

New Zealand Government

NEW ZEALAND'S RESEARCH, SCIENCE & INNOVATION STRATEGY

Draft for Consultation

SEPTEMBER 2019





**MINISTRY OF BUSINESS,
INNOVATION & EMPLOYMENT**
HĪKINA WHAKATUTUKI

Ministry of Business, Innovation and Employment (MBIE)

Hikina Whakatutuki - Lifting to make successful

MBIE develops and delivers policy, services, advice and regulation to support economic growth and the prosperity and wellbeing of New Zealanders.

MBIE combines the former Ministries of Economic Development, Science + Innovation, and the Departments of Labour, and Building and Housing.

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Our Research and Innovation System

RSI STRATEGY

Our research, science and innovation system consists of people, institutions (including research organisations and businesses), and infrastructure. Many people are engaged day-to-day in innovating, researching and connecting with each other in a wide range of activities that contribute to research, science and innovation.

The processes of research and innovation rely on fluid connections between the components of the system. Those connections are a key theme of this strategy.

REGULATION

Regulation sets the scene for a lot of innovative activity in our economy, although we have not yet been explicit about its use or potential.

We want to consider regulatory systems approaches to some of the key goals in this strategy. These can be activity-specific, such as supporting our innovative aerospace industry, or more generic, such as enabling free transaction of knowledge and ideas between research institutions and businesses, and a strong commercialisation system.



Much of our work over the past five years has focused on ensuring our funding systems are fit-for-purpose and work well together to support the full range of research, science and innovation activity.

Our next tranche of work will focus on ensuring that the other components of our system - people, institutions, regulation and Government - are working in concert and set up for success.

INSTITUTIONS

Around 4,000 businesses in New Zealand report performing R&D, with many more engaging in innovation. We also have 8 Universities, 7 Crown Research Institutes, and a number of independent research organisations dedicated to research activity.

We need to continue to ensure that our research institutions are set up and well supported and to succeed as world-leading producers of knowledge, and that our businesses and public services have access to the research and support they need to build on and use that knowledge.



PEOPLE

Not including students, New Zealand has around 20,000 FTE researchers, of which around 40% work in business.

People are at the heart of research, science and innovation. We currently have few policies directly focused at developing, attracting and retaining excellent researchers. We also need to increase the diversity of our researchers, and ensure greater opportunities for Māori.

We also need engaged users of research, and a general public actively interacting with the future possibilities of research and innovation.



GOVERNMENT

The Government works in this system through setting the overall strategy and direction, investing, ownership of some institutions, and creating enabling regulatory frameworks.

Government, and the public services it provides, is also an important user of research and innovation, to inform decisions and provide better and more effective public services across social, health and environmental functions.

MBIE functions as system steward across all domains of research, acting on behalf of Government for the research system.

INFRASTRUCTURE

Research and innovation infrastructure is housed in our businesses and research institutions. Government directly supports some large parts of this - from research vessels to pilot plants and particle accelerators.

We want to focus on sustainable provision of future-focused infrastructure, in particular our databases, collections, and e-research infrastructure. We also want to create or participate in opportunities to share infrastructure with our international partners.



INVESTMENT

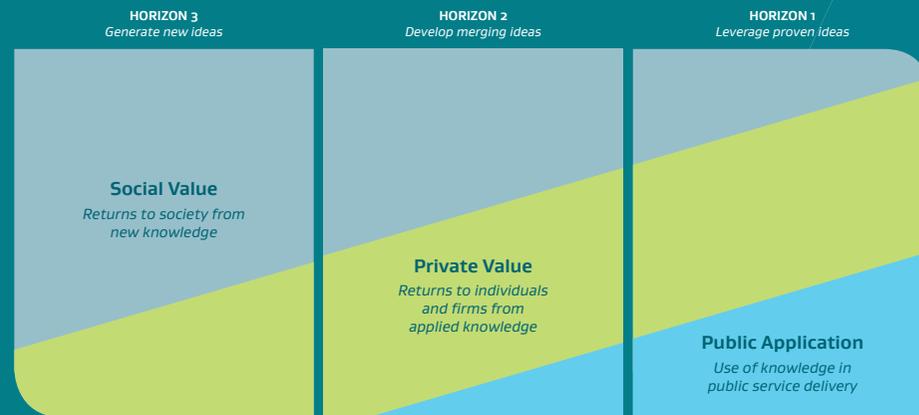
Both Government and businesses invest in the research and innovation system - and this investment needs to grow. More detail on our investment system is shown on the next page.



Our Investment System

We think about investment in research, science and innovation as occurring over three horizons: 'generate new ideas', 'develop emerging ideas', and 'leverage proven ideas'. Activity in horizon one will usually be close to application, and would normally be development of a new public service, or a new product by a firm. Activity in horizon three will be more fundamental research or development of ideas that will take many years to be used.

It is important that our activity is spread across these horizons, and that government maintains an appropriate role as an investor proportionate to the spread of public and private value. Government will be a major investor in horizon 3 research (for example via the Endeavour fund), but a minor investor in a business developing a new product (for example, via the R&D Tax Incentive). In horizon 1, value can also arise from the use of research in delivery of specific public services. This is not the broad social value arising from knowledge, but the specific social value arising from better public service delivery. Investment and decisions here are best made by the public sector entity charged with delivering the service.



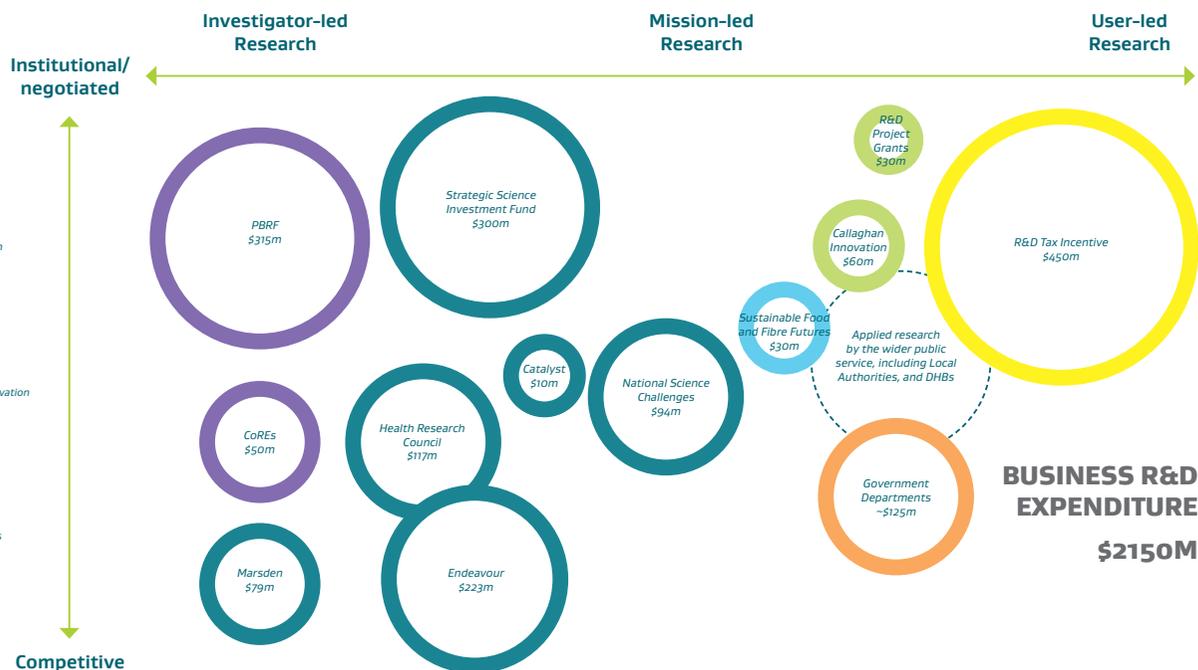
INVESTMENT

Our investment systems are designed and maintained to support a range of research, development and innovation activity, from blue- skies investigation to applied R&D. All of this activity is important, and needs to be supported in balance across the system.

We support this activity with complementary investment mechanisms. Stable long-term institutional funding is important to build and grow teams and make significant progress on big challenges and problems. Competitive funding creates dynamism and the opportunity for new ideas. Some less-targeted funds offer the opportunity for researchers or industry to use their knowledge to determine the best direction for research. Targeted by the wider public service, including strategic funds enable the government to make directed purchases for the benefit of New Zealand's future.

We have worked to ensure that these funds are deployed appropriately and in balance, that we are clear on the objectives of all funds we operate, and that the way the funds operate closely matches those objectives. This work has been accompanied by significant increases in support from government - an increase of almost 60% since 2010.

- MBIE
- MBIE/Callaghan Innovation/IR
- MOE/TEC
- Callaghan Innovation
- MPI
- Other Agencies



Harnessing research and innovation to advance the wellbeing of all New Zealanders into the future

By 2027, New Zealand will be a global innovation hub, a world-class generator of new ideas for a productive, sustainable and inclusive future.

Guiding Principles

Excellence - Connections - Impact

1. MAKING NEW ZEALAND A MAGNET FOR TALENT

Develop a large scale talent initiative to grow, attract, and retain the best researchers, entrepreneurs, investors, and visionary thinkers.

Ensure diverse talent can thrive and grow in our research and innovation system.



2. CONNECTING RESEARCH AND INNOVATION

Develop a global best practice research commercialisation system, with a growing network of technology incubators, and a regulatory systems approach to publicly-funded IP.

Connect New Zealand with global research leaders working at the knowledge frontier. Integrate with overseas RSI systems for mutual benefit on global challenges, such as climate change, and opportunities to share research infrastructure.

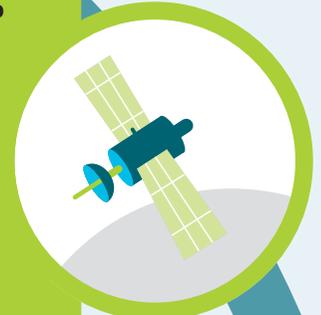


3. START-UP^SCALE-UP

Scale up our research and innovation capabilities in key focus areas at the global frontier.

Develop a flexible and graduated system of support that enables start-up firms to fast-track their growth and achieve scale.

Establish innovation missions to address public good opportunities, such as kaitiakitanga of our biological heritage, and health system delivery.



4. TOWARDS AN EXTENDED VISION MĀTAURANGA

Ensure the RSI system is open to the best Māori thinkers and researchers.

Ensure the innovation system is open to the energy and ideas of our Māori entrepreneurs.

Resource and protect Mātauranga Māori.

Create an environment where Māori entities and businesses invest with confidence in research and innovation.



5. BUILDING FIRM FOUNDATIONS

Create a progressive investment programme to enhance the contribution of main RSI funds to government health, social, environmental and economic objectives. Focus on sustainable increases to the R&D Tax Incentive, the Endeavour Fund, the Marsden Fund and the Health Research Council.

Ensure our structures, funding, and policies encourage our public research organisations to form a coordinated, dynamic network of research across the horizons of research and innovation.

Ensure our research infrastructure is placed on a sustainable footing. We will focus on e-research, databases and collections, and international scale infrastructure collaborations.



Consultation on the draft RSI Strategy

This is a draft version of the RSI Strategy which has been produced for public consultation.

We have included some suggested questions throughout this document, but welcome any other comments you may have. You can find out more about how to submit your feedback on the MBIE website - <https://www.mbie.govt.nz/have-your-say/draft-research-science-and-innovation-strategy>.

Consultation on this draft closes on 10 November 2019.

About this document

The purpose of the Research, Science and Innovation (RSI) Strategy is to communicate the government's objectives for RSI in New Zealand; to highlight priorities for government action within the Research, Science and Innovation portfolio; and to signal its intentions and directions. This will ensure all actors in the RSI system understand the government's direction in advance and are able to act on that information.

This updates and replaces the 2015 National Statement of Science Investment, which was the previous strategy in this portfolio.

The RSI Strategy is set out in five parts.

Part 1 provides context and definitions. It sets out what research, science, and innovation are; why they are important; and the contribution we expect them to make to New Zealand.

Part 2 describes our key challenge around connectivity. This is where we set out **where** we will focus the government's activity for greatest effect, and **why** we think this is the right area to focus on.

Part 3 contains our high-level guiding policies. This sets out **how** we will act.

Part 4 sets out our proposed actions. This is where we discuss **what** we plan to do.

Part 5 sets out how we will know if we have been successful.

There are also two annexes. Annex One sets out descriptive and technical policy information on the government's current policies and funding systems, and the fundamental logic for government investment in RSI. The annex also describes design principles for any future policy initiatives. Annex Two sets out possible success indicators and metrics.

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Summary

This government has a bold ambition for New Zealand, looking to bring about a productive, sustainable, and inclusive future that works for all New Zealanders. We have set ourselves an ambitious agenda, including tackling big challenges such as the transition to a zero-carbon economy by 2050, supporting our regions to grow, preserving and protecting our environment, creating fulfilling and high-value jobs, and increasing our wellbeing.

