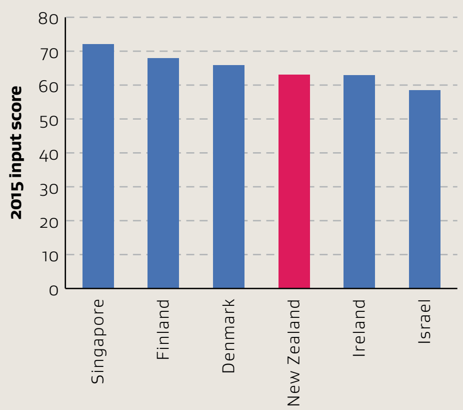
› Inform the way we govern and use our marine resource

A comprehensive performance framework has been developed that will monitor, evaluate and review the NSCs. It will analyse their impact against their environmental, economic, health, cultural and social objectives, the objectives of Vision Mātauranga, and the overall aims of the NSC policy.

WE EXPECT TO SEE INCREASING CAPACITY FOR INNOVATION AND IMPROVED INNOVATION PERFORMANCE

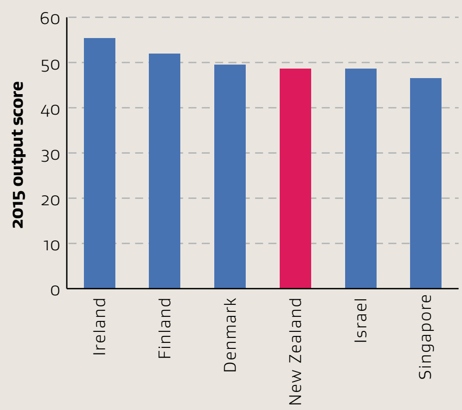
The Global Innovation Index scores countries on their innovation performance.

The Index scores countries on the **inputs that enable innovative activity**, including institutions, human capital, research infrastructure, market and business sophistication.



Source: Global Innovation Index, 2015

The Index also compiles a score for countries' **innovation outputs**: including knowledge and technology outputs and creative outputs.

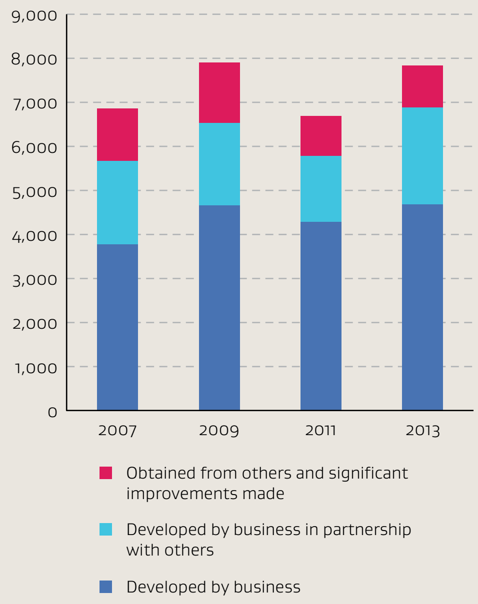


Source: Global Innovation Index, 2015

AND NEW ZEALAND MAKING BETTER USE OF SCIENCE TO INNOVATE AND LIFT PRODUCTIVITY

The science system delivers many of the building blocks to improve productivity and wellbeing, thereby raising living standards.

NUMBER OF NEW ZEALAND FIRMS INTRODUCING NEW OR SIGNIFICANTLY IMPROVED GOODS OR SERVICES



Source: Statistics New Zealand Business Operations Survey, innovation module

Government is investing in information about performance and impact

As an initial action, MBIE will publish a system performance report that will cover system-wide performance measures such as:

- R&D intensities
- research quality and commercialisation outcomes
- public investment in science and innovation
- institutional performance
- business innovation measures
- progress against Vision Mātauranga
- public engagement with science and technology.

The Report will improve in detail and evaluative effectiveness over time as better information becomes available.

Government's role is to...

- encourage high-quality research for the benefit of New Zealand
- achieve a balance of risk, impacts and timeframes in its portfolio
- be the principal long-term investor in generating new ideas research where social returns are potentially high but private returns are uncertain

Section 3:

Our Science System Now and in the Future

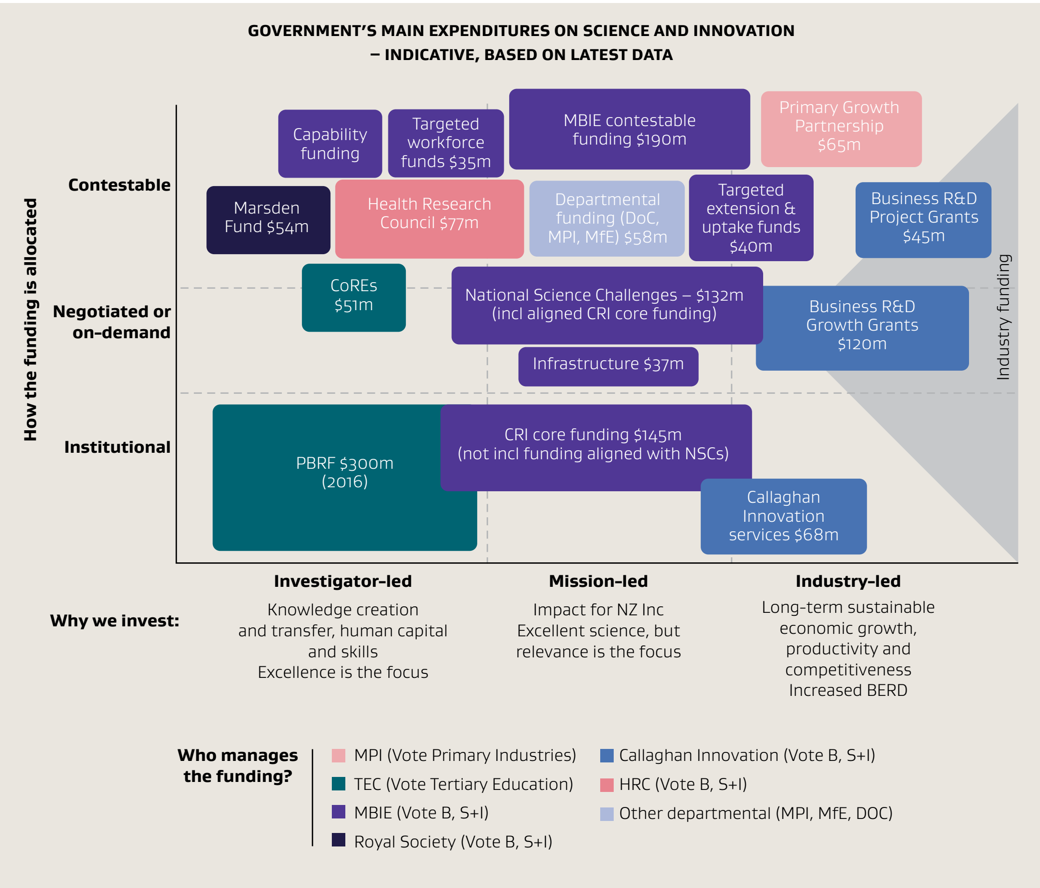
Investment in science

This section of the Statement describes the science system in terms of its financial inputs, and how Government will think about the balance between those in the future.

THIS SECTION CONSIDERS FOUR LINKED CONCEPTS

› **Government's investment in science.**
› **The performance of the New Zealand science system.**
› **Government's role as an investor.**
› **Future investment by sector.**

The following diagram illustrates the major government-funded parts of the current science system by allocation method and type of investment – scaled to the size of the investment. A mix of sources and categories have been used to explain government's investment in science in this document. As we undertake the work described in **section 5** to improve evaluation and performance measurement of the science and innovation system, we will seek to standardise our approach wherever possible.



Our science investment system is more complex than it needs to be. This complexity reduces transparency, and makes it harder for scientists, end-users, and taxpayers to understand what the system is for and what it is trying to achieve. Over time, Government intends to reduce this complexity to improve the efficiency and effectiveness of the system. Some preliminary actions to inform and achieve this are discussed further in **section 5** of this Statement.

Building on the descriptions of funding set out in the draft Statement, this first part of **section 3** seeks to clarify the function and priorities of the system's components. This statement considers science investments of three types: investigator-led, mission-led and industry-led.

INVESTIGATOR-LED SCIENCE

Investigator-led science is undertaken to acquire new knowledge but the direction of research is led by researchers. This type of research generates ideas, expands the knowledge base, and contributes to the development of advanced research skills. Value can be significant, but unclear at the outset, and often accrues over the long term, to a large number of end-users and to a broad range of outcomes.

Some evidence indicates that the type of research that tends to happen more in investigator-led projects – long term, exploratory, and potentially game changing – can have the greatest impact on the productivity and wellbeing of a country. But this less predictable, highly dispersed, future-focused impact makes it much less likely to attract investors other than government.

Government therefore has a clear role as a primary investor in investigator-led research. Scientific excellence is the main evaluation criterion for most of the mechanisms in this category, as it is particularly challenging to identify possible future impacts and attribute impacts back to funded research.

Government will continue to fund investigator-led research primarily on the basis of excellence.

New Zealand's main investigator-led funding mechanisms are:

- **Marsden Fund ($53.6m):** a competitive mechanism to fund excellent, investigator-led research that advances and expands the knowledge base. Also contributes to the development of advanced skills in New Zealand. Research is not subject to government's socio-economic priorities.
- **Centres of Research Excellence ($50.7m):** a competitive mechanism to fund collaborative research networks (hosted by tertiary education institutions) to support growth in research excellence and the development of world-class research and researchers in areas of importance to New Zealand.
- **Performance-Based Research Fund ($293.8m, rising to $300m in 2016/17):** allocates funding to tertiary education organisations based on their past research performance, reports on this performance to create financial and reputational incentives for excellent research, and supports research utilisation, and research-led teaching and learning.

MISSION-LED SCIENCE

Mission-led science is undertaken towards a particular policy aim or goal. The intended goal may be broadly or narrowly defined but is often identified by the funding agency – sometimes in partnership with research providers. The value of this type of research can be clear but may be far in the future and is typically geared toward broad public benefit.

Benefits could accrue through policy and practice, and in social and environmental spheres, as well as through commercially viable outputs. In New Zealand, the scale of the science required will often necessitate coordination of resources at a national level.

Government's role here is as a co-investor, or principal investor where there is a significant public benefit element (eg research into characterising the environment, understanding global processes and their impact on New Zealand, or health issues) that would otherwise face a lack of investment. Mechanisms may need to encourage collaboration, and account for non-commercial returns, or seek to encourage private sector co-funding where appropriate. Where there is a long term mission, a mechanism providing for long term funding stability may be justified.

Evidence of excellence and impact is an important criterion for investment in mission-led research.

Our main mission-led science investment mechanisms are:

- **MBIE contestable funds ($190m):** uses competition to fund excellent research with the potential to deliver long term, transformative impact for New Zealand.
- **National Science Challenges (NSCs) ($68m plus up to $64.3m of aligned CRI core funding):** a collaborative mechanism to fund research that addresses complex, long term, national-scale issues for New Zealand
- **Health Research Council (HRC) funds ($77.2m):** mainly contestable funding focused on health and quality of life
- **CRI core funding ($201.6m):** direct funding to CRIs to enable them to meet their core purpose.

INDUSTRY-LED SCIENCE[2]

Industry-led research typically is applied research. It is either conducted within firms or in partnership with public research organisations. It is expected to result in measurable benefits to firms and the economy and is focused on the practical development of new materials, products, processes, systems or services. Research tends to be 'close to market', with an obvious commercial or practical application that can be realised within a timeframe acceptable to commercial investors. Industry-led or, more accurately, demand-led research can also include research led by other non-government actors (eg charities, communities or iwi.)

Innovation lies at the heart of smart, sustainable and inclusive economic growth. Economies and firms that innovate do better over the long term. Research has shown that firms with a persistent R&D strategy outperform those with an irregular or no R&D investment programme.[3] Innovative firms and sectors also tend to create highly skilled, well-paid jobs and go on to generate opportunities in other higher-value and higher-tech sectors. Some research suggests that the long-term social returns to countries from research undertaken by business are higher than the returns to research undertaken in the public sector.

The total amount of R&D funded by New Zealand businesses was $1,068 million in 2014.

This is different from BERD, which records R&D performed within New Zealand businesses.

$927 million (87 per cent) of this business-funded R&D was performed within businesses, $107 million (10 per cent) was contracted out to government research organisations, and $33 million (3 per cent) to universities.

