

Response to Feedback Document:

New Zealand's Research, Science and Technology Priorities

18 November 2009

Summary

Science New Zealand endorses the overall direction of the feedback document, *New Zealand's Research, Science and Technology Priorities (23 October 2009)*. In particular:

1. Setting a strategic direction for the New Zealand science system;
2. Setting national science priorities;
3. Clarification of the system purpose;
4. A reduction in system complexity.
5. Statement of well-founded general principles which will underpin the direction and decisions of the science system;
6. The statement of intent to foster an environment in New Zealand which will value and support science research that is excellent, relevant and well-linked to benefit to New Zealand;
7. The shift from excessive competition to a well-balanced system focussed on what New Zealand needs, and consequent attention to how best to deliver on those needs;
8. Government's commitment to long term, strategic funding, transparency and accountability.

Strategic Principles for Publicly-funded Science

Science New Zealand endorses the Strategic Principles for Publicly-funded Science, including the General Principles, the Principles underlying Priority Setting and the Operational Principles.

Priority Investment Areas

Individual Crown Research Institutes are better placed than Science New Zealand to provide informed contributions on the balance and proposed major domains. Science New Zealand welcomes the reduction in complexity and the commitment by Government to give clear signals on priorities.

Science New Zealand recognises that Government has the responsibility to determine the outcome areas and major domains, and is doing so within the context of its economic growth agenda and national strategic interests.

As a general point, it seems to Science New Zealand that the outcome areas, proposed major domains and the strategic direction permit attention to science research that is both incremental and transformational, that addresses the needs of current sectors and raises opportunities. This is a system which can reconcile the tensions of flexibility, stability and resilience and avoids stasis and stagnation.

Recommendations

The attached response provides a discussion around the areas covered by the feedback document. Some recommendations for clarification and development as the work proceeds to more detail, arise.

Science New Zealand recommends that:

1. the Government states the weighting, in dollar terms, of each of the outcome areas and also the quantum into each of the proposed major domains;
2. presentations to Cabinet, Parliament, officials and the public clearly indicate the national spend in each of the outcome areas as well as the allocation from Vote RS&T within each outcome area. Total national spending will include other Government investment, via other Votes; and also the private sector pending. This is to ensure that the Vote RS&T allocations



- are not confused with national spending; and enables the Government to be clear about its role in supporting investment into each of the outcome areas;
3. the definition of “excellence and impact” is inclusive of the differing objectives of types of science research;
 4. the institutional arrangements for research organisations – and Crown Research Institutes in particular – be determined by governance and management of the entities in discussion with the shareholder and led by science, sectors and strategy; with accompanying responsibility and accountability;
 5. top talent not be solely defined in terms of Marsden Fund awardees; or as individuals. [This relates to the previous recommendation re defining excellence in a more inclusive way than hitherto; and with respect to the general principles of science research being excellent, having impact, and with relevance to New Zealand];
 6. comparative disadvantage as well as comparative advantage be included in the criteria for selecting research priorities to support business areas or technologies to be located in New Zealand;
 7. formation of multidisciplinary teams be encouraged, but not made mandatory or a default position in assigning funding;
 8. the distinctive and complementary natures and purposes of Crown Research Institutes and universities, as the two major elements in the nation's publicly-funded science research system, be stated and supported. [*Science New Zealand understands the CRI Taskforce will assist government on the clarity of mission and purpose of CRIs; this is warmly welcomed*]. This will also assist the developing levels of collaboration between the entities, especially in areas of student and staff interchange;
 9. formation of multi-organisational approaches should be encouraged when it makes sense, and not made the default setting;
 10. the CRIs collaborative and collegial approach to sharing ideas and capabilities, built on trust, shared expectations, values and processes is encouraged; and looked at as a model for wider engagement of professionals across research organisations;
 11. government, CRIs and universities further explore, within context of this wider review of Vote RS&T and its relationship with Vote Education, how universities and CRIs can work collaboratively to train and develop top talent for New Zealand;
 12. research organisations be encouraged to work on collaborative means of purchase and use of major items of infrastructure; and engage with government in this process;
 13. the work of the CRI taskforce, the science priorities work, and the work on translating publicly-funded RS&T, be linked and considered as a whole. We understand this to be the intent of the Government;
 14. the Government honour existing contracts and consider transition funding as appropriate, for the period of priority shift;
 15. the office of Prime Minister's Chief Science Adviser be made a permanent establishment;
 16. a commitment to Mataranga Maori be made visible within the science priorities process;
 17. Science New Zealand work with government on backbone development, status and stewardship, as per the feedback document;
 18. Government implement, as per its proposals, a greater level of strategic funding to assist business planning for Crown Research Institutes so that the mission and purpose of each can be better achieved for New Zealand;
 19. science be promoted as a defining element of being Kiwi;
 20. science degrees be promoted as a route to a variety of careers, not solely research careers.



Introduction

Science New Zealand welcomes the Government's paper on research, science and technology priorities. It is part of a suite of initiatives which has the potential to substantially improve the efficiency and effectiveness of the contribution science can make to New Zealand's prosperity.

The other elements include the *Taskforce on Strengthening CRIs*; and the work by the Prime Minister's Chief Science Adviser, Professor Sir Peter Gluckman, and the Ministry of Research Science & Technology on *improving the transfer of science ideas through to utility for New Zealand benefit*.

The initiatives are interdependent. For example, there is a close relationship between long term, strategic funding and the ability of Crown Research Institutes to steward nationally important science capability. So some issues will be resolved by a parallel consideration of the three initiatives.

The high level of interdependence is recognised in the Science New Zealand response to the feedback document. Science New Zealand will also submit on the other streams of work.