Achieving these goals requires fresh thinking and better ways of doing things. Research, science, and innovation (RSI) will play a central role in delivering this future for New Zealand. This strategy sets out how RSI will play that role, and how the government plans to act to support it.

To drive and focus New Zealand's efforts in RSI we have set an ambitious vision:

By 2027, New Zealand will be a global innovation hub, a world-class generator of new ideas for a productive, sustainable, and inclusive future.

To support this goal, this government has set a target to raise national research and development expenditure to two per cent of GDP by 2027. The share of our collective resources dedicated to knowledge creation and use must grow quickly to enable us to achieve the future we want.

This strategy focuses on how New Zealand can innovate towards the frontier – the leading edge of what the world knows and can do. This means introducing products, services, and processes that are new to the world; solving problems that nobody else has solved or is likely to investigate; capitalising on new areas where nobody else has been successful so far; and making the most of opportunities that are unique to us. It means investigating areas where New Zealand is the only country likely to do so.

The three principles at the heart of this strategy outline what we think is important to effect the change we need to see, and are: excellence, impact, and connections.

Excellence and impact were established by the National Statement of Science Investment (NSSI) in 2015, the previous strategy in this portfolio. Excellence and impact have been updated for this RSI Strategy and will continue to be key guiding principles.

However, we believe the greatest opportunity for strengthening our RSI system lies in building stronger connections within this system and beyond. Improving connections is important in many aspects of our RSI activity: within New Zealand's research community; between researchers and end users; and internationally with other experts, business communities and markets. Weak connections can limit the flow of information, knowledge, capital, and ideas within parts of system, both domestically and abroad.

Strengthening these channels will help us build create denser, richer networks of people, ideas, and resources. We need to encourage ease of transaction – between innovators and entrepreneurs, and the beneficiaries or users of the knowledge and innovations they create. This needs to happen between institutions, across different spheres and types of activity, and internationally as well as nationally. We want to create a fluid, dynamic marketplace where knowledge is shared and used easily in the right places at the right times.

Impact remains central to RSI, ensuring we are focused strongly on the change to the economy, society or environment that will arise as a result of our research and innovation. Better information on impact will help us make better decisions in the future, and help demonstrate the value of government's enduring investment in RSI to the taxpayer.

Our proposed action areas build on these themes. Much work has been done for the past five years on ensuring the RSI investment system is well-designed and fit for purpose, most recently with the introduction of the Research and Development (R&D) Tax Incentive. We now need to turn our attention to the other components of our system: people, institutions, infrastructure, and regulatory systems.

Key to our actions is the idea that we want to build scale in selected areas of opportunity, advantage, and critical need. Concentrating some of our effort across our policy tools in a small number of areas where we can make the biggest differences will help New Zealand work at the global frontier in those areas, as will ensuring we have a thriving start-up sector creating new high-value jobs and solutions for our future.

People are absolutely central to RSI, and our proposed action area around developing, supporting, retaining, and attracting world-class talent will have a transformative impact on what we do. We want to make New Zealand a magnet for talent. To achieve this, we will need to ensure we are nurturing the careers of those researchers who choose to work in New Zealand.

The most important component of this must be to act with urgency to improve the diversity of people in RSI in New Zealand. Our RSI system is not yet fully capable in terms of engaging productively with Māori, and our research system has significant gender disparities. This is bad for all of us. It is only by combining diverse ideas, backgrounds, knowledge, and experience that we will truly innovate at the global frontier, and have a research and innovation system that reflects the needs of our own society.

We also want to make sure that the basic building blocks of our RSI system, which are our research organisations and infrastructure, are working well and fit for purpose. We need to continue to ensure that our research institutions are set up and well supported to succeed as world-leading producers and users of knowledge, to help ensure a productive, sustainable and inclusive future for New Zealand.

Part 1 – Background

The Contribution of Research, Science, and Innovation

Our ambition for New Zealand

This government is committed to a productive, sustainable, and inclusive New Zealand. We have set an ambitious agenda to achieve that outcome. We are bringing fresh energy and thinking to tackle big challenges, such as transitioning to a zero-carbon economy by 2050, ensuring everybody has a warm, dry home, and making New Zealand the best place in the world to be a child.

We are building a modern economy that is fit for the 21st century and beyond. That means being smarter in how we work. It means an economy that produces and exports higher value goods, and one that protects the environment, supports our regions to grow, and makes sure all New Zealanders share in the rewards of economic growth.

We also want every New Zealander to have access to world-class education and healthcare, to live in a home that is healthy and in a community that is safe, and to realise their potential.

The role research, science, and innovation will play in achieving our goals

Achieving these ambitious goals requires fresh thinking and better ways of doing things. This vision cannot be delivered with the same old approaches. We need new ideas, innovation, and new ways of looking at the world, as well as the ability to share and work with the knowledge and ideas we already hold. We need to make sure we use this knowledge well.

RSI will play a crucial role to help deliver these goals. By systematically exploring problems and opportunities through research, we generate new knowledge. This helps us to understand and address social and environmental challenges, as well as generate ideas and technologies. By applying this knowledge through innovation, we can develop capabilities and services that can make a real difference to our people and our environment. By turning this knowledge into new products, processes and services we can reduce our emissions, preserve and protect our environment, create fulfilling, high-value jobs, and increase our wellbeing.

Not only is RSI critical for the achievement of these goals, in many instances it is the only way of making progress. These activities are some of the most important we undertake collectively to secure a productive, sustainable, and inclusive future for New Zealand.

To reflect the importance of RSI in achieving our goals, this government has set a target to raise R&D expenditure to two per cent of GDP by 2027.

Our vision for research, science, and innovation in New Zealand

To drive and focus our efforts in research, science and innovation, we have set an ambitious vision:

By 2027, New Zealand will be a global innovation hub, a world-class generator of new ideas for a productive, sustainable, and inclusive future.

In this context –

Productive means making the best of what we have, and providing opportunities and the means for our people to maximise their wellbeing and prosperity.

Sustainable means our resources, environment, and people are brought together in ways that respects their value in the future, as well as today, and that we exercise kaitiakitanga responsibly over these resources.

Inclusive means the ability to participate in and benefit from RSI, which will be widely and equitably shared.

How this Strategy Supports the Government's Priorities

We have determined twelve priorities we want to focus our efforts on as a government. These are –

Build a productive, sustainable and inclusive economy

1. Grow and share New Zealand's prosperity
2. Supporting thriving and sustainable regions
3. Deliver responsible governance with a broader measure of success
4. Transition to a clean, green carbon neutral New Zealand

Improving the wellbeing of New Zealanders and their families

5. Ensure everybody who is able to is earning, learning, caring or volunteering
6. Support healthier, safer more connected communities
7. Ensure everyone has a warm dry home
8. Make New Zealand the best place in the world to be a child

Providing new leadership by government

9. Deliver transparent, transformative and compassionate government
10. Build closer partnership with Māori
11. Value who we are as a country
12. Create an international reputation we can be proud of

We expect the new knowledge and ideas generated by our RSI activities will contribute to all of these priorities. RSI is an essential input to any transformational change. Over time, we expect to continue to align our RSI activity to all of these priorities, and to understand the gaps and opportunities we can address. Research, science and innovation are at their most powerful when linked to clear purpose.

In the near term, we expect RSI to make specific contributions to the priorities where it is best placed to do so.

Supporting a **transition to a clean, green, carbon neutral New Zealand** is a central part of our RSI efforts. Our environmental research covers not just climate change but biosecurity, conservation, fresh water, and numerous other projects in related areas.

On the next page, we set out an example of how the RSI system functions practically to support government priorities; in this case, around the transition to a clean, green, carbon neutral New Zealand. Under the RSI Strategy we will intensify this support in two ways. One of these is by strengthening international connections, which will help New Zealand to access knowledge and solutions that are available elsewhere and address some of this country's challenges. The other is by focusing resources on those areas where New Zealand faces a unique challenge or has a specific need that others are unlikely to address (eg, reducing methane emissions from dairy cattle). This will provide a greater chance of generating solutions than if resources were spread evenly across all areas.

As we proceed to implement this strategy, we plan to deepen this analysis and conduct similar analysis under other priorities to help identify alignment and duplication. We will also consider where RSI can bring world-leading knowledge and innovation to bear on our collective challenges and opportunities. More information on this approach is provided in Part 4.

How does the RSI system contribute to work on climate change?

- › Research, science and innovation are critical to achieving our goal of transitioning to a clean, green, carbon neutral New Zealand.
- › The Productivity Commission's low-emissions economy report (August 2018) highlighted that we need to devote more resources to low-emissions innovation and technology to account for the long timeframes involved in bringing these innovative ideas to fruition.
- › The RSI system contributes to this in a wide variety of ways – from basic research which grows our understanding of climate change, its impacts and how to adapt, to practical technology development and investment in solutions to reduce agricultural emissions. It is important that we continue and grow research and innovation across all these horizons of activity.

We have identified over \$100m per year of RSI expenditure that relates directly to climate change. This doesn't include early stage research whose potential impact is unknown, or R&D support to businesses which may be working on emissions-related products or services.

We set out below some examples of projects and investments which contribute in different ways.

PLAYING OUR PART IN UNDERSTANDING GLOBAL CLIMATE CHANGE

We contribute a great deal to the global effort to understand the history, causes, and progress of climate change. Some examples include –

- › **The Deep South National Science Challenge** (funded for \$51.1m over ten years) aims to improve our predictions of climate change and its impacts.
- › **The Antarctic Science Platform** (\$49m over 7 years) includes a wide range of work to understand Antarctica's impact on the earth's climate and how this will change under global warming.

The **Marsden Fund** has funded smaller projects on improving the accuracy of carbon accounting tools, and improving our understanding of human induced climate change.

UNDERSTANDING NEW ZEALAND'S EMISSIONS

The **Endeavour Fund** regularly supports projects which examine and extend our understanding of New Zealand's emissions. Some current examples of these include –

- › Advancing New Zealand's carbon inventory (\$11.4m)
- › City-scale emissions sources modelling (approx. \$1m)

RESEARCH CONTRIBUTING TO LOW-EMISSIONS TECHNOLOGIES

Our research efforts include science with the potential to contribute to future low-emissions technologies. For example, the **MacDiarmid Institute** is a Centre of Research Excellence, with one research focus on exploring novel ways to capture and store energy, and to absorb greenhouse gas emissions. It is funded from a range of research funding streams, and receives around \$8m per year from the CoREs programme.

HELPING NEW ZEALAND ADAPT TO OUR CHANGING CLIMATE

Our research is helping communities and our climate sensitive industries to adapt to the increasing impact of climate change. Some current examples include:

- › **The Endeavour Fund** – climate change impacts and extreme weather assessments (2018, approx. \$1m), improved sea-level rise projections to anticipate and manage coastal impacts (\$7m over 5 years); research on the rates of coastal ocean acidification and management of their impacts on marine resources (\$7.1m over 5 years).
- › **The Climate and Weather Hazards Platform** – measurement and predictions of climate change regionally across New Zealand and the wider Pacific; improving forecasts of extreme weather events such as floods and damaging storms to build community resilience; predicting future changes to freshwater resources and its impacts; estimating the risks and costs of future sea level rise, and providing measures of changes in atmospheric gases to international climate change databases to guide future emission reductions (\$104m for 7 years).

REDUCING NEW ZEALAND'S AGRICULTURAL EMISSIONS

New Zealand has for some time been a significant player in research to reduce agricultural emissions. We supported this work with investment of over \$25m in Budget 19 alone. For example, we are currently investing:

- › \$8.5m in the **Global Research Alliance on Agricultural Greenhouse Gases** over 2019/20 with a focus on research, technology and practices that grow more food but produce fewer emissions.
- › \$48.9m over four to five years to research agricultural emissions and build on the work of the **NZ Agricultural Greenhouse Gas Research Centre** and the **Pastoral Greenhouse Gas Research Consortium**.

WORKING ON RENEWABLE ENERGY

In Budget 19, we announced two cornerstone initiatives to complement and grow our base of research in renewable energy. These are:

- › **The Advanced Energy Technology Platform** under the Strategic Science Investment Fund will enhance our capability, opening-up opportunities for NZ to support the transition to a low-emissions economy (\$20m, Budget 2019).
- › **The National New Energy Development Centre** will help NZ move towards clean, affordable, renewable energy sources (\$27m, Budget 2019).

CREATING NEW LOW-EMISSIONS INDUSTRIES

We are growing our attractiveness to international firms seeking to conduct R&D on low-emissions and carbon zero technologies in New Zealand. For example, our **Innovative Partnerships** team has worked alongside Zephyr Airworks to support testing and development of its prototype all-electric air taxi 'Cora' in New Zealand, now with over 400 test flights conducted. One of the factors that attracted Zephyr was that New Zealand was committed to building a sustainable energy ecosystem, complementing the zero-emissions potential of electric air transport.