New Zealand businesses funded 17 per cent of all R&D performed by government research organisations and 4 per cent of all R&D performed by universities.

New Zealand businesses funded 74 per cent of their own R&D in 2014, with government funding sources such as R&D grants (11 per cent, $139 million) and overseas sources (12 per cent, $144 million) funding the remaining R&D performed by businesses.

Government supports business R&D because businesses are unable to capture all the benefits of innovation and hence will tend to invest less than is socially or economically optimal. Some businesses will also invest less because they have insufficient information to assess the risks and rewards of R&D investments. The social returns to R&D investment are also particularly high, that is, the value (environmental and social) not currently reflected in conventional financial accounts.

Over the longer term, we expect increased business investment in R&D to lift the share of medium- and high-technology industries in the New Zealand economy, especially where these sectors provide products and services to more traditional industries. For government investment in business R&D to be successful, business must be the primary investor in, and director of, research.

> Government also has a role in supporting and coordinating the development of generic or enabling technologies where benefits of the research would flow to many end-users.

In industry sectors such as primary production, a large number of small businesses producing similar goods would benefit equally from investment in one piece of research, but this discourages any single business from investing. Government can coordinate such programmes of research across a sector, and coordinate investment among a large number of small businesses through use of a levy.

Our main industry-led funding mechanisms are:

- **Callaghan Innovation ($68m):** assists firms to develop the skills, expertise and connections to successfully develop ideas and take them to market
- **R&D grants ($165m):** market-led cash incentives for firms to increase their R&D investment and support commercial R&D skills and capability development
- **Primary Growth Partnerships ($65m):** drive substantial economic growth in the primary and food sectors, through joint investment by government and the industry. Aimed at market-driven innovations
- **Partnerships ($25m–30m per year):** partnerships between end-users and research organisations to solve industry issues – industry provides co-funding.

TACTICAL FUNDS

The three investment types used above – investigator-led, mission-led and industry-led – are a useful way of thinking about our science system. In addition to these categories, the system contains some funds with more specific, immediate policy aims. These supporting funds go across all three categories above and support science across the whole system.

- **Vision Mātauranga Capability Fund ($6.6m):** invests in development of skilled people and organisations undertaking research to unlock the innovation potential of Māori knowledge, resources and people for the benefit of New Zealand.
- **International relationships ($9.35m):** building international relationships to ensure New Zealand science operates at the forefront of new knowledge and technology and leverages international opportunities.
- **Science in Society ($9m):** invests in encouraging greater engagement with science and technology across all sectors of New Zealand to ensure the public is able to benefit from advances in science and technology and deliver on the objective and outcomes of *A Nation of Curious Minds: He Whenua Hihiri i te Mahara*.
- **Infrastructure investments ($24.6m under contract to research infrastructures):** support access to fit-for-purpose and internationally competitive large-scale science infrastructure.

Government's role as an investor

Government seeks to achieve multiple objectives through its investments in science – with the end goal of delivering benefits for New Zealand and New Zealanders.

These objectives include building national innovation capacity and knowledge-based capital; improving the availability of knowledge to address economic, environmental, health, cultural and social priorities; and incentivising greater investment in, and use of, scientific research by firms and other end-users.

Government aims to encourage higher-quality research that eventually transforms into benefits for New Zealand. In order to achieve this, government invests in the provision and use of science directly, and takes actions to create an environment that enables wider investment in, and uptake of, scientific research.

Across the science system, Government intends to achieve a better portfolio of risk, impacts and timeframes. We must be clearer about where government has a role as a primary investor or investment partner to deliver significant value for New Zealand. Too much of our science and public science investment, across government and industry, is currently focused on low-risk projects with more certain short-term impacts.

As well as thinking about a portfolio of market and technical risk, we also think about our science investment in terms of overlapping horizons of activity, including often shorter-term, near-to-application research and investigator-led research for which the eventual applications are often uncertain.

Each horizon of activity requires a different investment approach and assessment of risk and value. As a long term investor, government needs to give active consideration to each of these horizons simultaneously, incentivising and funding a diverse portfolio of research activities.

Realising benefits in the future means investing in the present. Government recognises that patient investment is required, and that very high-impact developments emerge from investigator-led research in ways that are hard to predict.

We have labelled the three horizons of research activity we think about as: **leveraging proven ideas, developing emerging ideas, and generating new ideas.**

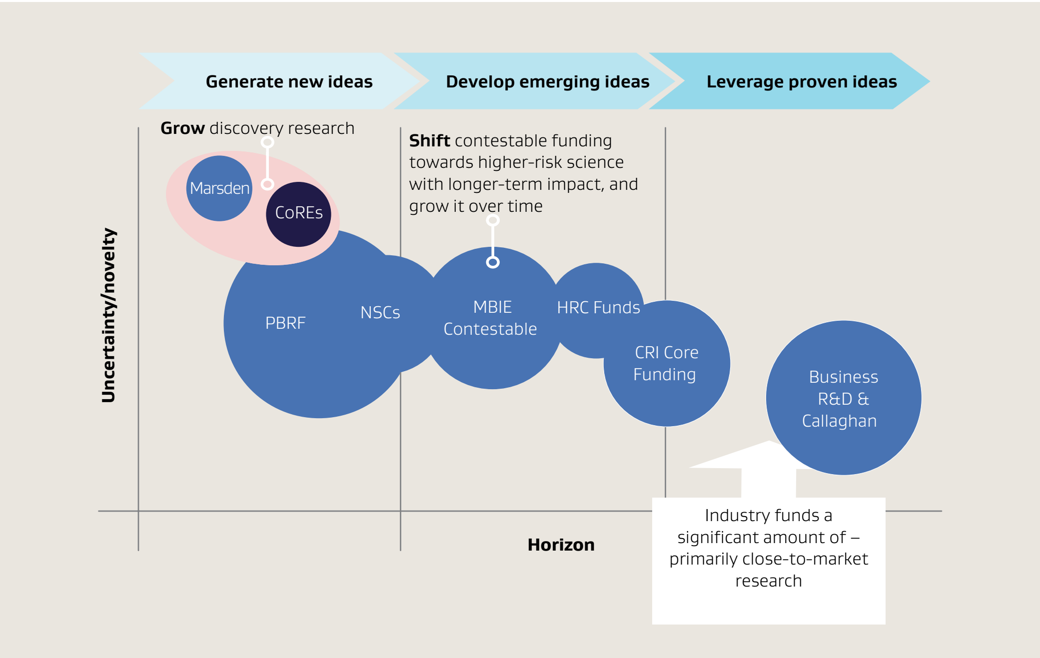
Uncertainty around outcomes – including potential applications and markets – increases across these three horizons. Government's science investments, like other portfolios of investments, should seek an appropriate mix of riskier, more speculative, high-potential activity, and programmes with better understood, more predictable outcomes.

Government's role as a long-term, principal investor is clearest in the 'generating new ideas' horizon, where the social returns are potentially high, but private returns too uncertain for most private investors.

The model as presented below should be considered as a broad strategic framework. It is focused on the predominant functions of major mechanisms. It suggests a current weighting of government investment towards less uncertain, shorter turnaround research that may not be appropriate.

Government's role is to encourage high-quality research for the benefit of New Zealand; achieve a balance of risk, impacts and timeframes in its portfolio; and be the principal long term investor in generating new ideas research where social returns are potentially high but private returns are uncertain.

A HORIZONS-BASED MODEL FOR THINKING ABOUT PUBLIC SCIENCE INVESTMENT



The most significant market failure occurs in investigator-led discovery research. Given government's role as the primary investor in investigator-led research, this points to focusing a greater proportion of additional investment at the discovery end over time. We expect New Zealand's total investment in more certain or close-to-market research to grow in parallel, but to see that growth driven primarily by industry, with ongoing government contributions where appropriate. In the medium term, better information and evaluation data will help inform where in the system future investment is specifically targeted.

Science and innovation will help raise New Zealand's economic productivity

NEW ZEALAND'S ECONOMIC PRODUCTIVITY

New Zealand has a persistent income gap compared to other advanced economies. Despite progress in reducing this gap in recent years, New Zealand GDP per capita remains 6.9 per cent below the OECD[4] average. This is partly because of a persistant a gap in labour productivity. New Zealand's labour productivity growth has been low compared to other OECD countries. Between 2000 and 2014, New Zealand's labour productivity growth was in the lowest quartile in the OECD. This productivity performance has been referred to as a 'paradox' given that New Zealand is considered to have growth-friendly structural policy settings.[5] Productivity growth is the primary means to deliver higher wellbeing for New Zealanders.

The OECD suggests that about a third of the gap in productivity performance could be explained by a lack of investment in knowledge-based capital (or intangible assets). Knowledge-based capital encompasses a broad range of activities, such as branding, software development, design, and scientific research and development. Investing in knowledge-based capital can create value, like new or higher-quality products and services, and is growing in importance as a source of productivity and economic growth. Our burgeoning ICT sector exemplifies this shift: ICT's contribution to GDP grew by $1.2 billion in the five years to 2013 to reach $8.3 billion, bringing with it skilled jobs. Employment in computer system design – the fastest growing sub-sector of ICT, including consulting services around hardware programming and software, software development, internet and web design – grew 12 per cent in 2013–14 alone, adding 2,870 jobs. Computer system design as a sub-sector of the New Zealand economy grew at a compound annual growth rate of 9.3 per cent between 2008 and 2013 and exports have doubled since 2008, reaching $930m in 2014.[6]

In some aspects of knowledge-based capital, New Zealand does well compared to other OECD countries, such as software investment and trademarks. However, in other aspects New Zealand compares poorly, particularly in scientific R&D. For example, our R&D intensity (total R&D expenditure as a share of GDP) and the share of total R&D performed by businesses are among the lowest in the OECD.

The experience of other small advanced economies shows that the move to a more knowledge-intensive industrial structure would most likely build on areas of existing comparative advantage, for example by combining digital technology and the digital economy with primary industries.

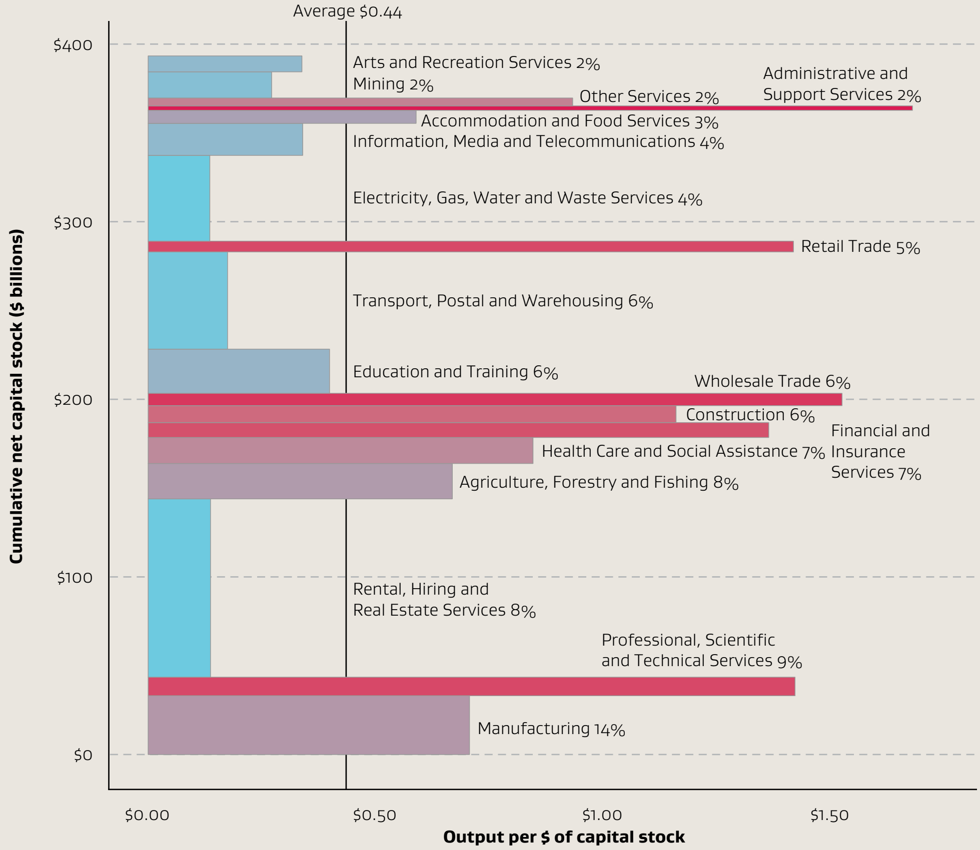
The charts on p35 shows New Zealand's economic productivity by sector, in terms of capital and labour productivity. It gives a picture of a small volume of highly productive sectors, and a larger volume of less productive sectors.