Science New Zealand has kept to a high level response to the science priorities document. This is for two reasons. One, that the Government is seeking feedback on the general direction it has outlined. It acknowledges detailed work is needed in the coming months following agreement on the overall strategy and the result of the other items of work. We welcome the opportunity to be involved in that process.

Second, individual Crown Research Institutes will make their own submissions on matters within their own areas of expertise around both the science and the sectors.

Science New Zealand

Science New Zealand is the peak body for the Crown Research Institutes. The Board consists of the chief executives of the CRIs. It does not advocate any particular number or structure of Crown Research Institutes.

Science New Zealand contributes to discussion on science-related matters of national importance, particularly where the value of science for New Zealand's economic and environmental wealth and well-being can be promoted or enhanced. Matters of education, training, innovation, productivity, business development, science management, governance and investment are therefore important.

Science New Zealand offers insights from the CRIs and their many associated entities (subsidiaries, partnerships, joint ventures, partnerships and collaborations). CRIs also bring the insight, knowledge and connectedness from the close collaborations with their various sectors, customers and research linkages in New Zealand and globally.

The Crown Research Institutes are owned by the Crown, with each having its own Board appointed by shareholding Ministers. They operate according to the CRI Act 1992 which sets out their purpose to be "research which benefits New Zealand" and are tasked to promote and disseminate the results of their research. The eight collectively have revenue of \$675 million, from public and private sources. The CRI Act requires each to be financially viable. The 4,400 FTEs include two-thirds of the nation's publicly-funded science researchers (excluding ICT and health researchers). CRIs have a lengthy track record in delivering value to New Zealand via both commercialisation and technology transfer routes.



1. Government's context and goals

Science and innovation

New Zealand has shown that having an economy highly rated on such measures as openness, ethics, transparency, and regulatory rigour, is not by itself sufficient to generate the sustained growth needed to move New Zealand up the OECD rankings, or improve national performance compared to Australia. OECD analysis shows that between 25-45 per cent of productivity gains come from innovation, of which science is an essential component.

No modern society has increased its economic wealth and greater societal and environmental well-being without a solid foundation of science. New Zealand needs the appropriate quantity, quality and direction of science research and application to make an effective contribution to New Zealand's ambitions.

RS&T priorities statement

Therefore, Science New Zealand strongly supports a clear statement of the nation's science research priorities. It enables the big picture to be well understood by both the public and private sectors. The priorities must reflect the ambition and requirements of both sectors, as these are so interdependent.

Public sector investment has traditionally been significantly higher than the private sector as a proportion of New Zealand's total RS&T investment. Private sector investment has been increasing in recent years, but is at 0.49 per cent of GDP compared to the OECD average of 1.49 per cent.

The Government is the major funder of the nation's science capability. This places great responsibility upon Government to ensure that it is well connected to both the current needs of New Zealand and to future possibilities.

Science New Zealand endorses the need to prioritise the nation's scarce science resources, so as to maximise their effectiveness. Prioritisation is required regardless of significant increases in investment. Even far wealthier countries cannot do all the science research that they want.

Having clear priorities encourages and supports investment by individuals and institutions in areas from study and careers through to infrastructure and business. It enables alignment by giving some certainty around national direction.

The priorities arch over both global and domestic activity. Indeed, being engaged internationally is a condition of providing excellent and relevant science domestically. Global and domestic RS&T activities combine to meet New Zealand's needs. New Zealand must have the ability to access, understand, capture and translate the science done off-shore that is of benefit to New Zealand. Within New Zealand, we need to focus on what matters here, and can be best done here, to benefit New Zealand.

New Zealand's science community can contribute to increasing New Zealand's productivity growth and reducing New Zealand's vulnerability to adverse effects. Both contribute to a high valued economy which creates and sustains employment and prosperity.



Priorities

Priority setting requires several elements:

1. A plan and a process
 - a. Consultation with stakeholders
 - b. Informed by good data and using transparent, key criteria
2. Knowing where we are now
 - a. Current allocation is a starting point, at both the high level and the next domain level down
3. A science taxonomy
 - a. The 'pots' into which funds are allocated, reflecting the basic criteria (e.g., science discipline or socio-economic benefit)
4. A statement of the government's high level goals
 - a. A statement of what the government views as desirable trends and changes in the medium to long term
5. A statement of priorities
 - a. An unequivocal statement showing where the government expects to allocate its science money in the next few years
6. Control of the relevant budgets
 - a. There should be a clear path between the priority statement and the movement of funds. This is not an advisory exercise, but an executive direction.
7. Funding and investment agencies which will adhere to the priority statement.
 - a. The priority statement must be the authority for distribution of investments at high level and next domain level.

Further stakeholder contribution to discussion should follow on from the feedback document.

Vote RS&T structure

Science New Zealand welcomes the simpler structure of Vote RS&T proposed in the Feedback document. The document also acknowledges links with other major RS&T investment vehicles, such as Vote Education and policy or operational Votes; and the contribution of the environmental and social elements to the wealth and wellbeing of the nation.

Simplifying the system will enable scientists and researchers to "get on with the job", whilst still maintaining the necessary levels of responsibility and accountability. Enabling scientists to spend more time doing science, rather than in form-filling and excessive bidding rounds, will improve both science productivity and science creativity.

Any system which allocates resources will need boundaries. Science, however, is often most creative at the margins, where overlap occurs between disciplines and sectors. Science New Zealand welcomes acknowledgement that public good science also contributes measurably to wealth creation; and that an intent of the mechanisms supporting each outcome area is to enable cross-sectoral engagement.

Science New Zealand strongly supports financial discipline, transparency and accountability in the investment and management of science research, and its implementation.

How much into each outcome area?

The document shows six '*Outcome areas of importance to New Zealand*'. The size of each of the areas reflects the mapping across of current spend in those areas.