WHAT NEXT?

Our broad base of research in relevant areas is helping prepare the ground for a just transition to a low carbon economy. But we need to do more in terms of innovation; helping businesses and public services identify the changes they need to adapt to our changing climate and begin their transition to low carbon. We expect Green Investment Finance will be a significant support here, but we will also consider initiatives such as innovation challenges to accelerate our progress.

RSI makes transformative contributions to other government priorities

It is not just in climate change where RSI will underpin the achievement of government priorities. We expect RSI to contribute in some way across all twelve of these priorities.

For example, RSI will **grow and share New Zealand's prosperity** and **support thriving and sustainable regions** by generating knowledge and ideas that improve the productivity of our existing economy, and help generate new products and industries. Harnessing the energy and invention of our excellent research and of our innovative firms will accelerate our prosperity and create new jobs and opportunities. This transformation will occur in our regions as well as our main centres. Our primary industries are disproportionately represented in our regions, and ICT will increasingly make location less important for some businesses. Government and industry investment in R&D across primary industries, manufacturing and ICT has grown significantly over the last ten years, and our R&D Tax Incentive will help accelerate this further. This strategy will sharpen the focus on those RSI activities and investments that are likely to have the greatest impact, thereby increasing the productivity of both the public and private sectors.

Under these broadly economic priorities, this strategy connects to and complements our industry strategy, *From the Knowledge Wave to the Digital Age*, published in July 2019. Both have a focus on innovation as a critical input for a more productive economy. However, the RSI Strategy mainly focuses on frontier innovation (see later in this document for more detail), whereas the industry strategy considers 'behind the frontier' adoption and diffusion of knowledge and technology already known to the world. Innovation 'at the frontier' and 'behind the frontier' are complementary, and both strategies are designed to reinforce the others' key goals without duplicating effort across portfolios.

That said, the distinctions between 'at the frontier' and 'behind the frontier' are not clear cut in real life, and for this reason we expect flexibility and cross-contribution across both strategies. The RSI system will generate new ideas, innovations and technology which specifically contribute towards achieving the productivity goals that will be set out in the Industry Transformation Plans developed as part of the industry strategy. The RSI system already makes large and significant contributions to productivity in food and beverage, agritech, digital technology, and forestry and wood processing, and we expect this to continue. Equally, there will be opportunities and emphasis within Industry Transformation Plans to identify and diffuse valuable frontier innovations, both domestically and globally. These plans will also consider industry transformation alongside support and development.

The focus of the RSI Strategy on frontier innovation aligns naturally with the activities of the main actors within the RSI system (research institutions, high-tech start-ups, etc.), whose primary purpose is pushing out the frontier. Hence, the resources put into the RSI system will be better targeted than if they were spread across activities both at and behind the frontier. This will improve productivity of those resources, and in turn improve the productivity of the economy as a whole by driving out the frontier to either create a competitive advantage for New Zealand or address the unique problems that New Zealand faces.

We also expect RSI to be a critical input across all of the shifts envisaged in the government's Economic Plan. RSI activities globally are a major driver of improvements in productivity, and we expect that improvement to happen in New Zealand, particularly when it comes to enabling and building innovative industries. We also expect RSI to contribute to creating sustainable and affordable energy systems, maximising and improving the sustainability of our land use, and revitalising regional economies.

We expect RSI to contribute strongly to **supporting healthier, safer more connected communities** and **making New Zealand the best place in the world to be a child**. In particular, our ongoing work implementing the New Zealand Health Research Strategy, jointly overseen by the Ministry of Business, Innovation and Employment (MBIE), Ministry of Health, and the Health Research Council of New Zealand, is focused on ensuring that the government's investment of almost \$200m per year in health research is being directed to areas of relevance and need in the New Zealand health system. The Health Research Council has recently published its prioritisation framework, developed with support from MBIE and the Ministry of Health. This is an action from the Health Research Strategy which aims to achieve continuous improvements in alignment between our health research and the needs of our health system.

We think we have more to do in terms of our social science responses to support the government's priorities. We need to consider innovation in our public services, and what our RSI system can do to provide knowledge and support to help public services identify the changes they need to make to accelerate progress on the government's priorities. Ensuring our approach to innovation encompasses public services as much as business is a key theme of this strategy.

We are clear on our need to **build closer partnership with Māori**, and the RSI system is one place in which we will be able to extend our partnerships and remove barriers to Māori participating fully. This strategy sets out our initial ideas on how we will go about doing that (see *Towards an Extended Vision Mātauranga* in Part 4).

There are current activities and future opportunities for RSI in terms of **creating an international reputation we can be proud of**. For a small country, and a producer of around 0.2 per cent of the world's research, we already punch above our weight in certain fields of research, with a strong reputation in areas such as agriculture, geological hazards, and health. Our vision for this strategy is that New Zealand will become a global innovation hub. That means extending the global reach of our innovative firms and public services, to match that of our most excellent research.

RSI has more to do to contribute to these priorities

This strategy mainly operates at the level of the RSI system, and deliberately considers generic challenges and opportunities that will have the broadest impact on our research and innovation activities. For this reason, it mentions few specific areas or sectors of research and innovation. Nonetheless, for this draft iteration of the strategy, we are keen to hear from researchers, innovators, firms, and providers of public services on what the system could be doing to accelerate progress on the government's priorities.

How the government connects on RSI

A key theme of this strategy is connections, and we are increasingly adopting cross-government ways of working to ensure the government is connecting effectively on the RSI system. Projects where different agencies share an interest will be jointly governed by those agencies, and those governance structures will have shared responsibility for delivery on the project. Examples of this include –

- Joint governance of the New Zealand Health Research Strategy across MBIE, Ministry of Health, and the Health Research Council.

- MBIE’s Innovative Partnerships function working jointly with the Ministry of Transport, the Civil Aviation Authority of New Zealand, and a range of other stakeholders on the Airspace Integration Trial Programme.
- Collaboration, and joint governance, between MBIE, the Ministry for Primary Industries and the Ministry for the Environment on the direction of food, fibre and farming research. This includes identifying critical primary sector science focus areas, looking for opportunities for New Zealand relating to Agritech and future foods, and reviewing the readiness of the research sector for rapid changes in food and farming science and technology.
- The shared governance and implementation of the R&D Tax Incentive between Inland Revenue, MBIE and Callaghan Innovation.
- MFAT and MBIE’s membership of the Steering Group for the Antarctic Science Platform, helping to ensure this research programme meets cross-government needs.

The government also adopts joint or complementary funding arrangements across agencies to ensure cross-government alignment on critical initiatives. These arrangements include programmes such as funding cooperation between MBIE and the Ministry for Primary Industries on the New Zealand Food Safety Science & Research Centre, and the New Zealand Agricultural Greenhouse Gas Research Centre.

We are seeking to extend these approaches to other areas of research work where responsibility sits across government departments.

The Contribution of Research, Science, and Innovation

Question 1: Where can the RSI System can make the greatest contribution towards the transition to a clean, green, carbon-neutral New Zealand?

Question 2: Where else do you see it making a major contribution?

Question 3: What else could the RSI system be doing to accelerate the progress towards the government’s priorities?

Our Research, Science, and Innovation System

Our RSI system consists of people, institutions (including research organisations and businesses), and infrastructure. Many people are engaged day-to-day in innovating, researching, and connecting with each other in a wide range of activities that contribute to RSI. There is no single overview of this activity held in any one place, and this is fundamental to its nature. To be successful, innovation relies on fluid connections, chance encounters, and free sharing of knowledge. The government works as a steward of this system by setting the overall strategy and direction, investing, ownership of some institutions, and creating enabling regulatory frameworks.

Our system consists of around 20,000 full-time equivalent (FTE) researchers (not including students), around 4,000 R&D performing businesses (with many more reporting innovation), eight Universities, seven Crown Research Institutes (CRIs), and many independent research organisations, business accelerators and incubators, and other support functions. Overall investment in this system was just under \$4bn in 2018, with government investment accounting for around 45 per cent of this.

In considering the activity in the RSI system, it can be useful to visualise this in terms of three horizons – generating new ideas, developing emerging ideas, and leveraging proven ideas. Our investment framework seeks to ensure that, across these horizons, the long value chain from fundamental research to the introduction of new public services or products is supported in balance. Each type of activity is equally important and necessary. Our investment systems and policy approach are designed to provide different types of support appropriate to those horizons and the differing role of the government across each one. More information on our approach to these horizons is included at Annex One.

Much of our work over the past five years has focused on ensuring our investment systems are fit for purpose and work well together to support the full range of RSI activity. Our next tranche of work will focus on ensuring that the other components of our system – people, institutions, regulation and government – are working in concert and are set up for success.

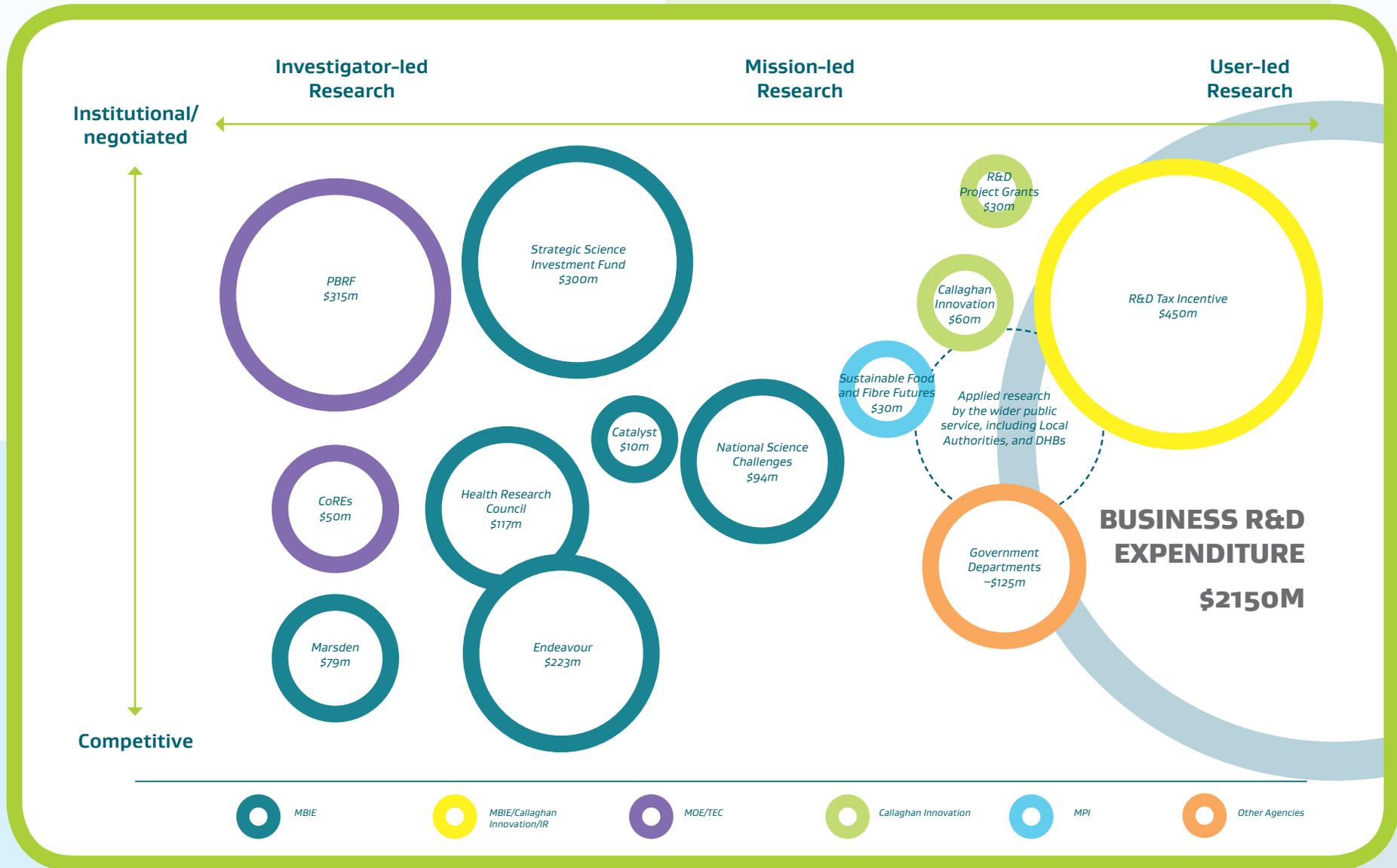
Our investment framework

Our investment framework is designed and maintained to support a range of research, development and innovation activity, from blue-skies investigation to applied R&D. All of this activity is important to achieving our overall goals. We support this activity with complementary funding mechanisms which we seek to deploy in balance.