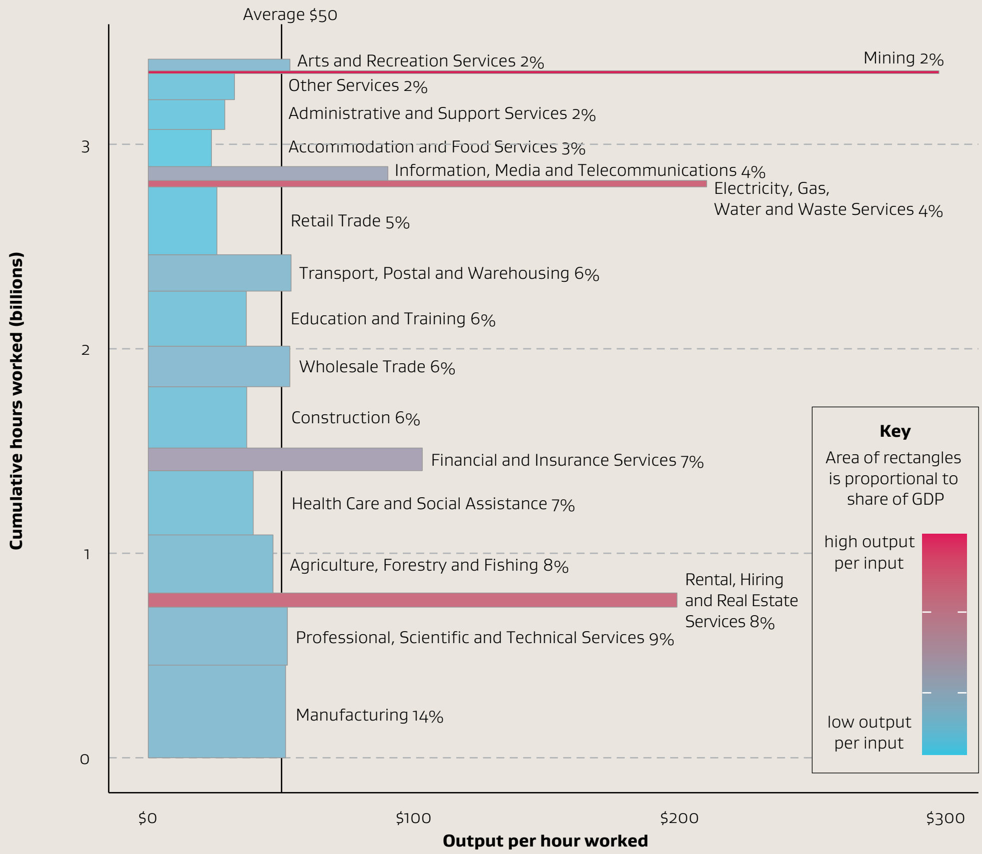
Productivity by sector in New Zealand: labour productivity and capital productivity

The charts on p35 also suggest that different economic sectors face very different challenges. For example, we may seek to leverage R&D to grow, strengthen and diversify our more productive sectors, while R&D could be the key to raising the basic productivity in some less productive sectors.

A critical focus for this Statement is the role science and innovation have to play in raising the productivity of the economy for the benefit of all New Zealanders – while also underpinning achievement of health, environmental and social objectives. The excellence and impact of our science will have a direct influence on the eventual productivity gains we achieve.

OUTPUT GENERATED BY LABOUR AND CAPITAL INPUTS, YEAR ENDING MARCH 2012



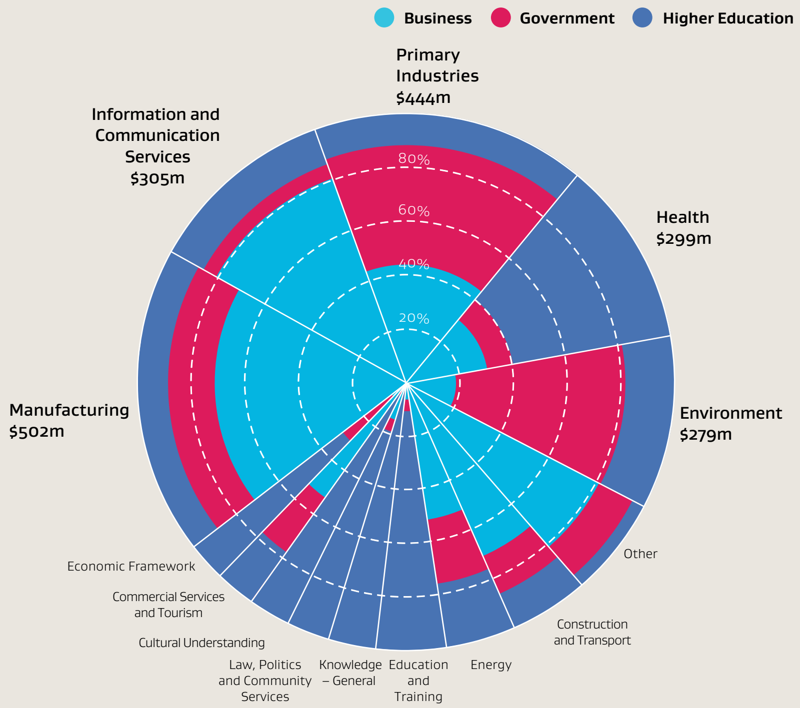


Source: Statistics NZ MBIE analysis

NEW ZEALAND'S SIGNIFICANT R&D SECTORS[7]

The chart below shows total New Zealand expenditure on R&D by purpose of research, and by sector of expenditure (business, government, and higher education). It shows significant differences in patterns of expenditure between government, higher education and business, depending on the purpose of research. These patterns will inform our general approach to investing in different sectors of research in the future. In particular, the chart shows our five largest areas for expenditure: primary industries, manufacturing, health, ICT and environment.

EXPENDITURE ON R&D BY PURPOSE OF RESEARCH AND SECTOR OF EXPENDITURE 2014



Source: Statistics NZ R&D Survey 2014

The following section summarises the character and performance of New Zealand research activity, highlights ongoing initiatives to support development of major sectors of research, and indicate where Government sees its future role and priorities. The five major sectors identified above: health, primary industries, manufacturing, ICT and environment are discussed in detail, and we have also characterised and summarised the future direction for Government in some other areas of research.

Section 4:

Future Investment by Sector

Health sector

HEALTH RESEARCH IS CRUCIAL TO DELIVERING BETTER HEALTH OUTCOMES FOR NEW ZEALANDERS

Health research underpinned many of the advances in human longevity and life quality during the 20th century.

Health research has also contributed to New Zealand's growing and innovative diagnostics, medical devices and health IT sector, and beyond to primary industries.

Our health research – comprising 36 per cent of New Zealand's academic outputs[8] – compares well internationally on quality measures. Medicine research is particularly strong.

Government is the primary investor in health research, which is appropriate given that much research is undertaken for public benefit.

The Health Research Council is the primary vehicle for government investment in health research. Private sector investment is growing.

Health research comprises five pillars:

- Basic biomedical research.
- Population and public health research.
- Applied clinical research.
- Health services and policy research.
- Medical technologies.

NEW ZEALAND HAS SIGNIFICANT OPPORTUNITIES IN HEALTH RESEARCH

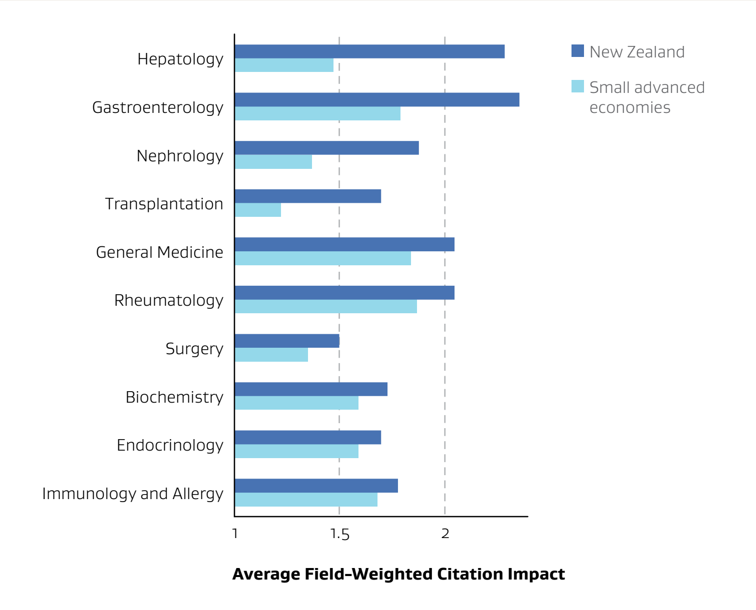
New Zealand is an attractive destination for researchers

A number of unique factors raise our health research quality and make New Zealand attractive as a health research destination. These factors include:

- a small, geographically isolated population
- a diverse demographic mix
- an efficient ethical review process
- rich health data, particularly patient-level information
- high-quality longitudinal health and wellbeing datasets.

We have several outstanding health research strengths

New Zealand outperforms other small advanced economies in 15 fields of health research including our largest subcategory of research by publications output, General Medicine.



And our health sector is generating high-tech exports

Medical equipment and pharmaceuticals accounted for $663 million of exports in 2012 – our largest grouping of high-tech manufacturing exports.

Healthcare firms within the TIN100 generated $1.3 billion in revenue in 2014 – 17 per cent of the TIN100 total.[9]

Healthcare firms are growing quickly – healthcare firms' revenue grew by 89 per cent between 2006 and 2014.

Health is New Zealand's second fastest growing sector and second largest by employment, growing 8.1 per cent in 2014. The size and growth of the sector heighten the need to improve productivity and provision.

Source: Statistics NZ R&D Survey 2014

The 2015 TIN100 report described the healthcare sector as "the largest opportunity of our generation"; **annual growth is expected to average 5.2 per cent between 2014 and 2018.**

Health research generates a large share of universities' commercial revenue: for example, $47 million, or 37 per cent of Auckland UniServices' revenue in 2014.

Source: TIN100 Technology investment network ranking

FUTURE DIRECTION

The strategic refresh of the Health Research Council will set the future direction for research investment. This is discussed further in **section 5**.

Government will consider increasing investment, particularly where we can leverage New Zealand's strengths by extending and diversifying related industries, and to ensure uptake of health research by service providers.

Primary industries

NEW ZEALAND IS A TECHNOLOGY AND INDUSTRY LEADER IN PRIMARY INDUSTRIES

Primary industries generate around 7.4 per cent per cent of New Zealand's GDP.

Another 5 per cent of GDP is attributable to manufacturing food, beverages, wood and paper.[10]

Many of our areas of comparative advantage lie in primary sector goods.

Primary industries are a significant user of natural resources, resulting in competition and conflict over issues such as freshwater, mineral extraction, biodiversity, and climate change.

Many of our primary industries are characterised by a large number of small producers making the same product, which means it is often uneconomical for individual firms to invest in R&D.

Historically, we have attempted to overcome this by creating a mixture of levy bodies and CRIs to undertake research on behalf of those producers.

This means that large parts of the primary sector will tend to spend money on research through government, which is not statistically counted as BERD.

Agricultural and biological sciences are New Zealand's second largest area of academic output by volume.

A significant amount of R&D is carried out in other sectors for the purpose of the primary sector.

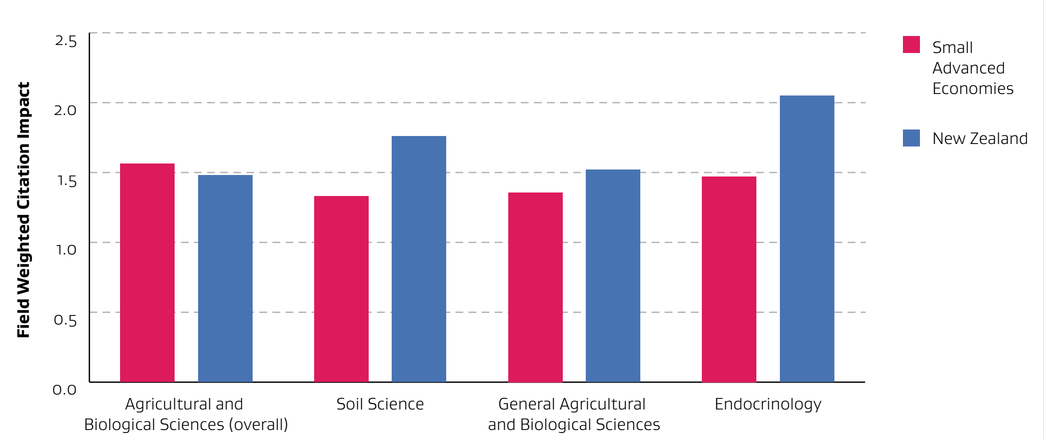
For example, if R&D undertaken by the food and beverage manufacturing industry for the primary sector was included, primary sector BERD would increase (in 2014) from $195 million to $269 million.