The final weight to be given each outcome area will be determined by Government, and will be the clearest expression of the RS&T priorities within Vote RS&T.

The Government should state how much will be spent in each outcome area of Vote RS&T, and also in each of the next domain levels (‘Proposed Major Domains’).

Vote RS&T is of course only one instrument for the expression of the Government’s science priorities. Total national spending includes other Government investment, via other Votes; and also the private sector spending.

Presentations to Cabinet, Parliament, officials and the public should clearly indicate the national picture. This will include the spend in each of the outcome areas as well as the allocation from Vote RS&T within each outcome area. This ensures clarity on the national spend, and on the Government’s role in supporting investment into each of the outcome areas.

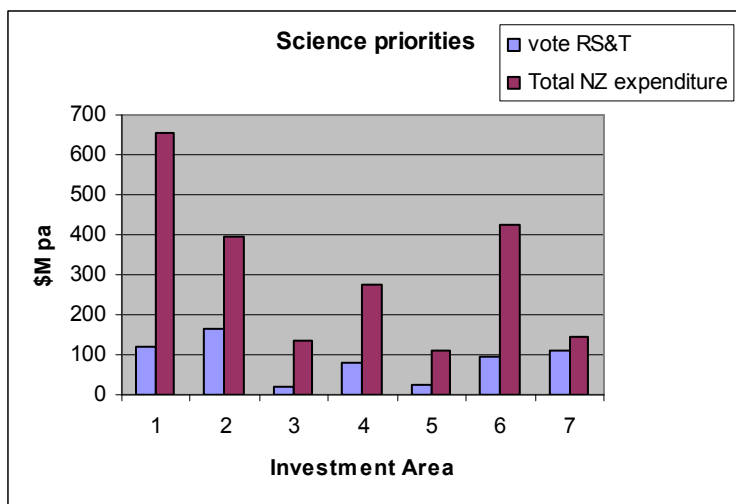
Science New Zealand has mapped the 2008 R&D Statistics Survey data into the proposed six outcome areas. It shows the spend from Vote RS&T (as per the feedback document), and also the spend from all of government and from the private sector.

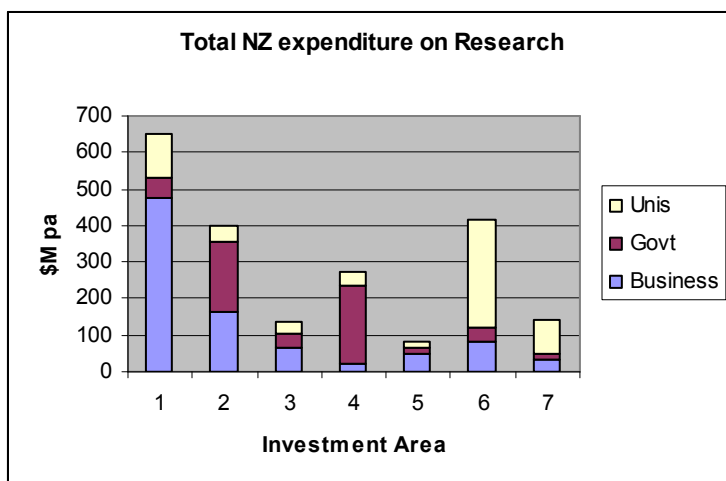
It illustrates for instance that the high-tech industries outcome area as described by the feedback document is already the largest investment area when public and private sector spending is amalgamated. It also shows that business does most of this investment itself. The Government therefore needs to look closely at the proposed major domains to see in what areas, and with what mix of research spectrum, it can most add value to the existing national effort.

Vote: RST research expenditure in the context of NZ’s total research expenditure

Investment Areas

1. High tech industries
2. Biological Economy
3. Energy/minerals
4. Environment
5. Hazards/infrastructure
6. Health & society
7. Other





2. Strategic direction of the New Zealand science system

Science New Zealand endorses the proposal that New Zealand's approach to publicly-funded science must be strategic.

Overseas investment levels, priorities and structures are useful comparators. Ultimately, however, New Zealand has to set its own parameters, based on the needs and the ambitions of New Zealand rather than some global average.

A similar conclusion was reached by a working group of chief executives and vice-chancellors from New Zealand universities, research associations and crown research institutes in a report to the Minister of Research Science & Technology. [*A Framework for Research & Development Investment in New Zealand*, 17 November 2004].

The Report recognised that the unique nature of New Zealand's needs and structures made a profile akin to the OECD average inappropriate. It accepted that it is desirable for the private sector to do much of the commercialising, tactical and strategic R&D, as in other OECD economies – but that the New Zealand circumstances require considerably more public investment than the global norm in the meantime.

Economic growth agenda and the environment

Science New Zealand supports placing science prioritisation within an overarching national agenda. This creates the essential context for allocating scarce resources.

We welcome recognition that New Zealand's economic growth is intimately linked with our environmental status. This is probably truer of New Zealand than of any other OECD economy. Primary production accounts for \$25 billion export receipts. Dairy alone accounts for 18 per cent of goods and service export receipts, followed by tourism at 16.5 per cent.

Our natural advantages are environmental ones (e.g. soil, water, ocean, temperature). This linkage is simply illustrated: "Take a photograph of New Zealand, and you will have captured a picture of New Zealand science."



Science research and application is embedded in our primary production products and processes, as well as in the knowledge and actions that protect and enhance our natural environment. Meeting the challenges of increasing productivity whilst protecting the environment will more and more rely upon science-driven innovation which is both incremental and transformational. Science New Zealand endorses this insight from the feedback document.

As Crown owned companies with the statutory role of undertaking research to benefit New Zealand, Crown Research Institutes seek to maximise these advantages for New Zealand's prosperity.