Stable long-term funding is important to build and grow teams and make significant progress on big challenges and problems. Competitive funding creates dynamism and the opportunity for new ideas. Demand-driven funds offer the opportunity for researchers or industry to use their knowledge to determine the best direction for research. Targeted strategic funds enable the government to make directed purchases for the benefit of New Zealand's future.

These different purposes and functions mean that the investment system may appear complex. However, we seek to ensure that funds are deployed appropriately, that we are clear on the objectives of all funds we operate, and that the way each fund operates closely matches those objectives.

Our Investment System



Dollar amounts represent the government's 'ideal per year' general funding commitments, rather than specific expenditure from a given year. For example, the amount shown for the Tax Incentive is from the fourth year of the scheme (2022/23) as while the scheme is introduced we expect a period of growth in uptake leading up to that year.

Growing Our System

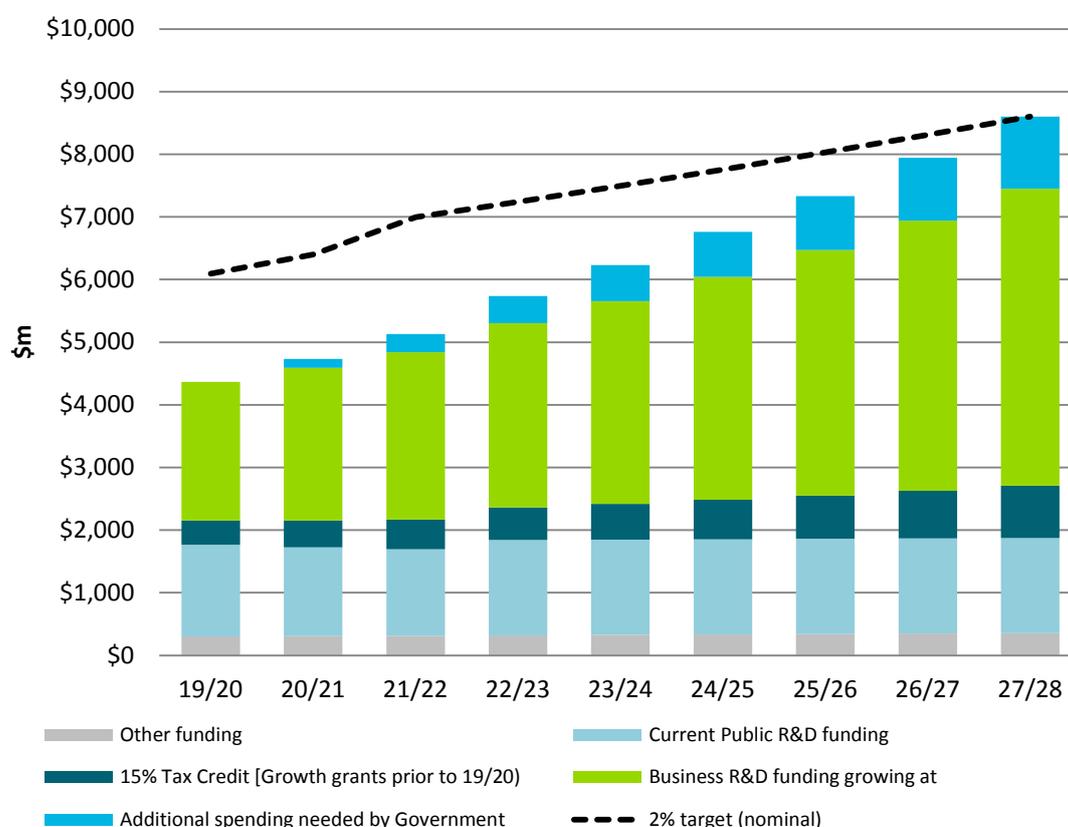
Our levels of research and development are too low. Even after the strong growth of the past four years, our R&D activity as a percentage of GDP is currently 1.37 per cent. This compares with the average of the countries in the Organisation for Economic Co-operation and Development (OECD) of around 2.4 per cent. Countries such as Denmark, Finland, Switzerland and Israel have rates above 3 per cent.

This means that the share of our collective resources dedicated to knowledge creation and use is not as high as it needs to be to create a productive, sustainable and inclusive future that enhances the wellbeing of all New Zealanders.

This is why the government has set a goal to raise R&D expenditure to two per cent of GDP by 2027. This will require large increases in investment from both business and government. We have already put in place the first part of our plan to achieve this by introducing the R&D Tax Incentive. Forecasts indicate that reaching the 2 per cent goal by 2027 will mean businesses spending over \$4bn per year on R&D, up from \$2.15bn in 2018.¹ Government spending needs to support and complement this growth, moving from our current level of support of around \$1.6bn to just under \$3bn in 2027 (not including the cost of the Tax Incentive).

A key aim must be to increase spending intelligently, focusing on areas where we can make the biggest difference to New Zealand and where we are able to maximise the social value of that investment for all New Zealanders. This strategy sets out the direction we propose to take.

Figure 1: Total expenditure on R&D required to achieve two per cent goal



¹ These are MBIE internal forecasts, based on Treasury projections of GDP in Budget Economic and Fiscal Update 2019.

How we think about Research, Science, and Innovation

Our definitions for these core terms are –

Research is the generation, gathering or organisation of knowledge. **Science** is a particular way of doing this. Research activities are systematic, and undertaken with a specific process in mind. Generation of knowledge does not have to be the only goal of research activity – for example, a firm might research an area for the purpose of making a new product. Nonetheless, this research will involve the creation of some new knowledge. Our definition of research is intended to include the distinctive ‘ways of knowing’ that make up Mātauranga Māori, as well as the many different knowledge systems that collectively form global research practice.

Innovation is the process of doing something new. An innovation may be a new or improved product, process, or function. Innovation is a process that leads to new or better ways of creating value for society, businesses and individuals. The value of innovation arises from the utilisation and implementation of an idea. The value created may be commercial, social, or environmental. Innovation may be unplanned or even accidental, but it does not have to be.

To these definitions, we add three core propositions that inform our basic structure for policy thinking –

Research and innovation are distinct but related activities. The common factor is that they deal with knowledge in some form. Innovation takes knowledge as an input and also produces new knowledge as an output. However, not all of the knowledge generated by research leads to innovation; and equally, innovation can occur without research. Successful innovation also requires skills, resources, insights from users or customers, and the ability to implement an idea successfully.

Innovation is a pervasive activity. It happens regularly everywhere. Any public sector agency introducing a new process, or any firm changing one of its practices, is innovating. Even installing a new piece of software is innovation on a small scale, and can lead to improved value in a local way. Innovation does not need to be related to technology. Innovation can occur in organisational structures, management techniques, marketing, and many other areas of activity.

The most valuable innovation is systematic, continuous, and occurs across multiple domains. Firms which consistently and systematically innovate across many domains of their business are more successful. We do not have any reason to believe that the same should not be true in our public services, or for public good efforts such as environmental preservation.

We also know that a lot of broader economic conditions and societal factors are important for innovation. These include availability of skills, regulation, availability of capital and investment, international connections, and quality of infrastructure. This strategy addresses some of those factors through the lens of the RSI system – in particular the availability of skills through its focus on talent, investment, and connections. Some other factors, such as regulation, tend to be specific to particular sectors of the economy. Where sector-specific opportunities or barriers are identified, we expect those to form part of the Industry Transformation Plans that will be developed as part of implementing our industry strategy *From the Knowledge Wave to the Digital Age*.

Researching and innovating towards the frontier

The definitions above provide us with a wide landscape of possibilities from which we need to select areas to focus our efforts. Innovation in particular could be a very broad range of activity, and we need to make choices. The focus of this strategy is therefore on innovation at the leading edge of what the world knows and can do – ie the ‘frontier’ of knowledge and its application. Innovation at the frontier means introducing products, services, and processes that are new to the world. By contrast, innovation behind the frontier is about adopting ways of doing things that are new to an organisation but are already known to others.

Innovation at the frontier extends the boundaries of what we are capable of doing. For New Zealand this is most likely to happen by –

- solving problems that nobody else in the world has solved, such as how to reduce agricultural emissions
- capitalising on new opportunities where nobody else is yet successful, such as civil uses of space
- making the most of our unique opportunities, such as our unique geology, biodiversity, and our heritage of Mātauranga Māori
- investigating areas where New Zealand is the only country likely to do so, such as questions arising from our unique population and greenhouse gas profile.

It is important that pushing out the global frontier is – or becomes – a guiding objective for a substantial number of New Zealand organisations, even if the work at the innovation frontier is only a small proportion of their total R&D activities.

Innovation at the frontier will often rely on research to provide new knowledge as an input. Equally, it requires a diverse set of people, high levels of advanced skills, entrepreneurship, and the means to invest intelligently to realise the value created by that new knowledge.

Innovating towards the frontier does not imply exclusively novel activities, nor does it imply only basic or ‘blue skies’ research. Applied research can extend the global knowledge frontier as much as basic research. What we do know is that where people are working at the global frontier in one aspect of their business, they are more likely to be drawing on leading technology and knowledge from elsewhere in the world. This in turn helps introduce that technology and knowledge to other people working in the same area.² In this way, frontier innovation becomes useful to the whole country.

What about innovation behind the frontier?

The focus on innovation at the frontier does not mean that innovation taking place behind the frontier (ie, the adoption of existing technologies) is not important. This is equally important for achieving the government’s goal of a productive, sustainable, and inclusive future, and is a key focus for economic development. This government’s industrial strategy *From the Knowledge Wave to the Digital Age* proposes the development of sector-specific Industry Transformation Plans to drive diffusion of innovation and uptake. This is in addition to existing programmes introduced across the government, including the Ministry for Primary Industries’ Extension Service Model initiative to support farmers sharing knowledge, innovation, and technology to improve their environmental performance and value creation. We intend that the frontier innovation supported by this strategy will feed into these adoption processes.

² Andrews, D., Criscuolo, C. & Gal, P. (2015). "Frontier Firms, Technology Diffusion and Public Policy: Micro Evidence from OECD Countries". OECD Productivity Working Papers, No. 2, OECD Publishing, Paris.

Innovating in the Public Sector

This strategy deliberately adopts a definition of innovation that is as applicable to the public sector as the private sector. Wherever the word 'innovation' is used, it is intended to apply broadly across both sectors, unless noted otherwise.

We do not have access to the same data on innovation in the public sector as we do for the private sector. However, when consulted, many stakeholders report similar problems and opportunities in the public sector as those we observe in the private sector.

It is important that we raise our levels of research, science, and innovation across government departments, District Health Boards, Local Authorities, and other public-sector actors. We are going to need new solutions to problems that affect the whole of New Zealand such as our changing climate, changing population, and challenges in environmental protection, conservation, public health, and social services.

In researching and innovating to address these problems and opportunities, we have the ability not only to improve the wellbeing of New Zealanders through more effective public services, but also to generate solutions that could have global impact if adopted elsewhere.

Researching and innovating towards the frontier

- Question 4:** Do you agree that the RSI Strategy should be focused on innovation at the "frontier" (creating new knowledge) rather than behind the frontier (using existing knowledge to improve the ways we do things)?
- Question 5:** In which research and innovation areas does New Zealand have an ability to solve problems that nobody else in the world has solved? Why?
- Question 6:** In which areas does New Zealand have a unique opportunity to become a world leader? Why?
- Question 7:** What do you consider to be the unique opportunities or advantages available to the RSI System in New Zealand?
- Question 8:** What RSI challenges are unique to New Zealand, that New Zealand is the only country likely to address?
- Question 9:** What are the challenges of innovating in the public sector? How do they differ from those in the private sector?

Part 2 – Our Key Challenge

This part of the strategy considers our assessment of the key challenge and opportunities we need to address over its term.

How are things going?

Two broad comments tend to apply to New Zealand's RSI activities. The first is that our scale of activity is small as a percentage of our total activity as a country. This is reflected in the proportion of gross expenditure on R&D (GERD) as a proportion of GDP. However, there has been recent significant growth in both the government and private sectors, and the government is committed to continuing and accelerating this growth, as demonstrated by our commitment to raising R&D to 2 per cent of GDP.

The second comment is that we do a lot with what we have. Considering the scale of our activity and investment, we produce a lot of research. On the ratio of publication to GERD, New Zealand performs well relative to both the OECD generally and the set of Small Advanced Economies (SAEs).³

Our researchers also appear to be making impact within their academic fields. Relative to other countries in the OECD, the ratio of New Zealand's very highly cited research papers (ie, research papers in the top 10 per cent of publications) to papers with few or no citations is just above the OECD average, although we still fall behind other SAEs on this measure.