Source: Statistics NZ R&D Survey 2014

NEW ZEALAND CAN LEVERAGE SIGNIFICANT PRIMARY INDUSTRIES KNOWLEDGE, R&D AND INNOVATION CAPACITY

We have strengths in some sub-disciplines

The overall quality of our agricultural and biological sciences output is lower than the SAE average, but there are some sub-disciplines where we show a comparative advantage. We also have notable areas of comparative strength in other relevant sub-disciplines of biochemistry, genetics and molecular biology, as the chart below shows.



Source: ©Scival 2015, Elsevier B.V

Government contributes a high proportion of funding for primary sector R&D

Many of government's funding instruments that support primary sector R&D – Primary Growth Partnerships, MBIE-led partnerships, and CRI core funding – seek lower levels of contribution from industry. Government often contributes 50 per cent of the cost of R&D through these schemes.

Government will seek to ensure that primary industries fund an increasing volume and proportion of their own R&D activity and that ongoing public investment in research that directly or indirectly benefits primary industries also incentivises the sector to invest in further R&D itself.

R&D carried out in other sectors benefits primary industries

Recently, the amount of R&D focused on the primary sector has been increasing. In particular there has been growth in R&D in high-tech areas such as chemical manufacturing, scientific and technical services, and computer services for the purpose of the primary sector – known as 'agritech'.

R&D in cross-over areas such as agritech – which currently generates exports worth approximately NZ$1.2 billion per year and is raising productivity and profitability and solving environmental problems – could provide New Zealand with a wider range of export options that will also build our manufacturing and knowledge-intensive services sectors.

Source: Statistics NZ R&D Survey 2014

FUTURE DIRECTION

Given the critical importance of the primary sector to the New Zealand economy, **we do not propose to reduce government's total investment in this area and will seek to increase it over time.**

We will target future investment carefully to foster and **incentivise more industry investment in R&D**, and seek to avoid crowding it out.

We will seek to decrease government's proportion of contribution to each project, but fund more or larger projects.

Where government is directly funding research that is not co-funded by industry, **we will seek to invest in more ideas-driven, discovery research into primary industries, and ensure long term critical industry-good research.**

Closer-to-market research that supports and extends existing business models should primarily be funded and led by industry, for example through levy mechanisms.

Manufacturing sector

R&D IN THE MANUFACTURING SECTOR IS CRUCIAL TO DRIVING EXPORT GROWTH AND DIVERSIFICATION

Manufacturing is our largest sector in terms of R&D expenditure, spending $522 million in 2014, mostly by business.

High-tech manufacturing is the most R&D-intensive subsector in the economy and the most export intensive.

Manufacturing accounts for:

- around **13 per cent of GDP**
- **10 per cent of workers**
- **4.3 per cent of all firms.**

Employment in the sector is declining overall, but food and beverage manufacturing employment is growing.

High- technology manufacturing is growing rapidly, with exports rising from less than $100 million a year in 1990 to $1.4 billion in 2012. Exports from medium-high-technology goods are twice the size, at $2.8 billion.

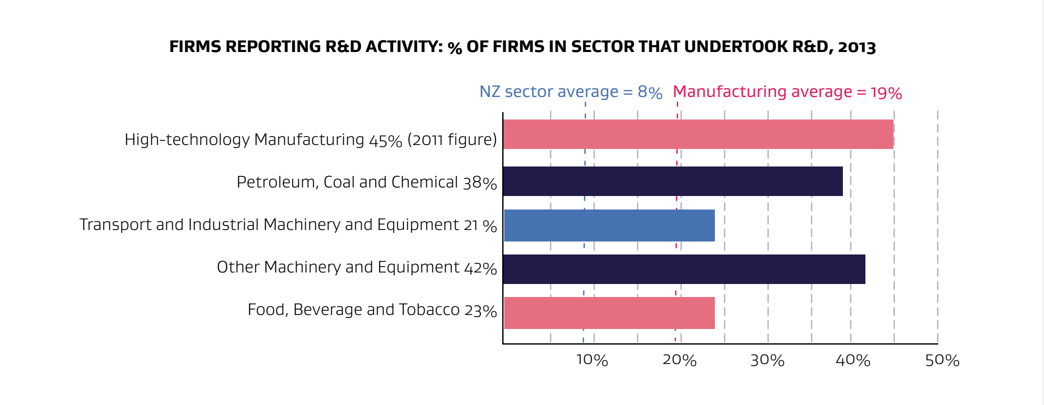
R&D expenditure in the manufacturing sector declined slightly between 2012 and 2014, from $536 million to $522 million. In 2014, it accounted for 20 per cent of total R&D in New Zealand.

Machinery and equipment manufacturing firms perform a significant share of New Zealand's business R&D ($295 million), as do food manufacturers ($109 million).

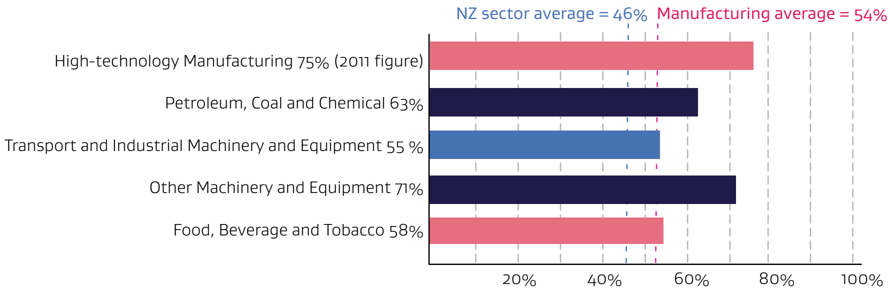
THE MANUFACTURING SECTOR IS R&D INTENSIVE AND OFFERS SIGNIFICANT OPPORTUNITY FOR HIGH-VALUE EXPORT GROWTH...

R&D and innovation in the manufacturing sectors

Significantly more firms in the manufacturing sectors engage in both R&D and innovation activities than firms in most other sectors.



FIRMS REPORTING INNOVATIVE ACTIVITIES: % OF TOTAL FIRMS IN SECTOR, 2013



We have niche areas of strength in our manufacturing sectors and are well connected internationally

New Zealand has niche areas of strength in high-tech manufacturing, ranging from, and for example, medical devices and quartz crystals for global positioning systems, to powered wheelchairs.

In 2012, New Zealand firms had $24 billion in direct investment overseas. Manufacturing sectors accounted for 41 per cent of this investment.

Food and beverage manufacturing was the highest goods exporting sector, with $24 billion in 2012 and the second fastest growth (6.1 per cent).

FUTURE DIRECTION

The Government's Business Growth Agenda (BGA) seeks to grow exports from the manufacturing sectors and raise the sector's R&D intensity. Within the BGA there are over 40 initiatives that seek to develop the high- and medium-high-technology manufacturing sectors.

These include, most importantly, **establishing Callaghan Innovation to encourage greater business investment in R&D, lifting R&D co-funding substantially (now up to $142 million per year)**, and helping to better commercialise smart ideas into successful products.

We need to adapt to a changing manufacturing sector. Digital modelling, advances in robotics, additive manufacturing (eg 3D printing) and ICT trends (such as big data) are changing manufacturing. R&D investment will ensure New Zealand can take advantage of these changes.

Supporting basic research is crucial to underpin future industry growth and diversification. We will continue to invest, and increase direct investment, in more basic, far-from-market, ambitious research and enabling technologies to support long term growth of manufacturing.

Our workforce needs to be responsive to science- and technology-driven change. **A Nation of Curious Minds: He Whenua Hihiri I Te Mahara** places special emphasis on young people and on science education. The Plan aims to **encourage science- and technology-competent learners, and ensure more choose STEM-related career pathways.**

Source for all statistics: Statistics NZ R&D Survey 2014

ICT sector

ICT IS PLAYING AN INCREASINGLY IMPORTANT ROLE IN OUR ECONOMY AND SOCIETY

The ICT sector's contribution to New Zealand's GDP is growing fast and reached $8.3 billion in 2013.

Every sector of the economy and many other aspects of life are being affected by rapid digitisation, with some sectors changing fundamentally.

The development of strengths in highly skilled, knowledge-intensive digital sectors is likely to be vital to our future.

The vast majority – more than 80 per cent – of ICT R&D is funded by industry. Most of the remainder is funded from higher education sources.

The boundary between R&D activity, product customisation (eg for export) and general product development is often fuzzy.

IT product firms are typically highly innovative and R&D intensive.

Nearly 40 per cent of ICT product firms undertook R&D in 2014, 4.5 times the New Zealand firm average.

ICT firms are generating both exports and skilled employment.

ICT generated the biggest component of growth in industry-led R&D between 2012 and 2014.

ICT IS TRANSFORMING THE WAY WE WORK

New Zealand is well placed to benefit from ICT R&D

The international Networked Readiness Index calculates that New Zealand has the second most favourable political and regulatory environment of 144 countries to exploit the opportunities offered by ICT innovation. We also have:

- **a thriving sector:** the number, size and revenue of firms in this sector in New Zealand are growing fast. We have emerging strengths, for example in our growing gaming industry, where around 90 per cent of New Zealand firms' revenue is derived from overseas
- **world-class people and research:** New Zealand's level of ICT skills is ranked 6th of 148 countries and government is making a further investment to increase the supply of skilled graduates for the ICT industry by the establishment of ICT graduate schools. New Zealand computer science research has improved from being below world average quality (by FWCI) in 2004 to being comparable in quality with the other small advanced economies in 2012
- **world-class infrastructure:** the quality of our ICT infrastructure is ranked 12th of 143 countries.

Our ICT firms are R&D intensive and growing fast

Some ICT firms in New Zealand are experiencing strong revenue growth in international markets

But the way some ICT products and services are delivered means that they might not be detected by traditional measures of exports – for example, where services designed and managed from New Zealand are delivered by offshore subsidiaries, including international IT platforms.

The combined revenue of the computer system design sector increased by $1.1 billion in the period 2009–2013, to reach $6 billion annually.

New Zealand has good levels of connectivity, but is not yet making the most of technological opportunities

New Zealand households and firms are in general well connected

Mobile broadband connections topped 3.7 million in 2014. The number of fibre connections grew faster in New Zealand than any other country in 2013/14, with annual growth of 272 per cent. New Zealand now ranks 15th out of 34 OECD countries for fixed broadband subscriptions, up from 22nd in 2004.

The impacts of this increased connectivity have not been exploited fully

Firms that make more extensive use of ICT are, on average, more productive. According to research by the Innovation Partnership, New Zealand firms could add a further $34 billion to the economy if they made effective use of the internet.

In the Networked Readiness Index, we rank 22nd of 148 countries for the impact ICT has on our economy and society, for example in patent generation and in improving access to basic services. This indicates scope to increase ICT's broader economic and social impact.

FUTURE DIRECTION

Government is investing in infrastructure, including Ultra Fast Broadband, and in the science sector specifically, in the National e-Science Infrastructure (NeSI); New Zealand Genomics Ltd; and Research and Education Advanced Network New Zealand.

Although primarily aimed at increasing the supply of skilled graduates for the ICT industry, **ICT graduate schools should, over time, become hubs of excellence for research into ICT.**

Our academic research strength in ICT should increase over time to support ongoing innovation and talent development. Research in ICT currently appears to be driven primarily by the pull of product ideas and market opportunities, rather than a drive to expand the knowledge frontier from within the research community.

We will seek to obtain a more secure long term basis for ICT R&D, rather than crowd out near-to-market, industry-led research activity. Business will continue to take the lead in developing innovative products and services.

We will examine opportunities for new investment in ICT research, particularly in basic research. This will support long term growth, encourage spillovers to New Zealand's economy and society, and develop our reputation as an international ICT destination.

Source: Statistics NZ R&D Survey 2014 and New Zealand ICT Sectors report

Environment

ENVIRONMENTAL RESEARCH IS CRUCIAL TO ENSURING WE CONTINUE TO DERIVE BENEFITS FROM OUR NATURAL RESOURCES

New Zealand's prosperity depends on a healthy and well-functioning environment.