Building on environmental advantage and the economically vital primary sectors need not constrain either the economy or science. Treasury has recently noted that some very successful economies, such as Canada, Australia and Finland, have built strong innovation around their traditional low and medium tech resource base. New Zealand has the opportunity to leverage science, trade and diplomatic advantage from the nation's knowledge in agricultural emissions, as it builds a global research alliance with the USA, India et al. This is a high-tech development from our past investment in environmental and primary sector science.

Science as a defining element of being Kiwi

We endorse the concept that science is central to New Zealanders' history and achievements.

Widespread appreciation of this, however, has been marginalised. New Zealand lacks high profile science heroes who have done their work in this country; there is little appreciation of how science-dependent are our major industries – including primary production and tourism; and by the elevation of the "Number 8 wire" myth that, by implication, devalues science research and development processes.

Science can, and must, become a much larger element in New Zealanders' identity. The Crown Research Institutes' experiences in promoting science show that there is a considerable willingness by many New Zealanders to identify with a 'smart New Zealand' image to complement the '100 per cent Pure' image. The latter is, on the face of it, Arcadian and science-free, yet is totally dependent upon science for its preservation.

'Smart New Zealand' will need to be fully authentic, reflecting people, achievements and results engrained here, and making the link to our prosperity and ambitions. Such a culture change encourages greater willingness to invest (via training, careers, and financially) in science and science-related activities which, in turn, creates the dynamic modern economy.

General principles

Science New Zealand strongly endorses the general principles.

The principles guarantee a focus on excellence, relevance and connection to New Zealand's current and future needs. They support the strategic intent of public investment into RS&T. It is not clear from the document if the general principles will apply to all publicly-funded RS&T, or solely to the Vote RS&T component of Government investment.

In any case, Science New Zealand recommends a national reporting of the science research occurring across all publicly-funded research, aligned with the six outcome areas. This should be set against private sector investment, if possible, to get a national overview.



Excellence is an essential element of a science system. There is growing understanding that the excellence criterion must reflect the intent of the investment in RS&T. In some areas of science, the research is aimed at the discovery of new scientific knowledge. There is also scientific and technological research conducted in support of a sector (perhaps an established industry or a government need for information).

The different types of research, including their context and purpose, will be measured in different ways. A single measure creates bias. *[See paper by Dr Garth Carnaby, at the Australasian Research Managers' Association Conference, Christchurch, September 2009]*

For example, high-impact science journals are published almost exclusively in the northern hemisphere. Excellent research of critical importance to New Zealand, but of interest to few outside New Zealand, struggles to be published in those journals. This leads to 'local science and technology' being consigned a lower status, and incentivises researchers to work towards what is of interest to the high impact journals. Excellence in New Zealand-relevant science and technology research and application needs equal status in the mechanisms for allocating funding, and in public recognition.

Science New Zealand supports investment where science research can advance New Zealand's economic performance, productivity and future development, and assist in developing our social fabric and protecting our environment.

Science New Zealand supports the full spectrum of science research, from basic and curiosity-driven research to the applied, within each of the outcome areas. This ensures linkage with New Zealand's science priorities, and also allows for serendipity. The research will be in areas in which New Zealand is more likely to have a need and/or capability to take the research or its output further, and in which New Zealand is more able to capture the value.

The linkage of science research to sectors and societal interests is a strength of the Crown Research Institutes. It enables essential two-way engagement and linkage, so that researchers and 'end-users' learn from each other on important intangibles (such as articulating the problem, understanding the drivers for the research, and how it will be used). This relationship-based linkage builds absorptive capability in ways that transactional relationships of purchaser/provider cannot.

Flexibility and leadership

Science New Zealand agrees that the science system must be flexible and responsive. In a fast moving world, involving multiple partners globally and domestically, with private and public sector cultures, and enormous opportunities lying in intellectual property, unnecessary delays and multiple approval or review processes can kill an opportunity. Due diligence and prudence can now be undertaken smarter and faster. Modern systems need to reflect that.

This has been a fact of development for Crown Research Institutes. When created in 1992, there were ten CRIs with carefully defined sectors. Developments since then include:

- The social science CRI proved not to be economically viable. Much of its work and staff transferred to universities, which have a lower economic test;
- Science researchers from a government department have been folded into a CRI;
- A research association has joined a CRI;
- Two CRIs have merged;



- A proposal for a CRI to merge with a university has been considered;
- A trans-Tasman unincorporated joint venture involving a CRI and CSIRO was trialled;
- A variety of formal and informal relationships have been developed to address pressing science-soluble problems in the short, medium or longer term.

The Crown Research Institutes recognise that science leaps sectoral boundaries, and CRIs must be flexible in maximising benefit from their intellectual property. For example, IRL's work in dental imagery led to work with Scion on the structural integrity of saw logs. From this came the *Hitman* forestry product. It has an 80 per cent penetration in its sector, and a return of \$235 million in annual productivity gains. It also illustrates how Crown Research Institutes cooperate to leverage their capabilities and investment on the basis of having a common owner and purpose.

Crown Research Institutes have maintained the quality of science outputs; research productivity; and their financial viability through trying times. They have also proven maturity in sector leadership; and capability in making extremely important strategic decisions (such as to close down; to merge or to initiate close partnerships).

Multi-organisational approaches

Science New Zealand endorses the operational principles, and offers the following observations on the efficiency in fostering multi-organisational approaches.

Crown Research Institutes have moved away from institutional competitiveness and primacy to focus on how best to deliver the science that maximises benefit to New Zealand.