New Zealand has been less successful in converting this research into products or public services, or using research to inform the products and services that that are created. New Zealand universities and public research centres file far fewer patents as a proportion of GDP than their counterparts in other OECD and SAE countries. There are fewer patent citations to New Zealand research than to the OECD and SAE average. Domestic patents in particular are quite a specific indicator of certain types of innovation, but our smaller number of these tallies with a broader story of low rates of innovation.

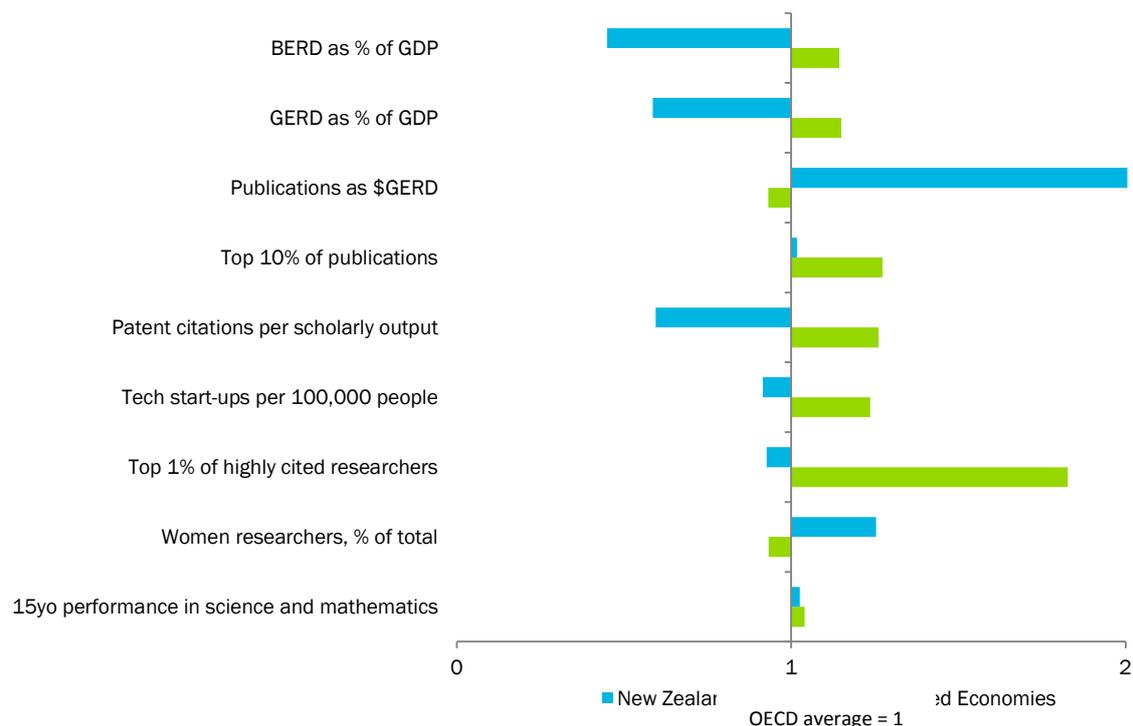
Our innovation system, while growing strongly, is not as developed as in other countries. For example, we have fewer technology start-ups per head of population than other SAEs and the OECD. We also have a lower proportion of innovative firms than the OECD and SAE average.

Our system is also weaker when it comes to people. We have fewer very highly cited researchers (those in the top 1 per cent) than the OECD average, and the diversity of the people in our system requires attention. While our proportion of women researchers in our public research institutions is above average, this figure disguises significant gender disparities by career stage, and does not reflect that we have far fewer Māori researchers than we should have. We suspect these disparities by gender and ethnicity are also reflected in our innovation activity.

Our pipeline of future researchers – measured in terms of the science and mathematics performance of our 15 year olds – is currently on par with other countries, but appears to be at risk, as it has been falling compared to OECD averages in recent years.

³ The Small Advanced Economies are Denmark, Finland, Ireland, Israel, New Zealand, Singapore, and Switzerland. All of these countries are advanced economies by International Monetary Fund standards, and are of similar scale in terms of population with around 5 to 10 million inhabitants. Together they are members of the Small Advanced Economies Initiative: www.smalladvancedeconomies.org

Figure 2: Summary statistics on our research, science, and innovation activity



Note: Indicators are derived variously from the OECD’s Main Science and Technology Indicators database, Scopus bibliometric database, and Startup Genome’s Global Startup Ecosystem Report 2019, and have been normalised to OECD average = 1.

What needs to be done differently?

Since the publication of the NSSI in 2015, we have organised our efforts around two key pillars of excellence and impact. We are seeing some progress in these areas, and they will continue to be important to the government’s work in RSI. They are discussed further in Part 3.

For this next iteration of our strategy, we consider that the key, underlying challenge facing the research, science and innovation system is building stronger connections within this system and beyond.

We observe weak connectivity in the following places –

Within parts of the research community. On some evidence, New Zealand researchers connect with each other about as well as their peers in other countries. We also think that policy instruments such as Centres of Research Excellence and National Science Challenges have helped increase the scale and nature of connection across the domestic research sector. Nonetheless, some incentives for researchers and research institutions can encourage a less connected approach, and some researchers feel that they are incentivised to pursue individual projects rather than connect more broadly between disciplines and institutions.

Between researchers and the potential users of the knowledge they create, in both the commercial and the public spheres. Most researchers and the potential innovators

that could exploit their research operate in disconnected spheres, are driven by different motivations, and have access to different sets of knowledge. In particular, some members of the Māori community do not see clearly how they can benefit from engaging with the RSI system. Enhancing connections to improve levels of innovation in the public sector is of critical importance, as is access to excellent research for public sector organisations.

Internationally to global experts, major business communities, and large markets for new innovations. There is some evidence of good international collaboration by scientific researchers, but many New Zealand researchers, institutions, and innovators are focused on New Zealand as their frame of reference. As a result they may fail to make connections with global experts, find their place within major business communities, or position their products to major markets.

Evidence on connections

In the research sector, some evidence suggests that our academic researchers are reasonably well connected with other researchers internationally. The proportion of our academic publications that are co-authored with researchers from other countries is on par with other countries of similar size. We are also comparable to other SAE countries in terms of the proportion of our science workforce that has come from abroad. However, despite recent strong growth in the amount of our R&D activity (both public and private) that is funded from overseas, this proportion is much less than in other SAEs or the OECD countries more generally. This speaks to lower international engagement by both business and researchers than our co-authorship statistics suggest.

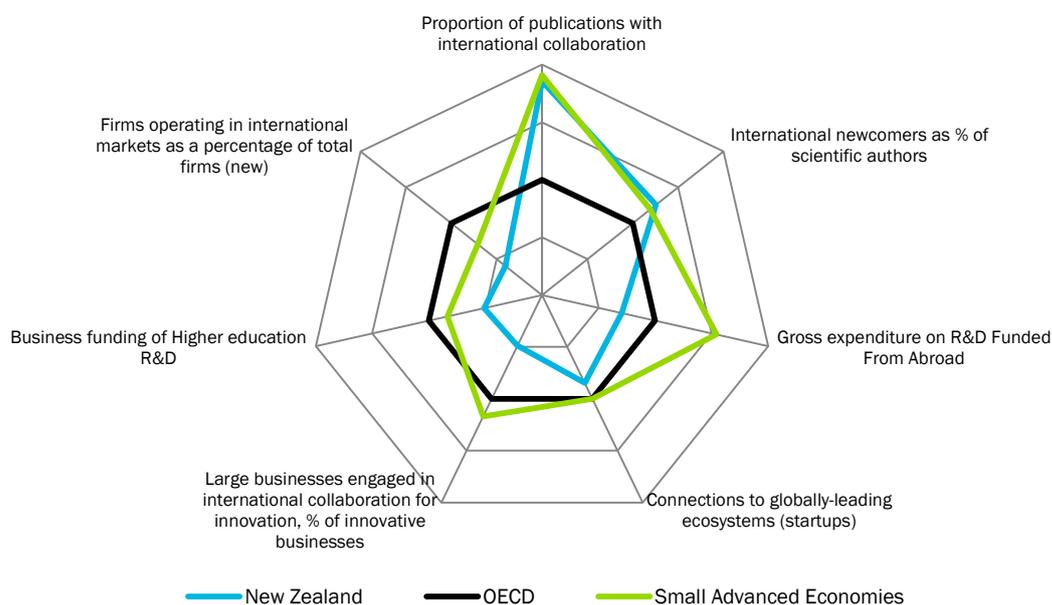
New Zealand researchers also appear less well connected with potential users of their research. New Zealand's proportion of academic publications co-authored with business is very low compared to other SAEs and the OECD. Our level of business investment into research by higher education institutions is also low compared to the OECD, although this is offset to a certain extent by our business investment into government research (through CRIs) being higher than many other countries; which is partially a factor of our unique CRI model.

There is also evidence that our participants in the New Zealand innovation system are not very well connected among themselves. On Startup Genome's Sense of Community Index, New Zealand founders score poorly relative to founders in other ecosystems in terms of the number of quality relationships they have with other founders, investors and experts.

In general, our businesses are not very well connected internationally. Even for our large firms – those we would most expect to engage in international collaboration on innovation – the proportion engaged in international collaboration for innovation is much lower than the OECD and SAE average. Similarly, the number of firms operating in international markets is well below the OECD and SAE averages.

According to Startup Genome, New Zealand start-ups frequently have strong ambitions to grow into global markets and to develop 'globally leading' products. However, this is not necessarily always matched with a strategy to target global markets or to focus on product development for those markets, as there is often an underdeveloped understanding of how those markets operate and how to build partnerships with key players.

Figure 3: Connections in the New Zealand Research, Science and Innovation System



Note: The figure above on business funding of higher education R&D does not include investment by business into CRIs. Indicators are derived variously from the OECD’s Main Science and Technology Indicators database, Scopus bibliometric database, and Startup Genome’s Global Startup Ecosystem Report 2019. They have been normalised to OECD average = 1.

Why is strengthening connections the key challenge?

We think there is sufficient evidence around our connections overall to support the idea that improving them is our key challenge. There does not appear to be a single factor that forms a compelling reason as to why our connections are weak. It seems to be a combination of factors: some already well-understood; others to be explored in more detail as we implement this strategy. Stakeholders have variously suggested the following factors –

- New Zealand’s geographical isolation
- New Zealand’s internal geography – having relatively few people spread over a large distance
- a tendency by New Zealanders to treat New Zealand as a primary frame of reference, rather than siting research, services, and products in a global context
- some policy settings which may discourage connections across the boundaries of research institutions
- a general lack of sources of coordinated information, and a great deal of difficulty in finding out ‘what everybody is up to’.

We appreciate that there are many candidates for the key challenge facing the New Zealand RSI system. However, most – if not all – of these can be traced back to weak connections in one way or other: either they are driven by poor connections or they result in tenuous connections.

Weak international connections in the innovation area limit the flow of information about what is happening at the frontier and the drive to stay up with the best in the world. These

weak connections reduce the flow of capital to support the development of innovations within New Zealand, and separate us from key sources of ideas and technology that help us stay at the global frontier.

Our international connections in the academic research sector are on a par with other SAEs when we consider co-authorship of academic papers. This is an encouraging metric, especially when we consider that, as a small system, we will need to be more internationally connected than other, larger countries. However, international investment into our research system remains comparatively low, both in the public and private sector. Larger scale, deeper, and more enduring international connections in both research and innovation will expose us further to the global frontier of excellence and impact, in whatever context we choose to be active.

New Zealand's international reputation in innovation suffers because connections to international players are not strong enough. Weak connections also hinder the transfer of knowledge, which results in good ideas not being recognised and the endurance of misperceptions about the quality of New Zealand researchers and businesses.

Improving the fluidity of connections between researchers, public services, businesses and users of research will greatly improve the excellence and impact of our endeavours, leading to higher quality research, more innovative and dynamic businesses, and improved and effective public services. In particular, ensuring our research institutions face as few barriers as possible to sharing resources and infrastructure, both between each other and with other parts of our innovation system, will help them form a coordinated, dynamic network of research activity and support.

Connections are at the core of many of the issues in the RSI system. Both excellence and impact are underpinned and enhanced by strong connections. The process of innovation itself is almost entirely reliant on connections – both random and structured interactions between different knowledge sets that lead to new opportunities, ideas, and solutions.

Enabling stronger connections is likely to make the greatest difference to the performance of the RSI system.

Our Key Challenge – Strengthening Connections

Question 10: Do you agree that the key challenge for the RSI system is enabling stronger connections? Why or why not?

Part 3 - Guiding Policy

This guiding policy sets out the key concepts that will form the basis for our policy action. The NSSI identified excellence and impact as key pillars of that strategy. The RSI Strategy will continue to emphasise excellence and impact, but we have built on and modified those concepts in light of further work done since the NSSI was published.

In light of the key challenge identified in Part Two, we propose that the RSI system be guided by an additional principle: connections. We expect these three principles of excellence, impact, and connections will guide all our investments and policy decisions in the future.