Environmental science that helps maintain and improve our environment can deliver significant improvements to our quality of life and wellbeing.

Our primary industry export markets and tourism depend on the quality and sustainability of our environment.

The World Bank ranks New Zealand as the eighth most endowed nation for natural resources and first for renewables. New Zealand also has the eighth largest marine Exclusive Economic Zone in the world; but our understanding of its economic potential is limited.

We must manage this inheritance sustainably. Effective policy, informed by excellent research, is key to tackling this challenging task.

Environmental research underpins the future of two our largest industries.

Environmental research contributes significantly to the survival of two of our major sectors – primary industries (eg agriculture, horticulture, forestry, seafood) and tourism.

THE ENVIRONMENT PROVIDES VALUE FOR ALL NEW ZEALANDERS

Most environmental research is for public benefit

Government is the main funder of environmental research. Government's high level of investment in environmental science is justified in areas where the public is the primary beneficiary, such as understanding the environment, its inherent processes, and threats and mitigations.

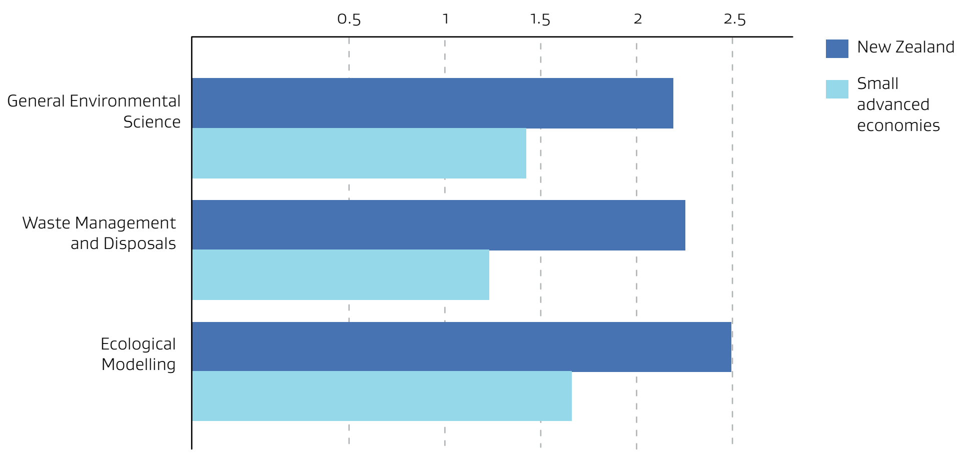
Other areas of environmental science have more direct application in addressing the impacts of some industries. These include technologies to mitigate adverse effects of agriculture intensification, or knowledge to inform management of fisheries and their impact on marine resources.

New Zealand has several strengths in environmental research

Overall, our environmental science outputs are of high quality, with an average FWCI of 1.51, although this is slightly behind the average of the Small Advanced Economies group (1.67). We have significant strengths in some areas, for example ecological modelling, waste management and general environmental science.

Currently, 27 per cent of environmental science research is in the top 10 per cent of journals worldwide and 19 per cent is among the top 10 per cent most cited publications worldwide.

FIELD-WEIGHTED CITATION IMPACT (AVERAGE FWCI BY SUB-CATEGORY 2010–2014)



Source: ©Scival 2015, Elsevier B.V

The Government will seek to continue increasing investment in building our research strengths and in excellent, high-impact science that underpins a range of applications or has a clear public benefit.

FUTURE DIRECTION

Effective environmental management can underpin economic goals

A significant opportunity for improving New Zealand's environmental management is to improve our information and evidence base, and our understanding of environmental opportunities and limits.

Unique natural resources require a New Zealand-specific approach

Government-funded environmental research should be relevant to the local context and natural heritage. It should take into account government's wider strategic plans and priorities for environmental management, and the unique relationship of Māori with their environment.

For example, priority research might support national and international environmental commitments, or the goals of the Crown-Māori economic growth partnership He kai kei aku ringa.

We will balance productivity and sustainability

Where environmental research has strong links to primary industries, we will continue to seek an appropriate balance of public and private investment.

We will seek to fund research that increases the productive potential of our environment, while preserving and enhancing its quality and sustainability.

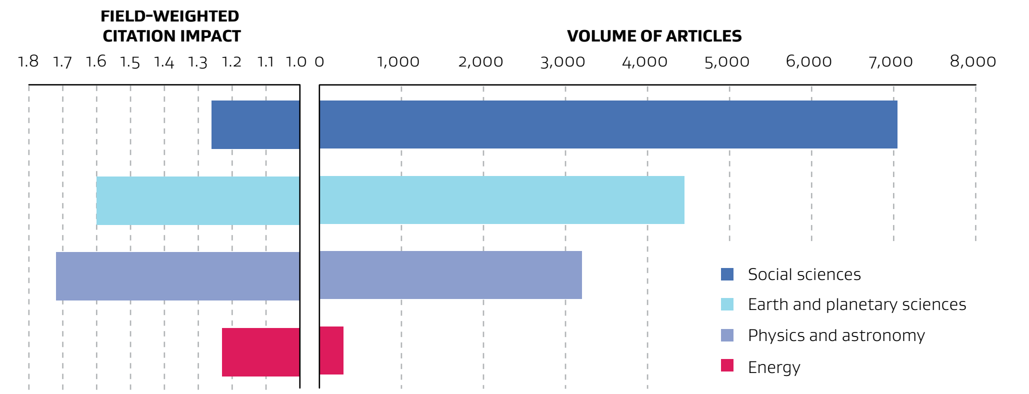
Research for a range of other sectors makes significant contributions to our knowledge output

NEW ZEALAND HAS DEPTH AND STRENGTHS IN A RANGE OF FIELDS, AND EXPERTISE IN CRITICAL AREAS

The 2014 R&D survey recorded $855 million of expenditure in New Zealand on research for the purpose of sectors other than health, primary industries, ICT, manufacturing and the environment.

This is approximately 32 per cent of New Zealand research expenditure. Of this, approximately 51 per cent was carried out in higher education institutions, 39 per cent in businesses and 10 per cent in government.

Research in the social sciences, earth and planetary sciences, and physics and astronomy makes up a large component of New Zealand's scientific output by articles published.



Source: ©Scival 2015, Elsevier B.V

THE SOCIAL SCIENCES CONTRIBUTE TO OUR UNDERSTANDING OF ISSUES AFFECTING NEW ZEALANDERS

New Zealand has significant breadth of expertise in the social sciences.

Social sciences research is a critical input into policy-making and wellbeing for New Zealand. Social sciences research and research with social components cut across multiple fields of science, from economic to environmental research. It indirectly delivers financial dividends, for example by mitigating adverse health or environmental impacts or generating better understanding of our resources.

Poor health or social outcomes are extremely costly to New Zealand, and social science contributes to effective safeguards, treatments and solutions. Effective interventions – for example in the education or justice systems – are generally far more feasible, cheaper and more effective than rehabilitation or restoration.

NEW ZEALAND'S RESEARCH STRENGTHS UNDERPIN CRITICAL WORK ON NATURAL HAZARDS

Physics and astronomy, and earth and planetary sciences are significant areas of research output and expertise for New Zealand. **Based on an analysis of citations, New Zealand has particularly strong competencies in earthquakes and volcanic eruption research.**

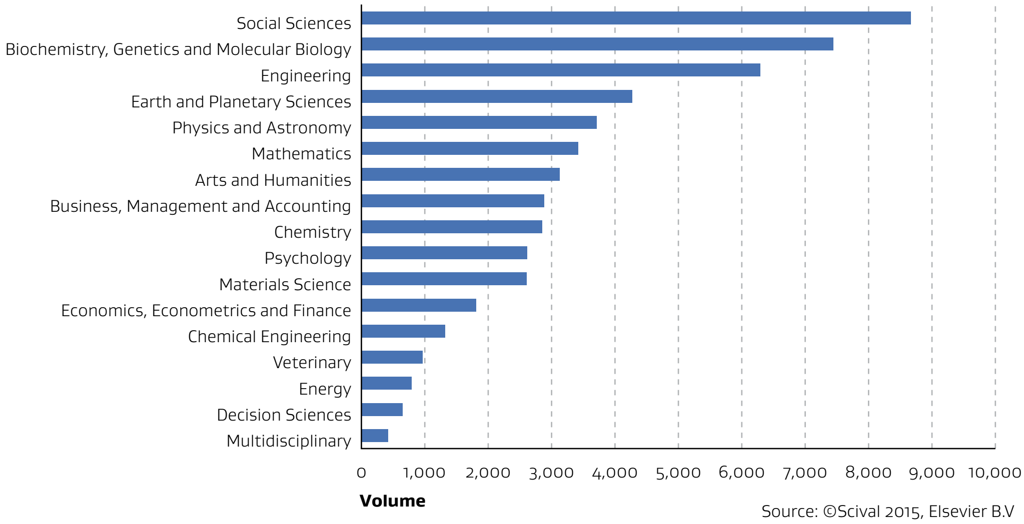
Enhancing New Zealand's resilience to natural disasters is critical to our safety and wellbeing – this is reflected in the Government's commitment to the Natural Hazards Platform and the *Resilience to Nature's Challenges* National Science Challenge, which support research across multiple disciplines including geology and the social sciences – to understand the natural hazards that may occur in New Zealand, and to build socially and economically resilient communities.

AND WE HAVE OTHER NICHE STRENGTHS, FOR EXAMPLE IN ENERGY-RELATED RESEARCH

New Zealand has concentrated expertise in areas of energy research, including in aspects of nuclear and renewable energy.

These strengths support a range of priorities including the sustainable use of natural energy sources and understanding of natural hazards.

VOLUME OF PUBLICATIONS, BY FIELD



Source: ©Scival 2015, Elsevier B.V

FUTURE DIRECTION

Social science supports delivery of the Better Public Services: Results for New Zealanders targets the Government has set for the public sector to achieve over five years, under five themes: reducing long term welfare dependence, supporting vulnerable children, boosting skills and employment, reducing crime, and improving interaction with government.

We recognise the critical role social research plays in underpinning outcomes in a number of different areas and will continue to support it in the future.

The impact of social sciences research is maximised with strong connections to end-users and when effective uptake mechanisms are established. The Government has invested in collaborative mechanisms such as Partnerships, Primary Growth Partnerships and the National Science Challenges. These initiatives aim to connect and pool resources and drive uptake.

The Government recognises the importance of attracting, developing and retaining talent in research areas of critical importance to New Zealand. We already have a range of mechanisms to support talent across different fields and levels of the system.

A three-year investment plan for the MBIE contestable research fund will provide greater predictability of research opportunity in a range of research areas. The fund will be focused on the excellence of science and its potential to generate impact on New Zealand.

Investment in people

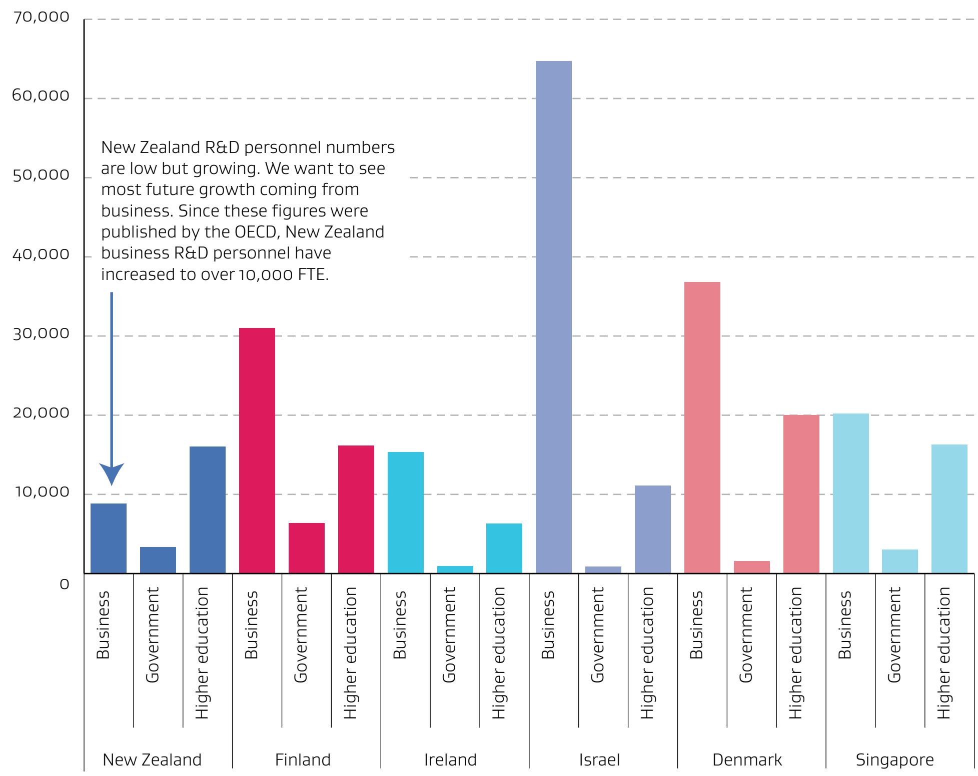
The success of New Zealand's science system depends critically on the people who work in it. Science is a human endeavour, and the excellence and impact of our science will be determined by the quality of our scientists.