This has often provided more creative, enduring and appropriate solutions to multi-institutional and multi-disciplinary problems than the immediate leap to considering merger. For example, two CRIs and an industry-owned research organisation created the Biopolymer Network Limited as legal entity; all CRIs created the Climate Change Network and invited universities to join; a Soil Land Use Research Initiative (SLURI) was created by relevant CRIs to work on major issues in this area, bringing together the networks and expertise each had from their sectoral science and knowledge. Many other examples exist.

In addition, numerous formal linkages across CRIs and with other research organisations such as universities and Centres of Research Excellence sustain a rich web of exchange. These include funding professorial chairs, joint appointments, mentoring and supervising students (400 PhDs and 150 MSc students per annum), and science teams. One CRI alone has calculated more than 1,000 formally identifiable activities (not counting students).

This fluid but controlled 'fit for purpose' approach enhances productivity and technology transfer. Mergers (especially if forced) of whole or large parts of entities distract from productivity for considerable periods. Formal transfer of units, as opposed to a multi-institutional collaboration, is a serious step. It decouples the capability from the other work streams and sectoral engagements of their original CRI.

It is notable that sectors express alarm when suggestions are made of amalgamations of CRIs. There is a sense of disempowerment. They are concerned that their ability to interact and engage with the resultant larger entity will be less, and their importance to the entity reduced.



In New Zealand terms, CRIs are significant-sized businesses. Many are amongst the larger businesses in their sectors. Yet they retain the cultural ease to work well with a wide range of entities. This shows up in partnering, access to decision makers, engagement with sector leaders and the ability to move with flexibility and speed. They are focussed on their sector and are agile.

The sectors themselves change, however. A marginal area may become core, or the sector expands into new areas. It is the change in its sector that should be a decisive matter in change of a CRI.

CRIs have shown their responsiveness to the dynamism of science, sectors and business cycles. They have demonstrated readiness to make recommendations on change when these are appropriate. This reflects a maturity in governance and management, with a focus on 'the work' – i.e. benefiting New Zealand through relevant, excellent science research and its transfer.

This flexible approach reflects the dynamism of the science, the sectors that CRIs serve, and the business cycles of the sectors and the CRI.

Flexibility needs to be matched by stability, to enable resilience. The feedback document envisages a system in which scientists have more time for reflection and creativity. This is enhanced by having the organisational resilience, flexibility and stability to plan, respond and organise. It is random change, caused by arbitrary decisions often made outside the strategic plan of the research organisation, which kills the ability to have a strategic response.

Change is a constant, however, and will be better handled within the proposed structures and mechanisms which put greater responsibility at the point of most knowledge. For example, ending a line of research is often the hardest part of a management process. Crown Research Institutes operate within a strategic Statement of Corporate Intent agreed with the shareholder. This makes the process of gate-keeping and prioritising of resources defined and transparent.

Principles underlying priority setting

People

We endorse the need to train, develop and retain outstanding scientific talent. This is a given, if New Zealand is to be a competitive economy. Likewise, highly innovative scientists need to be nurtured. These may not be the same individuals.

Additionally, New Zealand needs to ensure that we have a full cohort of relevantly skilled scientists and technicians to deliver the results required. At present, New Zealand is very dependent upon the ability to attract and retain talent from offshore. Almost 60 per cent of PhD level recruits into CRIs in the past two years have come from abroad. This includes some returning New Zealanders.

Offshore recruitment generates considerable benefit in terms of global linkages and new ideas. CRIs will recruit the best talent they can, but many report that they are finding it increasingly difficult to recruit in a competitive global market for science researchers. Many economies, New Zealand included, are setting up networks to recruit their nationals to return.

Science New Zealand estimates that the nation needs a further 40,000 scientists and technicians if New Zealand is to match the Australian GDP by creating more high tech industry. This is based on the ratio of science staff to revenues in top New Zealand high-tech companies. The total is about five times the current number employed in New Zealand's private sector.



The nation's universities produced some 185 Bachelors in Agricultural Science in 2008, compared to some 2,500 people in film and media studies. The universities are responding to their institutional incentives, and students are responding to cultural and economic signals. Is the nation comfortable with the ability to meet future needs, whether from offshore or onshore?

Top talent

Top talent will emerge in a wide range of fields, some by serendipity and some by good luck. Not all will be suitable for New Zealand's strategic development. New Zealand will need to look abroad to attract and retain relevant top talent, as well as seek to nurture top talent domestically. It is inevitable that top talent will have to go offshore for some time, to build their skills and networks.

Science New Zealand also draws attention to the vital importance of those who are not top talent. Top talent is by definition a rare occurrence. New Zealand needs to have sufficient numbers of highly trained people with relevant skills to ensure delivery. For top talent to fully flourish, including translation of ideas into results, it needs great colleagues, and quality teams.

Competitive advantage

New Zealand's competitive advantage will change over time, especially as the nation's economy is strengthened and diversified by this strategic approach. Competitive advantage will also require us to consider areas of comparative disadvantage, and possibly disinvest from those areas.

In addition, while it is useful to grow businesses that are not reliant upon our natural resource base (although they may emerge from it, in some way), New Zealand should be wary of investing in businesses or technologies which are disadvantaged by being located in New Zealand, and therefore will always struggle to be competitive.

Multidisciplinary research

New Zealand is a small society, relatively well linked internally and globally. Nonetheless, internal and global linkages can be improved, and this is being assisted, for example, by the Advanced Network. Surveys within New Zealand and overseas show a consistently remarked feature of the New Zealand culture is the ease with which people collaborate, cooperate and form teams. OECD statistics rank New Zealand in the top five for SMEs collaboration with public research organisations by innovating firms.

The Crown Research Institutes have deliberately fostered such attributes across the CRIs and with other research organisations in recent years. This has led to significant networks of informal relationships and transfers of implicit knowledge, to the great benefit of all involved. Further developments have been formalised via MOUs, or various agreements. More advanced still, formal partnerships have been developed across CRIs and with other research organisations.