Excellence

Investment in research and innovation, especially that funded by the government, should be concentrated on achieving excellence.

Excellence is the ongoing pursuit of the best thing possible. It applies equally across research and innovation, but in different ways.

Researchers define excellence in their own context, and within the context of global endeavours. It should be defined in reference to the frontier – the leading edge of what the world knows and can do. Excellence is necessarily the ‘best possible’ within that global context, and cannot apply broadly to all activity or researchers.

Often, international literature and indicators providing information on RSI consider ‘excellence’ to refer solely to the number of times an academic paper is cited. That is not the definition we use here. Excellent RSI does not have to result in a publication. It is as likely to occur in a small start-up firm as in a large academic institution. Excellence is a term that can apply just as easily to applied research as it can to basic or fundamental investigation. Our public services need an enduring commitment to using the best knowledge and ideas at our disposal.

Excellence in innovation means growing, attracting, and retaining the best visionary thinkers, entrepreneurs, investors, and firms. This is true for our public services as much as our innovative businesses.

While excellence resists a single definition across the broad range of activity that makes up RSI, we can say it has the following characteristics –

- **People** are the critical determining factor. Excellent people will do excellent things. Diversity is vital within that. We can only maximise the excellence of our activity if diverse talent is able to thrive in the RSI system, regardless of gender, ethnicity or socio-economic background. Diversity is centrally important for innovation. Only by combining diverse ideas, backgrounds, knowledge, and experience will we truly innovate at the global frontier, and better reflect the needs of our own society. In particular, we want to improve opportunities for Māori to participate in RSI (see *Towards an Extended ‘Vision Mātauranga’*).
- **Global outlook.** Research, science, and innovation are global endeavours, and knowledge, techniques, standards and products will only be excellent when consistently seen in a global context. This will be true even when we consider activities with a domestic focus, such as native biodiversity. A characteristic of excellence in these activities is that they draw from the best technology, people, and ideas internationally.

- **Partnership.** Broad networks of relationships are important for generating new ideas and accessing the best knowledge. Scientific papers that are co-authored tend to be cited more often than papers which are written by a single author. Papers co-authored by teams from across academia and industry tend to be cited more frequently than those that are written solely by academics.

Concentrating on excellence will mean that New Zealand’s RSI system is not duplicating what is being done elsewhere – that is, not ‘reinventing the wheel’. Instead it is directed toward extending the frontier of what is possible.

Towards an Extended ‘Vision Mātauranga’

MBIE’s existing policy statement on Māori and RSI, Vision Mātauranga, sets out a framework to ‘unlock the innovation potential of Māori knowledge, resources, and people to assist New Zealanders to create a better future’. The four themes of Vision Mātauranga – Indigenous Innovation, Taiao, Hauora/Oranga, and Mātauranga, continue to provide a powerful framework for considering the outcomes we expect from RSI as they relate to Te Ao Māori.

We consider for the purposes of this strategy that this framework can be built on and extended to recognise the growing role and importance of Māori in New Zealand’s RSI activity. The Māori economy is flourishing and has become an important contributor to New Zealand’s future. Vision Mātauranga has enabled new opportunities and innovative approaches at the interfaces between Mātauranga and RSI. There is also increasing awareness of the importance of the distinct research approaches necessary where that research is intended to benefit Māori. We now want to extend our policies and ambitions under the Vision Mātauranga framework. It is important that we do this in close collaboration in the context of Māori Crown relationships. We plan to take a co-design approach to all our activities in this area.

Māori should be able to participate in RSI activities on an equal basis to others. By extension, this means a number of possible roles for Māori in RSI activities –

- as researchers, working in any field of research on an equivalent basis to their pakeha peers
- as entrepreneurs and innovators, working with new knowledge and new ideas in both the public and the private sector
- as participants in research processes, including as direction-setters, designers, and co-creators
- as beneficiaries of research, whether from specifically Māori-focused research or more generally
- as funders, sponsors, and purchasers of research, and as investors in innovative enterprises.

Evidence suggests that we perform poorly on many of these counts. For example, there are far fewer Māori researchers than we would expect, and few Māori entities investing in or funding innovative enterprises. We will therefore work with Māori stakeholders to address the opportunities these areas present.

Mātauranga Māori – distinctive knowledge held within Māori communities – has developed in New Zealand for at least 600 years, and is a focus of the Vision Mātauranga policy. We recognise the central importance of this way of understanding the world, both to Māori and to all New Zealanders. However, we have more to do to understand or articulate the Crown’s role

in supporting or protecting this system of knowledge. We will need to work over the coming years to develop initiatives which support and protect Mātauranga Māori while acting appropriately within the framework of the Treaty of Waitangi.

In addition to the above, the WAI 262 claim⁴ and the Waitangi Tribunal's report Ko Aotearoa Tēnei raised matters of great importance with regards the Crown's approach to Mātauranga Māori. The Crown is currently working actively towards a response to WAI 262, and our work will form part of that response.

Guiding Policy – Excellence

Question 11: Do you agree with the definition of excellence presented here as the best thing possible in its context? Why or why not?

Question 12: How can we achieve diversity within our research workforce? What are the current barriers preventing a diverse range of talent from thriving in the RSI system?

Question 13: Do you agree that excellence must be seen in a global context, and draw from the best technology, people, and ideas internationally? Why or why not?

Question 14: Do you agree that excellence is strengthened by stronger connections? Why or why not?

Impact

Research, science, and innovation – especially that funded or supported by the government – needs to have an impact. We consider impact to be a change to the economy, society or environment, beyond contribution to knowledge and skills in research organisations. Impact may be commercial, non-commercial, or both. The impact of our research on our health, environment, society and wellbeing is as important as its impact on our economy, as these are inextricably linked.

There are five key goals that are served by placing impact at the heart of this strategy –

- enabling researchers to make their research more relevant and connected to end-user needs
- allowing the government and RSI funders to develop policies which support impact
- informing the government's future investment decisions
- enabling public research institutions to demonstrate how they meet their social responsibilities and attract further resources
- demonstrating to taxpayers the eventual benefits of their investments.

The attention to impact provides an alternative approach to an undifferentiated policy towards research and innovation investments, where funding is distributed broadly across a

⁴ WAI 262, also known as 'the flora and fauna claim', was a claim lodged in the Waitangi Tribunal in 1991 which led to the Tribunal's first whole-of-government inquiry.

wide range of projects on the understanding that some of them may eventually ‘pay off’. New Zealand’s investment in RSI is too small as a percentage of the global effort to be confident that a broad-based investment strategy will eventually realise domestic benefit. We need to consider more carefully than larger countries the relative impact that different investments have to the future of New Zealand.

Measuring impact from research is challenging, but not impossible. To date we have relied on generic findings in the international literature, along with selective evidence of impact from a small number of projects within the New Zealand science system. This is no longer adequate to direct and optimise the scale of new investment by the government. We need to move beyond measuring outputs and assertions that the skills and knowledge generated by research are valuable, to systematically demonstrating across our investments the real-world impact for New Zealanders.

In the research sector, all of our publicly funded research should have a strong line of sight to impact. This means researchers and institutions receiving public funds should be able to articulate the impact of their research portfolios. Line of sight to these benefits does not mean focussing exclusively on applied, ‘close-to-market’ research or on individual projects. Historically, basic research has been essential to expand the knowledge frontier and challenge paradigms. However, even if the outcomes of more basic or high-risk research cannot be predicted, we need to be able to demonstrate its contribution – even if attribution is imprecise or we do so after the research is completed.

Pathways to impact include multiple actors and factors, but researchers and research organisations are the originators and custodians of the knowledge they produce. As part of the government’s commitment to considerable new public research investment, we expect researchers and institutions to step up to play an integral role in demonstrating, understanding, and delivering more impact from public research.

MBIE would like to work with the research sector to understand the resourcing needs of the proposed stronger impact agenda. MBIE will soon publish a policy position paper on the impact of research that establishes principles and approaches to measuring the impact of research, including linking impact to the Treasury’s Living Standards Framework.

Guiding Policy – Impact

Question 15: How can we improve the way we measure the impact of research?

Connections

To achieve impact from excellence, the system needs strong connections between the various players to encourage collaboration and engagement.

Stronger connections allow a smoother, easier flow of people, knowledge, capabilities, funding, and capital within and across our RSI system. An increased diversity of connections also increases the chance of new ideas being generated.

Strengthening connections – and concentrating effort and investment in areas where there are stronger connections – will help to maximise the impact from that research or innovation, and the benefits that flow to other parts of the system.

Our activity in this area will focus on enabling fluid connections, and reducing barriers and costs which prevent connections from happening. We want to see an increase in the ways by

which knowledge may be shared and utilised easily, and recombined into new knowledge and ideas. We are seeking to create denser, richer networks of people, ideas, and resources. We need to encourage ease of transaction – between innovators and entrepreneurs, and the beneficiaries or users of the knowledge and innovations they create. This needs to happen between institutions, across different spheres and types of activity, and internationally as well as nationally. We want to create a fluid, dynamic marketplace where knowledge is shared and used easily in the right places at the right times.

We think dynamism borne of a large number of small, easy transactions is an important feature of the system we are trying to create. We have structures within our research and innovation system that already encourage deliberate, coordinated collaboration, such as the National Science Challenges, and we think they are working well. This type of broad collaboration is useful and appropriate for instruments such as National Science Challenges, but we do not want to increase transaction costs across the board by requiring large collaborations or consensus-based decisions where these are not appropriate. Rather, we want to focus on increasing the opportunities for individuals and resources to connect easily.

We expect this will mean mainly re-examining some of our rules around how our system functions, rather than making specific investments. For example, we may consider our policies around open access to data and research, management of intellectual property within our research organisations, and the incentives our policies place on researchers and innovators to connect and share freely. We also need to continue to consider the fluidity of transactions between our research institutions, and continue our work on strong mechanisms to invest in and share research infrastructure, both nationally and internationally.

Guiding Policy – Connections

- Question 16:** Where do you think weak connections currently exist, and what are the barriers to connections at present?
- Question 17:** What actions will stimulate more connectivity between parts of the RSI system?
- Question 18:** How could we improve connections between people within the RSI system and people outside it, including users of innovation, international experts, business communities and markets?

Part 4 - Actions

Based on the key challenge and guiding policy set out above, we propose to take actions in five main areas as discussed below –

1. Making New Zealand a magnet for talent
2. Connecting research and innovation
3. Start-up^scale-up
4. Towards an extended 'Vision Mātauranga'
5. Building firm foundations.

Our core concepts of excellence, impact and connections run across all our action areas. As we consider these concepts are closely interrelated, we expect our actions to have complementary effects in achieving our goals. This complementarity is expressed particularly in our goal of scaling up (action area 3).

Achieving our vision will require concerted government action

The RSI Strategy is seated amongst other key directions we have set. This government's Economic Development Strategy sets out the role that RSI will play in achieving our productivity goals. Between these strategies, there is a clear division of responsibilities for different stages of the innovation pipeline to ensure we have support from knowledge generation to use of innovation by end users. Similarly, our proposed Zero Carbon Bill sets out the role that new innovations will play in our transition to a sustainable and low-emissions economy.

Callaghan Innovation and New Zealand Trade and Enterprise (NZTE) will both have central roles in delivering the objectives of the RSI Strategy. Callaghan Innovation's core role is to support science and technology-based innovation, and its functions include to facilitate networking and collaboration between businesses and research providers, and to facilitate the transfer of knowledge and technology. These functions are vital to the delivery of the RSI Strategy, particularly with regards to our focus on improving connections. Similarly, NZTE plays a key part in helping to deliver the RSI Strategy, as its functions include strengthening global linkages through trade and investment promotion, and fostering collaborative networks. This will help in improving international connections across our RSI system.

NZTE and Callaghan Innovation are also central to facilitating a business support system that provides information and advice across a wide range of areas in order to lift business performance in New Zealand. Working with the private sector and other central and local government partners, NZTE and Callaghan Innovation help firms to build capabilities and develop the mindset that enables them to undertake more growth enabling activities, including innovation.

Wider government action outside the RSI portfolio will also contribute to achieving our vision. The government's industry strategy will encourage the adoption of new technology and frontier innovation in target sectors. This will in turn increase the demand for innovation, stimulating new investment and R&D activity. The independent review of the Performance Based Research Fund (PBRF) also seeks to expand how the impact of research is assessed, and may lead to increased commercialisation of university research.

1. Making New Zealand a Magnet for Talent

People are at the heart of research, science and innovation; and excellent people are vital to achieving the goals of this strategy. Specific initiatives to develop, support, retain, and attract

the most talented researchers and entrepreneurs in the world will be transformative to our RSI efforts in New Zealand.