New Zealand is an outlier among small advanced economies both in the relatively small number of scientists working here and in the high proportion of them who work in the government and higher education sectors. However, we have also seen strong growth: the number of R&D personnel grew by 5 per cent between 2012 and 2014 (to 29,900) and FTE researchers in the business sector increased by 20 per cent over the same period (from 5,100 to 6,100).[11]

Getting more scientists working in industry, and the broader economy, is important for growth and wellbeing

It is in the business sector that we expect to see most growth in scientists in the future as this will enable new and existing businesses to innovate and generate new products, collaborate with research organisations and make better use of external research and technology.

R&D PERSONNEL BY SECTOR, 2012



Source: OECD MSTI indicators and Statistics NZ R&D Survey 2012

High-performing scientists have an important role in improving the overall quality of science, and attracting new pools of talent and investment from industry

Scientists who are thought leaders in their respective fields can influence the quality and direction of research carried out by other scientists. Some evidence suggests that high-quality individuals, and the teams around them, can help raise the excellence and impact of research, and of researchers within their institutions.[12] High-performing scientists also tend to help attract new pools of talent and investment, and they initiate new collaborations with other research organisations, industry and international partners.

We already have a wide range of mechanisms to attract, develop and retain talent in the science system

Government already has a large number of funds and programmes that support talent at different levels of the science system.

These range from indirect mechanisms, such as weighting of components of the PBRF and the expectation that National Science Challenges will include opportunities for early career researchers, to more direct mechanisms such as Marsden Fast Start Grants and Rutherford Discovery Fellowships.

New Zealand already attracts high-performing scientists, and New Zealand scientists are well connected internationally

Analysis of bibliometric data suggests that New Zealand has one of the most mobile research communities among small advanced economies – 77 per cent of New Zealand researchers have moved out of New Zealand at least once.[13] And New Zealand is successful in attracting scientists. Our inflow and outflow of researchers are slightly positive in favour of New Zealand, and researchers arriving in or returning to New Zealand tend to show better performance on academic publication metrics than those leaving.

We will consider further measures to attract, develop and retain talent

Over the period of this Statement, we will consider direct and indirect approaches to support and retain talent in the science system.

As with many other areas of science policy, we will initially require better data and reporting on the performance of our system, and scientist roles in contributing to that performance, to ensure that any intervention we put in place is efficient and effective, and is the best route to achieve excellence and impact in our system.

In 2011, the Government established Te Pūnaha Hihiko - Vision Mātauranga Capability Fund (around $6.6m per year) to invest in projects that contribute to the development of skilled people and organisations undertaking research that supports the four themes of the Vision Mātauranga policy. We anticipate that the skills and networks developed and supported through the fund will contribute to an ongoing increase in the quality of proposals and research in this area.

We will also consider carefully how such initiatives work alongside our research institutions and industry

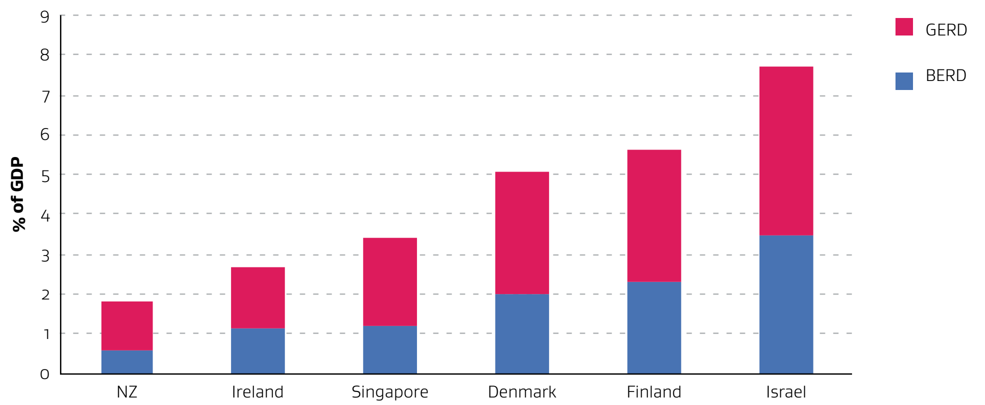
Our research institutions hold the primary responsibility for attracting, developing and retaining their scientists, and we do not wish to encroach on their ability or flexibility to do so in the way that best meets their needs. Any initiatives need to be based on sound evidence, a clear sense of roles and responsibilities, and clear benefit to New Zealand.

The future investment pathway

New Zealand's investment in R&D is low compared to other small advanced economies, although public investment has grown significantly – by over 70 per cent – since 2007/08.[14]

New Zealand's level of business R&D, although also growing, remains particularly low, and the Government's aspirational goal to lift it to 1 per cent of GDP by 2018 is critical to boost New Zealand's productivity, and, through that, improve wellbeing.

BERD AND TOTAL R&D EXPENDITURE AS A PERCENTAGE OF GDP, 2013 OR MOST RECENT DATA

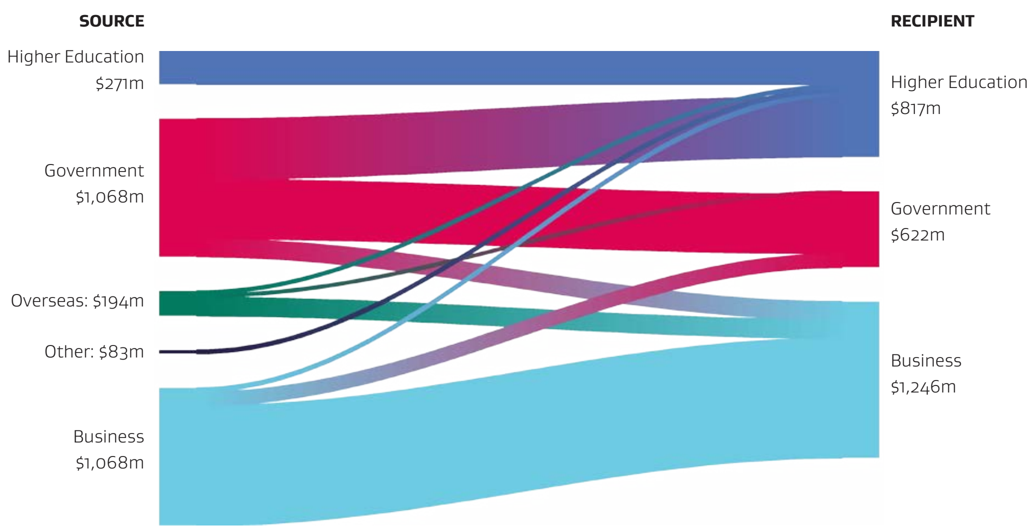


Source: OECD MSTI. Data extracted on 28 Aug 2015 from OECD.Stat

Government has also stated its intent to raise its own expenditure on R&D to 0.8 per cent of GDP as fiscal conditions allow, part of which will support the BERD goals through grants to businesses. Government will make further investments where there is strong evidence to indicate performance, that is where there is a strong likelihood that excellent, high-impact research will result.

The relationship between government, business and higher education expenditure on R&D is complex, as all actors support the others financially in some way, whether through grants, contracts, direct funding, or other mechanisms. The chart below shows these flows.

SOURCES AND RECIPIENTS OF R&D EXPENDITURE – FLOWS, NEW ZEALAND, 2014



Source: Statistics NZ R&D Survey 2014

RAISING GOVERNMENT EXPENDITURE TO 0.8 PER CENT OF GDP, AS FISCAL CONDITIONS ALLOW

The Government has committed to increase public expenditure on science to 0.8 per cent of GDP as fiscal conditions allow. The additional investment entailed in meeting this commitment is substantial.

Additional investment will be contingent on evidence of performance and guided by the priorities and design principles set out in **section 5** of this Statement. Our intention is to establish stable priorities over the period to 2025. We will seek to make progress on all our priorities simultaneously, although some will take precedence over others at certain times.

Additional funding will be invested to:

› increase support for investigator-led discovery research. In particular, we will consider increases to the Marsden Fund, and MBIE contestable funds

› continue to support the BERD goal through initiatives such as Growth Grants

› increase investment in health research, particularly considering how this additional funding could be used to leverage New Zealand's strengths in health research by extending and diversifying related industries and ensuring uptake of health research by health service providers

› support ICT research by investing in basic, investigator-led facilities, talent, and projects.

The Government will consider progress and update this investment strategy and priorities when the Statement is refreshed in 2018.

THE LEVEL OF GOVERNMENT SUPPORT FOR BERD

The Government financial support for BERD is a critical component of raising business investment. Businesses tend to under-invest in R&D, and government financial support is a recognised and useful policy instrument to correct this, particularly as the benefits of business R&D tend to accrue to society as a whole. Investment will not be the Government's only policy to increase BERD – more detail on our plan to lift business innovation is set out in **section 5** of this Statement. The Government wants to see New Zealand firms funding a greater proportion of BERD in future.

To meet the goal of increasing BERD to 1 per cent of GDP, annual BERD will need to increase substantially. Government's support for that goal will vary by sector. Achieving this goal will require substantial additional investment by industry, intensified government support and continuing co-funding by government.

The Government wants to see a New Zealand science system that is...

- as simple as possible
- transparent
- stable, and
- high performing.

Section 5:

Investing in the Future

Design principles

This section of the Statement sets out an ambitious programme of work for the Government over the next five years – one that will continue to have impact beyond this period. A number of complex and cross-cutting projects are planned, and these will have multiple impacts on the system and its users.

To guide us in ensuring these changes are complementary, and achieve the desired aims, we will adopt the following design principles throughout our work.

1. We will work to ensure an **appropriate role for the Government**. This statement has set out a rationale for different types of government investment in science and innovation, and we will ensure, as far as possible, that these are central to any policy changes. This means making sure that where individual firms or other end-users receive the benefits of science, they are meeting an appropriate proportion of the cost. It also means ensuring that where the government is funding a significant proportion of the cost of research, the results of that benefit New Zealand as a whole. We want to ensure the systems we establish or reform are functioning effectively with minimal need for ongoing direct intervention from the government.

2. We want to create **as simple a system as possible**, with clear expectations and incentives. A complex system makes it more likely that the incentives put in place – for example, to improve the excellence of our research – do not work as effectively as they could. Science systems are naturally complex; however, we want to take every step to ensure our mechanisms for supporting the science system are efficient and effective.

3. New Zealand's science system should ensure **high performance and transparency**. To ensure a high-performing system, we will develop easily accessible information on our science, and the people, institutions and funding that support it. This is important so we can make intelligent, well-informed investments, use information to monitor and raise the bar on performance and, most importantly, be able to account for our actions and use of public money.

4. Finally, we want the system to be **stable** in its objectives and instruments. Science is, for the most part, a long term endeavour, and stability is necessary to support this. This does not mean we will shy away from making changes where needed, and equally we will not hesitate to admit something is not working and take appropriate action. But our aim across the reforms outlined in this section will be to create flexible, responsive systems that will remain stable over time, and will be able to adapt to changing circumstances without the need for major redesign.

The Government wants to see a New Zealand science system that is as simple as possible, transparent, stable, and high performing.

Improve evaluation and performance measurement in the sector

WE WILL UNDERTAKE A PROJECT TO MAKE SUBSTANTIAL IMPROVEMENTS TO OUR INFORMATION AND DATA SYSTEMS

Timely and reliable information is needed to underpin the effective functioning and steering of any system. Information on the science system is currently subject to significant gaps, although bibliometric datasets are becoming increasingly sophisticated and comprehensive.

A key priority for government is to improve evaluation and performance measurement of the science and innovation system. Assessing the impact and value for money of government investment in science and innovation requires some basic information which needs to be available system-wide.