Sometimes, this has been made more difficult than necessary by the ad hoc nature of the developments, the differing cultural expectations of the parties, and also legal differences arising from ownership and tax requirements.

Crown Research Institutes recognise the value that multidisciplinary research can deliver, and will continue to encourage this development. This may reduce some of the current costs and delays in agreeing such research programmes, and agreement on the ownership and transfer of any resultant intellectual property. It will be a significant part of research design.



Government's proposals to commit to long term, strategic research will by itself grow the multidisciplinary levels of science research in New Zealand. One cannot deliver on long term science research without multidisciplinary elements. This arises naturally from the work, and its absence will be remarked by any review of the lead organisation in the area. Crown Research Institutes are multi-disciplinary, based on sectors. They will assemble the best team to deliver on the task required.

Research Providers

Science New Zealand endorses recognition that there are different types of research provider. It is not only the mix of science disciplines that stimulates innovative thinking; it is also the differing perspectives of the, say, academic researcher and the more sector-connected researcher.

Organisationally, differences reflect purpose and ownership (the latter linked to control and direction by a shareholder).

Changing the structure or financial responsibilities of Crown Research Institutes will not alter that CRIs are owned by the Crown, and thus subject to its direction; and that the purpose of CRIs is to advance ideas and deliver results from science research specifically intended to benefit New Zealand.

Universities are complementary to this. They are, as per statute, research led teaching institutions with particular societal responsibilities (e.g. to be critics and the conscience of society; to have freedom of academic research and comment; to develop highly educated people). The science research element is a varying percentage of each university's focus. Universities are not subject to Crown direction, although may be influenced by particular purchase decisions by the Crown.

Industry or charitable-based private research organisations are likewise not subject to Crown control and direction. They have no obligation to attract, nurture or retain science capabilities of national importance; and are subject to the varying importance placed upon them by their sectors. They are, nonetheless, important elements in New Zealand's science eco-system.

Crown Research Institutes have a unique composition and role. As corporate entities, CRIs can direct staff to work in particular areas; can centrally assign and re-assign corporate resources; can make long term commitments to areas of strategic national importance – and continue that commitment even if the principal investigator departs the entity. Excellence is measured by delivery of research that makes an impact to the benefit of New Zealand.

Crown Research Institutes and universities comprise the bulk of publicly-funded science research. Two-thirds of science researchers, apart from health and ICT, are in CRIs. The relationships are deep and deepening. CRIs fund professorial chairs, especially in areas where CRIs are keen to encourage more students; or in which there is no academic route at present; and to encourage research beyond the more sector-driven scope of the CRI.

CRIs mentor or supervise some 400 PhD and 150 MSc students per annum. This benefits all parties: it broadens the practical and applied experience of students; introduces them to the excitement of a commercial-style world, dealing with customers, clients and results-based service and delivery; and also helps stimulate new thinking. Universities point students to CRIs as future employers.



It is useful to further explore, within context of this wider review of Vote RS&T and its relationship with Vote Education, how universities and CRIs can work collaboratively to train and develop top talent for New Zealand.

Operational Principles

Science New Zealand endorses the operational principles.

Multi-organisational approaches

It should be noted, however, that multi-organisational approaches should be encouraged when it makes sense, and not made the default setting. Multi-organisational approaches will continue to evolve, as noted above in our comments on multi-disciplinary science.

To make them the default setting will provide a barrier already seen in some bidding processes, where forced collaboration creates a weakened team (and takes further time to organise and then manage) in order to satisfy some bureaucratic tick box.

Infrastructure and critical mass

Enhanced relationships between various research organisations will also assist development of appropriate infrastructure and critical mass (point 1 of *principles underlying priority setting*).

In today's networked world, which permits high levels of connectivity and flexibility, old style thinking that focuses on single large organisations may in fact impede science research and the ability to capitalise on it. Strong and trusting relationships between research organisations, researchers, companies and sectors, are the critical element for mobilising ideas into results.

Entrepreneurial experts comment that it is the ability to articulate the issue that then leads to finding the right person or organisation to solve the problem. That in turn may lead to long term relationships which foster embedded innovation practice.

Smart organisations create an eco-system of support which recognises the expertise of various players, and brings them together in the relevant way to solve an issue. This ranges from problem definition, to research, application and commercialisation and financing. In other words, a diversity of relationships is required to build an innovative society.

Smart organisations also identify when it is necessary to respond to, or anticipate, growth needs, by structural rearrangement. This can take the form of divesting some elements to another entity; acquiring new capability; or amalgamating entirely.

Crown Research Institutes have identified that some intellectual capital and intellectual property developed in one or other CRI, which may be of marginal value to that CRI, can be of importance to a sector with which another CRI is better connected. Rather than let it languish, or have its transfer or commercialisation handled sub-optimally, CRIs are working collaboratively to maximise the value transfer and impact.

This is a collegial approach built on the deliberate development in recent years of trust, shared expectations, values and processes. It has practical outcomes, and is reflected in, for example, meetings of the commercialisation managers across the CRIs as well as chief executives and science strategy managers. Positive examples have emerged of the benefits in terms of both technology transfer and commercialisation outcomes. The Crown Research Institutes believe that more can be made of this development, and that the approach may be able to be extended further.



Science New Zealand recommends that this approach be encouraged.

Science infrastructure is increasingly sophisticated, and costly in terms of capital purchase and operational expense. In some instances, an entity can make the business case for capital expenditure but the inflexibility of full cost funded contracts mean that the increased operational costs cannot be recouped until a new contract is bid for and agreed. Crown Research Institutes and others are exploring ways by which major items of kit are made available beyond the major user, in such a way as to satisfy the different needs of curiosity-driven researchers and those with applied obligations.