Our research and innovation funding mechanisms tend not to fund directly for talent at large scale, whereas other countries tend to invest more time and effort in this aspect of their systems. We want to ensure initiatives are in place to nurture and grow emerging researchers within New Zealand, and to offer stable pathways to continue their research careers in this country. Additionally, we want to attract talent with unique skills and experience from overseas – and how RSI related businesses and skills are considered under New Zealand’s migration settings may be a factor in how well we do this. At the same time, our systems are not making the best of the talent we could have. There are large disparities in our research system by gender and ethnicity; disparities that we judge are reflected in our innovation activities.

We plan to –

- implement a large scale initiative to grow, support, attract, and retain the best talent in our research and innovation systems, building on the success of initiatives such as the Rutherford Discovery Fellowships. We will also consider how these initiatives can nurture the careers of our most promising researchers, and balance sufficient stability to enable those careers to grow against enabling the dynamism that allows emerging talent to break through and flourish.
- develop initiatives to ensure talented thinkers from diverse backgrounds can thrive in the RSI system, starting with a programme based on successful international models
- develop initiatives to support excellent entrepreneurs from diverse backgrounds to develop innovative businesses
- expand the government’s successful Curious Minds initiatives, which are focusing on building the interest and science literacy of young people in hard to reach communities
- investigate proactive investments in leadership development in our research community, including building a pipeline of future research leaders from more diverse backgrounds.

Actions – Making New Zealand a Magnet for Talent

Question 19: How can we better nurture and grow emerging researchers within New Zealand, and offer stable career pathways to retain young talent in New Zealand?

Question 20: How could we attract people with unique skills and experience from overseas to New Zealand?

Question 21: What changes could be made to support career stability for researchers in New Zealand? What would be the advantages and disadvantages of these approaches?

Question 22: Do you agree with the initiatives proposed in the Strategy to support and attract talented researchers and innovators? Are any changes needed for these initiatives to be successful? Are there any other initiatives needed to achieve these objectives?

2. Connecting Research and Innovation

The concept of connections is at the heart of this strategy. Without strong connections we will struggle to bring together diverse ideas, knowledge, capabilities, and investment needed to innovate at the global frontier.

We intend to organise our efforts around two main themes: developing a global, best-practice research commercialisation system; and improving international connections.

Develop a global best-practice research commercialisation system

We are likely to gain the greatest value nationally from innovations based on unique deep technology. The knowledge base for this technology is likely to be derived from work in the research system, but will be used or commercialised by businesses or public service providers. We need close and enduring connections between research institutions and the users of their research, and a system of initiatives that supports those efforts effectively.

We plan to –

- extend our Technology Incubator scheme to attract international talent and resources to support commercialisation of deep technology; over time, increasing the number of incubators and the number of firms
- take a regulatory systems approach to our policies that govern ownership, use, and licensing of intellectual property by research organisations, with the aim of ensuring transparent, predictable, common IP arrangements that maximise the potential social value from our publicly funded research.

Improve international connections

Our co-publishing record suggests that we perform well on researcher-to-researcher connections, but our other international statistics suggest that these are not connected into richer networks of researchers or enduring institutional connections. Connecting New Zealand to the global frontier requires us to connect networks of New Zealand researchers to global leaders, and to build scale alongside neighbours such as Australia and Singapore. Some of our best research institutions have the capability to lead global science in their area, but need dedicated support to do so. Initiatives in this area include the trans-Tasman Single Economic Market (SEM) agenda, and the Australia New Zealand Science, Research and Innovation Cooperation Agreement (ANZSRICA). However, only a small proportion of our research and innovation investment is currently directed towards funding New Zealand researchers to collaborate internationally, and to participate in international science projects.

We plan to –

- build a portfolio of international science investments with the scale to connect high-quality New Zealand research networks to global leaders, and to enable world-class New Zealand institutions to lead science at the global frontier
- pursue deep integration with neighbouring research and innovation systems, in particular Australia and Singapore. This will include joint infrastructure investments, connection of support instruments, and shared funding for international research and innovation projects.

Actions – Connecting Research and Innovation

- Question 23:** What elements will initiatives to strengthen connections between participants in the RSI system need to be successful?
- Question 24:** What elements will initiatives to strengthen connections between participants in the RSI system and users of innovation need to be successful?
- Question 25:** What elements will initiatives to strengthen connections between participants in the RSI system and international experts, business communities and markets need to be successful?
- Question 26:** Are there any themes, in addition to those proposed in the RSI Strategy (research commercialisation and international connections), that we need to take into consideration?

3. Start-up^Scale-up

Start-up

Our innovative start-up firms will be a central element of our future economy. Hi-tech high-growth firms generate new jobs, alternatives to emissions-intensive industries, and new opportunities for New Zealand's future. Furthermore, growth in productivity in businesses is linked to export readiness. We need to grow the number of start-ups in New Zealand, along with the opportunities for them to scale, by ensuring they have access to the support they need at each stage in their life journey – from idea to seed to expansion. Our extension of the Technology Incubator scheme is part of this, as is our recent investment in expanding New Zealand's early stage capital markets through the New Zealand Venture Investment Fund.

In addition, we plan to –

- develop a flexible and graduated system of support that enables start-up firms to fast-track their growth and achieve scale
- ensure start-ups are able to access talent for scale-up and growth
- provide integrated support and advice services to start-ups through Callaghan Innovation and NZTE to make it easier for them to access global market and global customer insights, and to go global from day one of business
- continue to ensure the R&D Tax Incentive supports start-ups by introducing broader refundability for pre-profit businesses and reviewing the R&D Tax Loss Cash-Out.

Actions – Start-up

- Question 27:** How can we better support the growth of start-ups?
- Question 28:** Do the initiatives proposed in the draft Strategy to support growth of start-ups need to be changed? Are there any other initiatives needed to support start-ups?
- Question 29:** What additional barriers, including regulatory barriers, exist that prevent start-ups and other businesses from conducting research and innovation?

Innovating for the public good

Our public services need to grow their focus on innovating to find new solutions to social and environmental problems, and respond effectively to the government's priorities. Engagement of public services with RSI, including through funding R&D specific to government services and goals, is going to be as important to achieving the objective of this strategy as increased business activity.

Responding effectively to the government's priorities will often mean the government coming together with businesses and other organisations to focus on developing innovative solutions to specific problems. For example, this may include maximising the advantages for New Zealand industry in the global shift towards clean growth and the development, manufacture and use of low carbon or zero-emissions technologies. Other examples could include how we use New Zealand's research and industry strengths to address issues around physical and mental health, while extending healthy, independent life expectancy to capitalise on the opportunities created by demographic change around ageing.

Such an approach requires a clear definition of a mission that partners across the government, society and the private sector. Achieving success in this mission will not only bring benefits to New Zealand in terms of better outcomes in areas such as health or the environment but will also ensure our industries are at the forefront of developing those innovative goods and services, both domestically and internationally.

We plan to –

- establish innovation missions to address public good opportunities, such as kaitiakitanga of our biological heritage, and health system delivery
- establish a new, flexible, and accessible mechanism to ensure public-sector organisations have access to research and the resources to enable them to innovate successfully.

Actions – Innovating for the public good

Question 30: What elements will initiatives to support innovation for the public good need to be successful?

Question 31: What public good opportunities should our initiatives in this area be focused on?

Scale-up

We plan to achieve improved connections in our RSI activity by building scale in focused areas. Scale fosters greatly increased connections by concentrating activity in particular areas or towards particular goals. We know this concentration is critical to successful innovation – specifically, to a large number of people in networks interacting and exchanging information.⁵ As a producer of around 0.2 per cent of the world's research, we must also recognise that we cannot do everything well. Building our competitive advantage on the global stage means building scale and depth in areas where we think we can make a unique contribution at the frontier of innovation.

We will concentrate our efforts to build scale in areas of emerging opportunity, disruption, or critical need to New Zealand. This does not mean cancelling existing research investments to

⁵ For example, Feldman, M.P. (1999). The New Economics Of Innovation, Spillovers And Agglomeration: A Review Of Empirical Studies, *Economics of Innovation and New Technology*, 8:1-2, 5-25.

focus on a narrow range of activities. Instead, it means focusing on supporting the key components of innovative systems – researchers, entrepreneurs, technology, investors, capital, regulation, and public services.

Our mechanisms for achieving this will be a combination of the mechanisms at our disposal, and will be informed by the needs of the particular area of focus. We are already seeking to build scale through our investments in the New Zealand Venture Investment Fund and in our approach to the next set of Technology Incubators.

In addition, we may consider –

- establishing a new Strategic Science Investment Fund (SSIF) platform, or extending an existing one, if the area needs to scale up underpinning mission-led science
- using new talent mechanisms to grow, support, retain and attract leading global research talent in the area
- supporting the relocation to New Zealand of global investment funds, start-ups, and entrepreneurs in the area
- establishing commercialisation facilities, such as technology incubators or pilot plants, with a specialised focus and expertise
- supporting larger scale government-research-industry partnerships or dedicated institutions in the focus areas
- providing integrated and coordinated support to tech start-ups and high-growth firms for accessing overseas markets.

Choosing our areas of focus

Our areas of focus will fall in one or both of two categories –

- where we can genuinely expect that New Zealand has, or will be able to build, a sustainable competitive advantage on the world stage. These may include:
 - opportunities for shifting from volume to value
 - areas complementary to existing strengths or other opportunities
 - areas with no obvious global leader where New Zealand has a head start
 - where New Zealand has an inherent advantage based on our unique heritage or resources
- where New Zealand faces a unique challenge or has a specific need.

Actions – Areas of focus

For this draft iteration of the strategy, **we seek input on the selection of possible areas of focus**. We will consider establishing around five focus areas, but, depending on the eventual selection, we are likely to introduce them over time rather than immediately. In addition to the criteria set out above, we invite stakeholders to consider the following factors in their suggestions –

- the ambition of this strategy to focus efforts in the RSI portfolio at the global frontier of knowledge and innovation

- ways in which the RSI system can accelerate progress towards the government’s goals
- the focus areas already determined by the industry strategy *From the Knowledge Wave to the Digital Age*
- work already underway where we are seeking to build depth and scale in the RSI system.

The following areas could be a useful start, and are highlighted in *From the Knowledge Wave to the Digital Age* –

- **aerospace**, including both autonomous vehicles and our growing space industry
- **renewable energy**, building on recent investments in the Advanced Energy Technology Platform
- **health technologies** to improve delivery of health services and explore opportunities in digital data-driven social and health research.

We invite comment on these suggestions and welcome input on other possible focus areas.

Actions – Scale up

Question 32: What elements will initiatives to build scale in focused areas need to be successful?

Question 33: Do the initiatives proposed in the Strategy to build scale in focused areas need to be changed? Are there any other initiatives needed to build scale?

4. Towards an Extended ‘Vision Mātauranga’

In extending the reach and scope of Vision Mātauranga, we will need to develop new initiatives and policies that work effectively within and around Te Ao Māori. This will require close consultation and collaboration with Māori stakeholders to ensure our actions support our shared outcomes effectively. A starting place for these conversations could be considering initiatives which –

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

Actions – Towards an Extended ‘Vision Mātauranga’

This section of the draft strategy signals our intention to consult and collaborate further with Māori stakeholders to co-design our responses and initiatives. From that perspective, we consider the signals in the draft strategy to be a start, rather than a set of final decisions. Nonetheless, we are keen on initial feedback in the following areas.

- Question 34:** Does our suggested approach to extending Vision Mātauranga focus in the right five areas? If not, where should it focus?
- Question 35:** How can we ensure the RSI system is open to the best Māori thinkers and researchers?
- Question 36:** How can we ensure that Māori knowledge, culture and world views are integrated throughout our RSI system?
- Question 37:** How can we strengthen connections between the RSI system and Māori businesses and enterprises?

5. Building Firm Foundations

We need to continue to ensure that the basic building blocks of our RSI system are working well and are fit for purpose. Part of our work will continue to focus on funding, institutions, and infrastructure to support our overall principles of excellence, impact and connections.

Create a progressive investment programme

We have already begun the process of introducing a world-class R&D Tax Incentive in New Zealand. This is the government’s biggest single investment in research and development in New Zealand’s history, and will grow to become the largest element of our support for business expenditure on R&D (BERD). In addition, we will create a progressive investment programme to enhance the contribution of main RSI funds to the government health, social, environmental and economic objectives. We will focus on enduring, sustainable increases to existing funds including the R&D Tax Incentive (driven by increased R&D spending from firms), the Endeavour Fund, The Marsden Fund, the Health Research Council, and the Strategic Science Investment Fund. We will also continue to work to ensure that the investment plans and priorities for those funds are closely aligned to the government’s goals.

Ensure future-focused, fit-for-purpose institutions and infrastructure

We need to continue to ensure that our research institutions are set up and well supported to succeed as world-leading producers of knowledge, as well as incentivised to improve connections and demonstrate a clear line of sight to the impact of their research. We also need to ensure that our businesses and public agencies have access to the research and support that they need.