Improving the underpinning information on science and innovation inputs, outputs and outcomes will provide a solid base for assessing the impact of the Government's investment in research and science over the long term. It will also serve in setting policy priorities, prioritising funding across the science and research system, and improving accountability. Better information systems will also lead to more efficient and effective processing of grant applications. We will consider different kinds of research according to their merits, but excellence and impact will underpin investment decisions.

The work programme in this area involves identifying the data needs, current data sources and gaps, followed by potentially establishing a system-wide data hub that can connect to the various information sources and databases. In addition to providing information to underpin policy decisions, a system-wide monitoring, evaluation and information system would also considerably reduce transaction costs for researchers when applying for funding and reporting on the use of funds. It could serve as a valuable tool for researchers and the general public to know what research is being undertaken and by whom. This information will also help New Zealand gain maximum value from historical investments.

We will publish an annual system performance report

A system performance report will provide a point-in-time snapshot of the performance of science and innovation in New Zealand. The system performance report will cover system-wide performance measures such as R&D intensities, research quality and commercialisation outcomes, public investment in science and innovation, institutional performance, business innovation measures, and public engagement with science and technology. It will improve in detail and evaluative effectiveness over time as better information becomes available.

Raising BERD

The Government has set an aspirational goal of lifting R&D performed by businesses to 1 per cent of GDP by 2018. As noted elsewhere in this Statement, raising BERD is of critical importance to New Zealand. Government wants to see the science system grow, and we want to see much of that growth driven by private investment. The Government's Business Growth Agenda (BGA), particularly the Innovation workstream, sets out the Government's action plans for achieving the goal. This Statement sits alongside that plan, and gives details of how the science system and the Government's future science and innovation investment will complement the actions set out in the BGA.

New Zealand faces unique challenges in increasing its levels of BERD. New Zealand has few large firms or multinational companies; these tend to be the largest investors in R&D. Large organisations have access to the scale, capital, and ability to manage risk that enables them to invest proportionally greater amounts in R&D. This is why attracting multinational corporations is part of our strategy for increasing BERD.

In New Zealand, firms with more than 250 employees perform less than a third of all business R&D, compared to 60–80 per cent in other countries. New Zealand also lacks significant scale in some sectors that tend to invest most in R&D, such as defence, automotive and pharmaceuticals.

We have already done much to support industry

The Government has significantly increased its investment in industry-led research since 2010. This includes:

- the establishment of Callaghan Innovation in 2013 to work with businesses to help them turn their knowledge into successful commercial products and services and to improve their growth and competitiveness. Its focus is businesses in the manufacturing and services sectors. It provides services to business and distributes the business R&D funds. The R&D grants incentivise firms to increase their R&D by co-funding 20–40 per cent of the cost of their R&D projects
- $566 million provision in Budget 2013 over four years for Callaghan Innovation's business R&D grants to assist business to engage in research and development
- $80 million additional funding over four years for business R&D Growth Grants in Budget 2015
- the introduction of the Primary Growth Partnership (PGP), in 2010. The PGP is aimed at market-driven innovations, including R&D, and encourages collaboration and connections between research organisations and business. A 2014 report by the New Zealand Institute of Economic Research estimated that the PGP could add up to $6.4 billion to New Zealand's GDP from 2025, with the possibility of a further $4.7 billion if the aspirational stretch of programmes is realised, the innovations are taken up widely, and all the research and development is successful
- changes introduced in the 2012/13 Performance-Based Research Fund (PBRF) review to increase the External Research Income (ERI) component from 15 per cent to 20 per cent of PBRF. ERI is a strong proxy indicator for knowledge transfer between tertiary education organisations and industry. Increasing the value of the ERI component rewards and encourages tertiary education research of relevance to end-users.

FUTURE INVESTMENT IN BUSINESS R&D

Significant further investment from various sources will be required in order to meet the goal of increasing BERD to 1 per cent of GDP by 2018, and Government will continue to work alongside business to achieve this goal. Our aim is to assist New Zealand industry to develop its own capabilities to invest in, and conduct a much greater share of, research than it currently does. New Zealand industry is likely to gain significantly from greater industry-led research activity, with equally significant spillover benefits to New Zealand generally.

Government's planned future investments include:

- increasing funding for business R&D grants (in particular R&D Growth Grants) on demand
- Callaghan Innovation implementing a comprehensive suite of services to accelerate the growth of the high-value manufacturing and services sector. These include:

    - **Technology and product development**
      Helping businesses take an idea from concept to commercial reality.
    - **Access to experts**
      Opening doors for New Zealand businesses seeking innovation advice, skills, support and technical expertise.
    - **Innovation skills**
      Helping businesses build in-house innovation skills and capability through a range of training programmes.
    - **Business collaborations**
      Collaborative innovation projects supporting businesses to tackle targeted technology projects jointly with other businesses, industry associations and research organisations.
    - **R&D grants**
      Adding scale to businesses' R&D investment by reducing the cost and risk of R&D for innovative firms.

- leveraging exports and international expansion to increase returns from R&D. Exporting and R&D are mutually reinforcing. New Zealand Trade and Enterprise (NZTE) assists companies to enter and grow in international markets by linking them to the market experts, capital and business partners. The Government is increasing NZTE's funding so they can provide these services to more firms
- attracting multinational corporations to invest in R&D in New Zealand by coordinating the Government's response to R&D opportunities, understanding what influences R&D investment decisions, marketing New Zealand as an R&D destination and ensuring complementary investments in the science system. MBIE has funded $1 million for this initiative from within baselines
- working with key sectors to identify and address barriers to R&D and sector growth.

ESTABLISHING REGIONAL RESEARCH INSTITUTES

There is provision in Budget 2015 of $25 million over three years for the establishment of new Regional Research Institutes, which will connect industry to science and research, and increase business R&D in the medium term. The creation of such institutes will also help improve the responsiveness of the science system to industry needs and will leverage private sector investment in doing so.

Our interest in establishing Regional Research Institutes in New Zealand has multiple aims. Government seeks to cluster and scale industry R&D investments towards the creation of new knowledge and potentially new technologies, mitigating the challenges faced by small firms. We also aim to direct 'external-to-firm' science expertise towards industry-led initiatives, where expertise is otherwise not available, easily accessible, or appropriable by firms.

By doing so we want to add to New Zealand's capacity to accelerate the development of science into technology, attract international R&D investment opportunities, and expand export opportunities.

Strengthen the science system and its institutions

Given Government's growing investment in science and innovation, we are focused on ensuring the publicly funded science system is coherent and fit for purpose. Government has already done much work in this area, and will continue to make progress with critical reviews and improvements. Evidence from this work will inform and underpin any future investments.

WE WILL ENSURE THE NATIONAL SCIENCE CHALLENGES DELIVER ON THEIR PROMISE

Government has committed to investing $351.8 million in new funding for 11 National Science Challenges (NSCs) over 10 years.

The NSCs, which commenced in 2014, are designed to take a more strategic approach to the Government's science investment. They target a series of objectives which, if achieved, will have major and enduring benefits for New Zealand. The NSCs provide an opportunity to align and focus New Zealand's research on large and complex issues by drawing scientists together from different research institutions and across disciplines to achieve each NSC objective through collaboration.

We are focused on delivering on the ambitious objectives of the NSCs. A mid-term review is scheduled to ensure the NSCs deliver on their objectives and generate additional impact through their collaborative structure. Alongside the mid-term review, a performance framework for the NSCs has been developed. The framework covers monitoring, evaluation, audit and review of the NSCs. It considers performance of the NSC portfolio as a whole against the aims of the policy, as well as the performance of individual NSCs and their components.

GOVERNMENT WILL REFORM MBIE'S CONTESTABLE FUND TO INVEST IN EXCELLENT RESEARCH TO DELIVER LONG-TERM, TRANSFORMATIVE IMPACT FOR NEW ZEALAND

The Draft NSSI announced a review of MBIE's contestable fund, alongside increased funding of $57 million over three years.

The review proposed reducing the six sector-based funds to fewer, larger funds and to align MBIE's contestable funding with the future direction and objectives of the science and innovation system. The review also aimed to improve flexibility and responsiveness of the fund and to reduce complexity and cost of operational processes.

The review found that the MBIE-administered contestable fund could be a powerful lever to drive an increasing focus on excellence and impact. It recommended a new approach to catalyse ideas-led research with the potential to collectively deliver long-term, transformative impact and improved outcomes for New Zealanders.

We are making changes to the fund's purpose in the science system, structure, and operational processes:

1. a single, more agile and responsive fund
2. increased predictability of funding opportunity through a three year investment plan
3. an increasing focus on excellence of research and impact for New Zealand
4. a broader focus on engagement and depth of relationship with end-users
5. managing and evaluating the fund as an investment portfolio.

Work has continued in this area, and this Statement is the first in a series of announcements that will lead to a reformed and improved MBIE contestable fund, which will be implemented for the 2016 investment process.

Key features of the new contestable fund are as follows. The contestable fund will remain one of the Government's main mission-led investments. It will support research with the potential to challenge and transform New Zealand's economic performance, how we strengthen our society, the sustainability and integrity of our environment, and give effect to Vision Mātauranga. This fund will use competition between scientists for funding to drive an increasing focus on excellent research with impact in areas of future value, growth and critical need for New Zealand.

A single fund, managed as an investment portfolio

We will move from six separate, sector-specific funds, to a single fund for excellent, impact-driven science. We expect this will provide greater investment flexibility for both the science sector and decision-makers. The new fund will have a clear purpose of supporting excellent research that targets long-term, transformative impact for New Zealand. We expect to fund an increasing quality of science and for the focus of the fund to shift to higher risk research.

This structure also provides the discretion and flexibility to shift funding between portfolio areas as needed. We expect a single fund to provide greater predictability of opportunity: scientists will be able to bid every year, and will not have to wait until money becomes available from expiring contracts in their particular field.

A three-year investment plan

Decisions within the single fund will be guided by an investment plan with a three-year horizon. The investment plan will provide clear signals on how government seeks to grow or change its investment. The investment plan will direct the Science Board on the level of funding available each year for new contracts. It will provide greater predictability for the science sector on bidding opportunities.

Funding will be offered through two investment mechanisms, with an annual call for proposals

The new fund will have two investment mechanisms:

- **The first investment mechanism will provide fast-fail support to test promising, but higher risk research ideas**
  Grants will provide short-term support by funding research projects with potential for significant impact for New Zealand. Grants will allow for high technical risk, innovative approaches or uncertainty over implementation pathway(s) to market or end use, which may be indicative in nature.
- **The second scheme will provide support for ambitious, but well-defined larger-scale research programmes**
  Grants will provide medium-term, larger-scale support by funding research projects and programmes to develop ambitious, but well-defined research ideas with the potential to deliver significant impact for New Zealand through credible implementation pathways. This investment mechanism expects a team with demonstrated complementary skills in science and delivery of impact, with strong, established end-user relationships, building on both domestic and overseas research and connections.

Clear criteria of excellence and impact

This fund will use competition between scientists for funding to drive an increasing focus on excellent research with impact in areas of future value, growth and critical need for New Zealand.

Investment decisions will be based on independent, expert assessment of the science excellence and potential for impact for New Zealand. Value for money considerations will be integrated as a consideration into these two criteria.

The independent Science Board will continue to make the funding decisions on proposals made to the contestable fund.

The contestable fund is not intended to support science where measurable benefits primarily accrue to the research organisation itself or primarily to an individual firm or organisation. Research with an obvious commercial or practical application that can be realised within a timeframe acceptable to commercial investors to be supported through separate industry-led funding mechanisms, primarily invested through Callaghan Innovation.

WE WILL CONTINUE TO INCREASE INVESTIGATOR-LED FUNDS

During the consultation for the draft NSSI, several submitters from tertiary education and peak science bodies suggested that funding for investigator-led research should be increased. The Marsden Fund is the primary source of funding specifically for investigator-led science, although Universities and CRIs also do significant amounts of other types of research funded from other sources. Government recognises that funding for excellent investigator-led research can generate substantial returns to society over time, and we will consider opportunities to increase Marsden, and other funds focusing on more uncertain types of research, as fiscal conditions allow. Over time, better data and information will help inform where future investment is best targeted.

GOVERNMENT IS UNDERTAKING A STRATEGIC REFRESH OF THE HEALTH RESEARCH COUNCIL

The Ministry of Health and the Ministry of Business, Innovation and Employment have provided advice to the Minister of Science and Innovation and the Minister of Health on how to maximise the contribution of the HRC to broader health and economic goals. Officials undertook an extensive consultation process, holding focus group discussions in the main centres to hear views from health researchers, district health board staff, the commercial sector and not-for-profit organisations. Many stakeholders also provided written comments that were an important input to the refresh.