Crown Research Institutes are also working with the shareholder on means by which facility refreshment and upgrading can be improved.

3. Vote RS&T: New Investment Structure

Our following remarks pertain to the outcome areas diagram, and to the further discussion of priority investment areas (Section 4 of the Feedback Document).

The six outcome areas provide a clear focus for identifying current spend and assessing the relative priorities. The clarity at this high level is useful for science researchers, research organisations, 'end-users' including businesses, councils and the wider public, and of course Government as the prime funder and strategists.

Science New Zealand endorses the separation of the outcome areas from the tools and investment processes. We also endorse the idea of allowing the whole spectrum of R&D (that is, from basic untargeted through to development) to be funded within a single programme in an outcome area. This will permit entities with a strategic focus to determine the point at which an idea can shift into a development or technology transfer phase and allocate resources accordingly.

The funding for each outcome area will be set by Government through the political process, and within the context of the Government's economic growth agenda.

Science New Zealand believes that Government should set dollar amounts at the proposed major domain level also. This will ensure clear direction to the funding and investment agencies regarding relative priorities within each outcome area. The FIAs are then given the role, not of deciding national priorities, but of choosing the best means to achieve them.

The Government reserves the right to change investment priorities across the major domains from time to time, particularly in the economic outcomes areas (high-technology, biological industries, energy and minerals). The feedback document says that this "will be driven by the quality of the science, the scale of the opportunity and the pathway to effective progress through research, development and commercialisation."

Science New Zealand endorses this strategic, top down approach.

Stability

The need to improve stability is strongly supported. We note that funding will be driven by New Zealand's needs as opposed to individual institutions. Crown Research Institutes exist, of course, not for their own purposes but to best serve New Zealand's needs. In this sense, CRIs provide a



mechanism by which to steward long term, strategic research of national importance in particular areas.

Stability is vital. It is not to be confused with stasis or stagnation. It enables resilience. By signalling Government's commitment, stability gives the confidence to grow, attract and retain key talent; to invest in advanced facilities and infrastructure; and to credibly make and build science research and business connections and networks, domestically and globally.

The OECD Report 2007 commented on the relative lack of core funding for Crown Research Institutes, and the consequent constraints on maximising their effectiveness. The proposed mix of funding and investment mechanisms looks sound. The optimum composition will vary across Crown Research Institutes.

Science New Zealand recommends that the 'total package' should be assessed and aligned against the mission of each CRI, as agreed with the shareholder, i.e. the Government. This is so as to ensure that the organisations necessary to steward the work actually have the wherewithal to do so. This will also overturn the policy agnosticism which has seen funding agencies allocate work programmes without regard to the maintenance of a coherent, linked capability.

This work will need to be aligned with the work from the CRI Taskforce.

4. Priority investment areas

The groupings distinguish between primarily economic outcomes, public good outcomes and capability building outcomes. That taxonomy has its advantages in analysing priorities.

Science New Zealand strongly supports the acknowledgement that in practice there is significant crossover among these groups. The awareness of this inherent linkage must be maintained in the thinking and implementation of the science priorities. Similarly, Mātauranga Māori flows through all six outcome areas and should be made visible.

Reprioritisation will occur in the 2010 Budget. In most jurisdictions where reprioritisation has occurred, the inevitable pain has been assuaged to some extent by new monies to boost the priority areas and a graduated move away from lesser priority areas. This allows for transition, including redeployment and retraining if possible. It also avoids perceptions by existing and potential staff, research partners and business users that New Zealand's system is subject to precipitate, unsignalled cuts. A commitment to honour existing contracts will soften the effects of sharp changes in priorities.

Vote RS&T is one element in the Government's overall investment into science research. Vote RS&T sits alongside substantial directed science-based activity in Conservation, Environment, Forestry, Agriculture, Energy and Health. In addition, Vote Education has substantial investments for science research and capability building. These activities are often complementary to the purpose of Vote RS&T, and attention should be paid to ensure that there is not overlap of purpose and mission.

Crown Research Institutes and universities have been increasing their levels of collaboration, as previously noted. The complementary nature of their purpose and mission is a strong base on which to build more such collaboration in the future.



RS&T for economic outcomes

The priorities are clearly weighted towards economic growth particularly through exports. Growth can be achieved through development of new products and processes; including new industries with an export focus. Export revenues can also be driven by innovation-driven productivity gains around existing products, processes and sectors. Relatively small percentage gains in large sectors can translate into major revenue gains for the country downstream.

It is pleasing to see that there will be no arbitrary bias towards one sector or another.

Crown Research Institutes have a very strong relationship with the private sector. The R&D Statistics biannual survey shows business expenditure on R&D has been growing, and more of it being placed at CRIs. This indicates confidence by the private sector in the quality of engagement with CRIs.

Private sector spend as a proportion of revenue is higher in CRIs (31 per cent in 2008) than any other research organisation. Between 2005 and 2007, university research funded by business fell by more than half, to 3 per cent of research revenue (reasons may include the primary drivers of the PBRF).

The vast majority of CRI activity is direct with clients. Thus the knowledge is "commercialised" through technology translation or transfer (such as reports which are action-driven e.g. on pest and diseases controls; decision support tools and the like), or via commercial transfer. While much is not codified IP, it is having measurable economic impact.

This level of research/industry relationship is now part of best practice. This is a significant improvement over the former 'silo' mentality which saw researchers "do" science research almost in a vacuum, and then try their best to "push it over the wall" into industry. A partnership, respecting the roles and virtues of both push and pull, is now recognised as the smart way to ensure science-based innovation occurs.