In particular, we need to consider the relationships between and within our public research organisations, and whether they are configured, supported, and incentivised optimally to form a coordinated, dynamic network of research providers across the horizons of research and innovation.

We plan to –

- ensure our structures, funding, and policies encourage public research organisations to form a coordinated, dynamic network of research across the horizons of research and innovation
- through the independent review of the Performance Based Research Fund, consider how this fund can support research connectivity and encourage further specialisation in our universities where appropriate
- review the CRI operating model to ensure it supports dynamic, connected institutions and globally leading research.

Global quality research infrastructure

Research and innovation infrastructure is housed in our businesses and research institutions. The government directly supports some large parts of this; from research vessels to pilot plants and particle accelerators.

We want to focus on sustainable provision of future-focused infrastructure; in particular our databases, collections, and e-research infrastructure. We also want to create or participate in opportunities to share infrastructure with our international partners where that will facilitate denser connections and enable investments we would not be able to make on our own.

We plan to –

- review e-research capability and place existing initiatives on a sustainable footing
- conclude our review of databases and collections to ensure future sustainability
- create or participate in opportunities to share infrastructure with our international partners.

Actions – Building Firm Foundations

Question 38: Do the current structures, funding, and policies encourage public research organisations to form a coordinated, dynamic network of research across the horizons of research and innovation? What changes might be made?

Question 39: Is the CRI operating model appropriately designed to support dynamic, connected institutions and globally leading research? What changes might be made?

Question 40: What additional research and innovation infrastructure is necessary to achieve the goals of this strategy? What opportunities are there to share infrastructure across institutions or with international partners?

Question 41: What elements will initiatives in this area need to be successful?

Actions – General

Question 42: How should the government prioritise the areas of action, and the initiatives proposed under each area?

Part 5 – What will Success Look Like?

As set out in Part 1, our vision is that “By 2027, New Zealand will be a global innovation hub, a world-class generator of new ideas for a productive, sustainable, and inclusive future”. To help drive the RSI system towards that objective, the government has set a proximate goal of raising national research and development expenditure to two percent of GDP by 2027.

Ultimately the test of whether we have achieved this vision, and specifically whether the strategy has contributed towards that achievement, will be its impact on the wellbeing of all New Zealanders. However, measuring wellbeing is complex – and attributing any changes in wellbeing specifically to the impact of the RSI Strategy is even more so.

We will continue to track progress toward the two per cent target for R&D expenditure using results from Statistics New Zealand’s biannual R&D Survey.

To determine whether and how the strategy is making a difference, we plan to monitor a range of indicators reflecting progress on outcomes related to the strategy’s three principles: excellence, impact, and connections. Annex Two contains a list of outcomes we would like to monitor, and some examples of possible indicators that we may use to track those outcomes.

Alongside this strategy, MBIE is also releasing a position paper on “The Impact of Research” that sets out its proposal for measuring this.

In some cases, we already have a well-established set of indicators that we can use to track progress on the outcomes (including those presented in Figure 2 and Figure 3). In other cases, we will need to build new data sources and develop new indicators. A primary source of data for this latter set will be the New Zealand Research Information System (NZRIS), which is currently being developed. This system will hold information about research activity in New Zealand including current and prior projects, the experts in particular fields, and the outputs they are generating. The data from NZRIS will be especially helpful for assessing the excellence of New Zealand research activity, including the diversity of the RSI workforce, and connections between parts of the research system.

We plan to extend this effort by collecting information on the ways the outputs from research activity are being applied in the public and private sectors. This data will help us measure the connections between researchers and users of their research, as well as the impact that this research is having.

We will document these indicators and also track progress towards targets in MBIE’s *Research, Science and Innovation System Performance Report*. This report sets out a range of high-level statistics on the activity of, and outcomes, from New Zealand’s RSI system and is released biannually. We are also in the process of developing an online dashboard of key indicators that will be updated continuously.

General

Question 43: Do you have any other comments on the Strategy which have not yet been addressed?

Annex One – Our Research, Science and Innovation System

Our RSI system consists of people, institutions, infrastructure, and businesses. It is not a closed system. Many people are engaged day-to-day in innovating, researching and connecting with each other in a wide range of activities that contribute to RSI.

The government, therefore, works in this system through setting the overall strategy and direction.

Why the government invests in research, science and innovation

The fundamental design principle for our system and funding mechanisms is that the government's primary role is to create value to society.

The economic literature on research distinguishes between the private and social values that arises from this. Private value is the value that is captured by a person or an organisation. If a business invests in research for a new product, the money it makes from selling that product is its private value.

Social value includes the value that results elsewhere from this research. It can include the value that other businesses get from copying the product or incorporating it into their own services, and the knowledge gained by the research personnel working on the product, which they can take with them when they move to a new job.

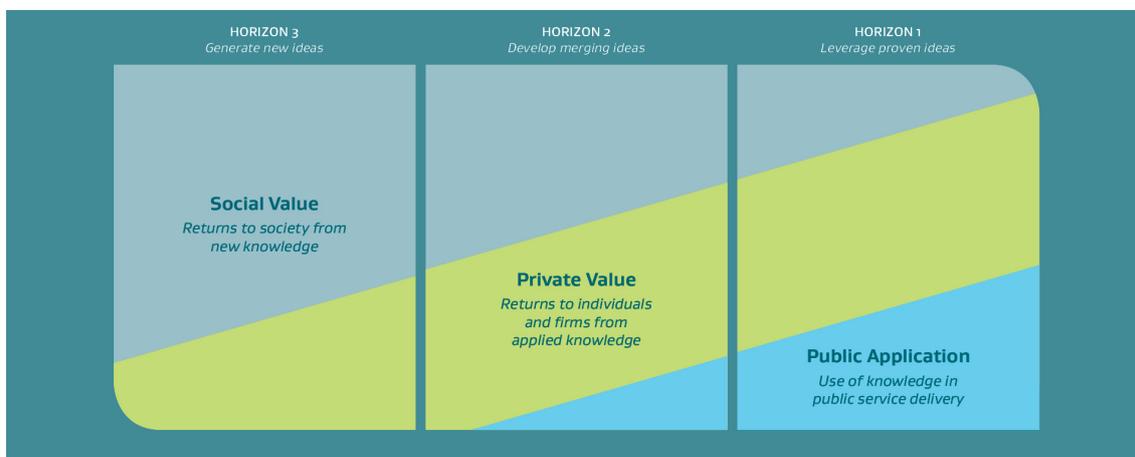
These are just some examples. There are many different ways in which social value can arise from research – so many that economic literature estimates that the social value from research, even that undertaken in businesses, is much higher than the private value.⁶ Moreover, the person or organisation investing in the research does not capture those benefits. This is why the government is a major funder of research. The benefits to New Zealand as a whole will be greater than the value to the primary investor in the research; so without support from government investment would be less than optimal from a social perspective.

In many fields of research, the private value to the person performing the research may be low. For example, for research investigating New Zealand's biodiversity, or fundamental research with no particular application in mind, the only private value for those directly involved will be the intellectual satisfaction gained from the research process. In these cases, the vast majority of the value is social and if the government wishes for that research to be undertaken it will need to meet the full cost of that activity.

Accordingly, the government's role in the RSI portfolio is to seek to maximise social value. This is primarily through its investment, but also via the direction it can set for the institutions it owns.

The NSSI set a clear direction for the government to focus its funding efforts on more novel and uncertain research at the global frontier, where the private sector is least likely to invest. It also considered a 'horizons' model for the types of research and the roles of different organisations. This model, which is still considered relevant, is reproduced below.

⁶ Hall, B.H., Mairesse, J. & Mohnen, P. (2009). "Measuring the Returns to R&D". NBER Working Paper No. 15622.



For research on the **generate new ideas** horizon, the government meets most or all of the research cost centrally, and ensures that a long term pipeline of research exists to extend the global knowledge frontier in ways that are relevant to New Zealand’s future. This is work that is usually undertaken in New Zealand’s research institutions and funded through dedicated research funds, such as the Marsden Fund or the Endeavour Fund.

On the **develop emerging ideas** horizon, the government meets part of the research cost and encourages institutions, the public sector, and businesses to collaborate on initiatives which might have a broad range of impacts across a sector or industry. The government may also help establish structures to enable this activity to take place: for example, National Science Challenges, or research-levy bodies. The government may also act by sponsoring structures and services that enable the free flow of ideas.

For research with clear application, as is found on the **leverage proven ideas** horizon, the government would generally expect the people or organisations likely to benefit from that research to meet a high proportion of the cost. This approach reflects the fact that, when the application is clear, it is more likely that the beneficiaries can be identified. Part of the government’s role on this horizon is to stimulate and support investment and activity. Support may be in the form of minority funding, such as the 15 per cent credit given to businesses via the R&D Tax Incentive. This rate of support recognises that the private value from some RSI investments already encourages much investment – it is just unlikely to be high enough to maximise social value.

However, not all activities that ‘leverage proven ideas’ will generate private value to a clear set of beneficiaries. On this horizon, value can also arise from the use of research in delivery of specific public services. This is not the broad social value arising from knowledge, but the specific social value arising from better public service delivery. Investment and decisions here are best made by the public sector entity charged with delivering the service.

For example, if the Department of Conservation creates a remote device to monitor wildlife populations using proven technology, this activity would sit on the ‘leverage proven ideas’ horizon, but the value would be spread across a large number of non-identifiable beneficiaries. In that case, the government agency with the greatest interest and operational responsibility (the Department of Conservation in this case) should firstly consider meeting the majority of the cost.

There is an enduring need for the government to increase the research intensity and investment in its own activities that focus on the broader public good, and particularly on the

‘leverage proven ideas’ horizon – and it is committed to doing so. There are examples of these activities in areas such as the health sector, as set out in the government’s Health Research Strategy, and also in areas such as environmental protection, biosecurity, and response to conservation threats such as myrtle rust, kauri dieback, and mammalian predators.

Design principles for the RSI system

Our overall direction for RSI remains to maximise the social value from our activity. The government should invest to appropriate levels, and provide leadership, structures and institutions that encourage broad-based benefits to all New Zealanders from our activity in research, science and innovation. The government will encourage and support businesses and public sector institutions to act where their actions are likely to generate social value. This also means making choices, as resources are invariably limited.

Significant reforms have been made to the government’s instruments in the RSI system in recent years; in particular via the creation of the Strategic Science Investment Fund and the Endeavour Fund in 2016. We are not planning further significant reforms to those funding mechanisms, but will continue to monitor their operation and make adjustments as necessary. Any adjustments will be guided by a set of design principles, which are derived from the comments above. These are –

- The government should act to drive social value.
- Government investment should be proportionate to the incremental social value.
- Funds deployed in a balanced way, with the expected outcome matched to the function.
- The system should be simple, while delivering the right support in the right places.

Annex Two – Indicators of Success

This annex presents some possible indicators we could use to track the RSI Strategy's success. We welcome input on the choice and efficacy of these and on any other possible indicators.

Excellence:

- Increase in number of researchers operating at the forefront of their field (eg, number of researchers in top 1 per cent by citations in international journals, weighted by country size)
- Increased diversity of RSI workforce (eg, proportion of women/Māori in RSI workforce, potentially weighted by seniority)
- Increase in number and/or valuation of New Zealand tech start-ups (eg, tech start-ups per 100,000 people, relative to international comparators)
- Increase in venture capital (eg, venture capital invested in New Zealand companies as proportion of GDP)

Impact:

- Increase in use of New Zealand research by industry (eg, New Zealand research publications cited by patents assigned to businesses in New Zealand and elsewhere; number of start-ups/spinouts coming out of New Zealand research institutions; BERD (business expenditure on R&D)/GDP)
- Increase in use of New Zealand research by the public sector (eg, New Zealand research publications cited by public agencies and/or other non-commercial organisations in New Zealand and elsewhere)

Connections:

- Stronger connections between researchers (eg, publications with researchers from multiple New Zealand institutions/departments; density of co-author/grant collaboration/co-inventor networks)
- Stronger connections between research and industry (eg, business funding of New Zealand research institutions; publications with academic and industry co-authors; patents with academic and industry co-inventors)
- Stronger connections between New Zealand researchers/innovators and international experts (eg, international newcomers as percentage of scientific authors; proportion of publications resulting from international collaboration; large businesses engaged in international collaboration for innovation)
- Stronger connections between New Zealand researchers/innovators and international sources of capital (eg, R&D funded from overseas; international venture capital invested in New Zealand companies)
- Stronger connections between New Zealand researchers/innovators and international business communities (eg, number of founders with connections to globally leading ecosystems)
- Stronger connections between New Zealand innovators and international markets (eg, New Zealand firms – especially tech start-ups – with operations in international markets)