The advice on the strategic refresh seeks to ensure health research plays a central role in both the health sector and the science and innovation system. The strategic refresh recommends an ongoing central role for the HRC in health research in New Zealand and signals health research as a priority for investment. The HRC has played a critical role in supporting health research in New Zealand and this role needs to continue in the future. The refresh seeks to ensure health research in New Zealand continues to compare well internationally, placing New Zealand science on the international stage.

Officials from the Ministry of Health and the Ministry of Business, Innovation and Employment will work closely with the HRC to implement the recommendations of the refresh, which include developing a health research strategy. The strategy will set priorities for health research, improve alignment between funding mechanisms, and enhance connections across the health research and innovation system. Other recommendations seek to clarify the role of the HRC and improve the governance arrangements of the HRC.

WE ARE REVIEWING CRI CORE FUNDING

Government introduced CRI core funding in July 2011. Core funding gave CRIs a much larger portion of stable, long term funding. Feedback from CRIs had suggested that the high level of contestability in their funding rendered them financially vulnerable, creating uncertainty and undermining their ability to act strategically.

CRI core funding is $202 million per year across all CRIs under a five-year contract. On average this equates to around 30 per cent of CRIs' revenue, but with a high degree of variability across CRIs. Core funding was introduced alongside wider changes in the performance arrangements for CRIs. Greater autonomy for CRI Boards to manage funding was matched by greater levels of accountability and performance monitoring.

The contracts for CRI core funding expire in June 2016. MBIE is therefore undertaking a review of CRI core funding to determine whether changes should be made to improve its effectiveness.

Given the changes to the science system that have taken place over the last five years and the planned future changes, it is timely to review the function and key objectives of CRI core funding in relation to other science funding instruments, in particular the NSCs.

The review will consider the ongoing role, performance and future alignment of core funding in the context of funding of the science and innovation system. The review will explore ways to maximise the effectiveness and impact of this investment mechanism.

WE WILL DEVELOP AN INTERNATIONAL SCIENCE AND INNOVATION STRATEGY

To be at the cutting edge of new knowledge, New Zealand's relatively small scientific output relies on international collaboration with well-recognised and sophisticated international partners.

We intend to publish a new international science and innovation strategy in the 2015/16 financial year. This will provide an international dimension across government's activity in science and innovation. The strategy will consider the role of the NSCs and the contestable funding round in supporting international science collaboration.

The new strategy will take a high-level and cross-government view. We expect that the scope of the international science and innovation strategy will encompass the following areas:

- Actions to build genuine depth and scale in science collaboration, ensuring that prioritised activities are making a measurable contribution to New Zealand's science outcomes, and that we are achieving a stronger balance of domestic activity and accessing international knowledge.
- International science cooperation, including prioritisation of regions/economies, prioritisation of partner organisations and prioritisation of sectors and research infrastructure access opportunities.
- Internationalisation of innovation, including attracting R&D investment from multinational companies, internationalisation of firms, and international connectivity of, and international talent attraction to, innovation hubs.

WE WILL CONTINUE TO WORK TO GIVE EFFECT TO THE VISION MĀTAURANGA POLICY

Vision Mātauranga is a policy framework intended to unlock the science and innovation potential of Māori knowledge, resources and people to assist New Zealanders in creating a better future. It focusses on distinctive issues, challenges and opportunities arising within Māori communities and encourages research that will contribute to New Zealand as a whole. The policy also advocates excellence in research related to the themes and outcomes of the policy.

The policy is also incorporated into the CRI Statements of Core Purpose as part of their operating principles. The review of CRI core funding will consider how effectively this has occurred to date and if necessary make recommendations to strengthen performance in this area. Vision Mātauranga outcomes are also integral to the delivery of the National Science Challenges, and significant work is occurring at this early stage to effectively integrate these outcomes into the development of the Challenges.

The Government established Te Pūnaha Hihiko – Vision Mātauranga Capability Fund (around $6.6 million per year) in 2013 to invest in projects that contribute to the development of skilled people and organisations undertaking research that supports the Vision Mātauranga policy's four themes. We anticipate that the skills and networks developed and supported through the fund will: contribute to an ongoing increase in the quality of proposals and research in this area; complement the business assistance offered by the Māori Innovation Fund; and support the Māori focussed research carried out by the recently selected Māori Centre of Research Excellence. Together, these initiatives support the actions in He kai kei aku ringa – the Māori Economic Development Strategy and Action Plan.

Given the increasingly prominent role Māori organisations are playing in the primary industries and other commercial sectors, we can also consider opportunities to work with these organisations to determine how appropriate research at the interface between Māori knowledge and R&D can contribute to growing our economy in an environmentally sustainable manner.

Giving effect to the Vision Mātauranga policy is not only about how the research responds to distinctive issues and needs of Māori and Māori communities, but also about how Māori can participate in research initiatives that benefit New Zealand. It will remain a key element of Government's approach to investing in science and in building capacity in the Māori economy and enabling Māori to realise their full economic potential.

WE WILL CONTINUE TO ENGAGE NEW ZEALANDERS THROUGH *A NATION OF CURIOUS MINDS: HE WHENUA HIHIRI I TE MAHARA*

A Nation of Curious Minds: He Whenua Hihiri i te Mahara (the Plan) was launched in July 2014 to encourage and enable better engagement with science and technology across New Zealand.

The Plan addresses science education, science communication, science literacy and the application of science-based evidence in public sector decision-making at all levels. It sets out a strategic direction for the next 10 years with specific actions for the next three years.

The actions in the Plan are intended to deliver on the following outcomes:

› More science- and technology-competent learners, and more choosing STEM-related career pathways.
› A more scientifically and technologically engaged public and a more publicly engaged science sector.
› A more skilled workforce and more responsive science and technology.

The Plan places special emphasis on young people and on science education. Science literacy is fundamentally important to the future of young New Zealanders. It gives our students a platform to engage fully, and to compete, both at home and internationally. New Zealand's future economic development and wellbeing are contingent on having a highly skilled workforce. The education system will underpin this and it must be able to prepare all New Zealanders to be participants, and leaders, in a 21st century economy and society.

WE WILL CONTINUE TO SEEK EFFECTIVE WAYS TO DELIVER ACCESS TO THE CRITICAL RESEARCH INFRASTRUCTURE OUR GROWING SCIENCE SYSTEM NEEDS

Over the past five years, the Government has directly invested around $90 million to support the development and maintenance of research infrastructure. In 2013/14, $24.6 million was invested to support large-scale research infrastructure initiatives.[15] A significant portion of this investment is matched by institutional investors and user co-funding, and in the case of the Australian Synchrotron was made achievable through international cooperation.

In general, investment in infrastructure will continue to be supported through full-cost funding, with institutions primarily responsible for developing and maintaining research capability. However, this approach does not optimise development, access and use of large-scale research infrastructure, where:

› there are challenges in coordinating effort because of a high number of users
› infrastructure can create future opportunities of strategic benefit for New Zealand
› there are public benefits associated with the infrastructure that extend beyond those who use it.

In these situations, the collective case may be stronger than the individual case, and government may work at a strategic level with research organisations to help them overcome the barriers they face to accessing critical infrastructure.

For example, government may facilitate a joint approach, establish governance structures, provide seed funding, or support risk-sharing arrangements. Strategic considerations for government involvement include infrastructure's role in:

› building capabilities and talent required for nationally significant research
› increasing the contribution to and benefit from global research and collaborations
› improving competitiveness and outcomes from science and innovation investment
› preserving valuable information across research areas over long timeframes.

Where the Government agrees there is a case for strategic involvement, it may request, or assist in the development of, a business case to respond to research infrastructure needs. As well as the value and benefits the infrastructure may provide, cases will have to consider options for sustainable delivery, including government financial support where required, and responsiveness to developments in technology, markets and capability needs over time.

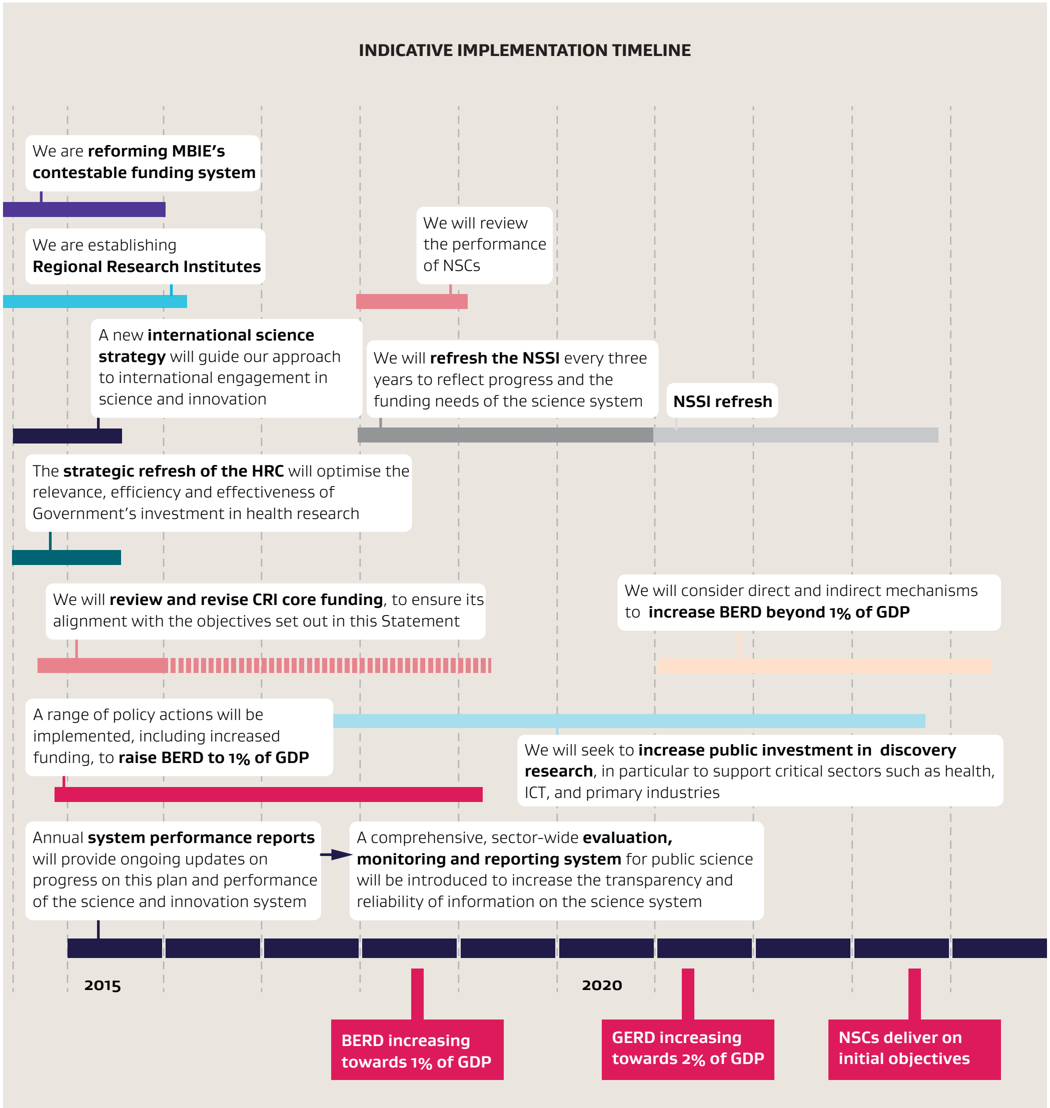
Section 6:

Implementation

Implementation timeline

The timeline for changes and key milestones set out in this Statement is presented in the diagram below. This sets out the Government's plan to achieve our vision for 2025 of a highly dynamic science system that enriches New Zealand, making a visible, measurable contribution to our productivity and wellbeing through excellent science.

The NSSI will be refreshed every three years to reflect progress and the funding needs of the science system.



Endnotes

1 NZ Treasury Estimates

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7 Using Statistics New Zealand R&D survey category classifications

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12 Azoulay, P., Graff Zivin, J., & Manso, G, (2011). Incentives and creativity: evidence from the academic life sciences. *RAND Journal of Economics*, 42(3), 527–554.

13 Source: Brain Circulation Report prepared for MBIE, 2014

14 NZ Treasury Estimates

15 NZ Treasury Estimates