Crown Research Institutes have a particular interest in sectoral relationships, as the feedback document acknowledges. The CRIs mission is to respond strategically to New Zealand's needs, so as to spur economic growth and ensure environmental and other benefits.

This includes managing the sometimes conflicting demands. On one hand, meeting industry's current and medium-term needs, which they may be able to identify and articulate; and on the other, also providing a sector-oriented future focus which recognises the latent research needs of the sector (which may even prove to be disruptive research).

This situation places Crown Research Institutes in a stewardship as well as partnership role with sectors. It argues for considerable alignment with sectors, but avoiding control by sectors.

The strong sectoral relationships have enabled this inherent tension to be increasingly well identified and managed by all parties.

5. Strategic Research Platforms

Science New Zealand supports the criteria for potential strategic research platforms.

The feedback document provides an indicative list of platforms. Science New Zealand strongly supports the concept of long-term investments in the areas that need sustained commitment to science research.



We agree with the principle that it is the science mission being funded, and not the individual institutions.

There are various mechanisms which can deliver such outcomes. A recently launched one is the Natural Hazards Platform, led by GNS Science and NIWA. This has particular governance and reporting agreements with the Foundation for Research Science & Technology.

Other forms of platform may also be appropriate. The detailed mechanism should be led by the purpose of the science research, and possibly the locus of the major capability.

Sector related platforms are relatively easy to identify within and across research organisations.

Discipline-based platforms are less so, and may have some distinctive management challenges associated with them. Formal networking which reaches across research organisations is already evolving in some discipline areas. Examples include recent MOUs between CRIs and universities in earth sciences, agriculture areas and climate change.

The establishment of discipline areas within Vote RS&T should adhere to the general principles set out in the opening section of the feedback document. This requires attention to science excellence and its impact, and ensuring that the need is not already being met via mechanisms such as CoRES (which lie outside Vote RS&T).

We would welcome a further discussion upon the possible platforms, and also the relationship with other potential and current mechanisms such as negotiated funding or variants. This can occur once the Government has concluded its parallel streams of work in the science review process.

Science New Zealand will not rank the list of indicative platforms at this stage.

6. Developing people and infrastructure

Science New Zealand endorses the view that scientific capability is built upon people building science careers. The ability to do so, with confidence, is dependent upon a density of supporting infrastructure. This includes a wide range and number of public and private research-intensive and/or research receptive entities and sectors. It also requires a culture that values and supports scientific endeavour. Thus, science researchers are an element in this overall eco-system.

Science New Zealand agrees that more can be done to promote the value of science and its personal and societal benefits (including economic benefits). This includes encouraging young people to continue their secondary school science studies into tertiary study. At present, too many decide that a BSc is a vocational degree, whereas traditional "professional" degrees such as Commerce or Law degrees are now seen as useful first degrees which open a wide world of possible careers beyond accountancy or being a lawyer.

We would encourage a first Science degree to be seen in the same light. The expectation is that this will grow the number of students exposed to science and increase the pool of science-literate people in industry or other sectors. It is likely to also increase the pool of science researchers, by gathering in people who may have chosen another path in their first year of tertiary study.



It is important to publically profile people in senior positions in government, business, and other parts of society, who hold science degrees. This again heightens perceptions of depth and breadth of science-based careers, be it in research or other areas.

Science New Zealand supports the need for curiosity-driven research as an essential element in a well-balanced spectrum of research opportunities in New Zealand. New Zealand has a relatively generous level of funding of basic research as a proportion of overall science investment (OECD high technology indicators, for example, place New Zealand in first place). Ensuring that more of the curiosity-driven research occurs in areas of relative importance to New Zealand will enhance the element of serendipity.

Top talent

The manner of the linkage or connection between top talent and desired outcomes (such as an increase in uptake of knowledge by firms and research-users) needs greater clarity. As previously mentioned, there is a significant role for those who may not be top talent in an academically-defined way, yet whose talent is essential to ensure New Zealand accesses and benefits from the work of the top talent (by definition, rare individuals).

In addition, as the OECD *Review of Innovation Policy: New Zealand, August 2007*, notes, there is a need to increase the ability of staff to deal with commercial end users. This has been a challenge accepted by the Crown Research Institutes. Internal and external means are now being employed to enhance the 'non-science' talents, which is a critical element in technology transfer and commercialisation. We would regard this as part of the Top Talent sphere.

We draw attention also to the work of Dr Garth Carnaby, President of the Royal Society of New Zealand. His essay on excellence within science and its application identifies equal excellence in the academic and the applied, and argues both should be accorded due respect. (*See reference on page 9, above*). We concur, not least because this recognises the complementary role of types and purpose of science research within different environments.

The general principles support the value of serendipity. This principle, as well as science excellence and impact, indicates that the 'Top Talent' funded from Vote RS&T should be in areas of likely research impact in New Zealand. This acknowledges that in a small country with limited resources, and operating within an economic growth agenda, we need to be clear about the general areas in which we can afford to grow, attract and retain top talent. It is not a constraint on the top talent, once they are identified.

Top talent may well involve teams, as well as individuals. Increasingly science and development is a team-based activity, bringing together multiple disciplines and skills. Teams can be formed and endure over quite long periods. They too need nurturing and recognition.

Top talent should not be defined solely with one mechanism, such as the Marsden Fund. That would be to automatically devalue the quality and contribution of the work of those who, for various reasons, will never get a Marsden Fund. Perhaps a parallel fund for excellence in applied science should be established.

Prime Minister's Chief Science Adviser

Science New Zealand is very supportive of the role and office of the Prime Minister's Chief Science Adviser. Such a role has been a long standing recommendation from Science New Zealand.



The profile and credibility of science research and its application to matters of significant public interest have been immeasurably enhanced by establishment of the office, its respected role and obvious authority within Government decision-making (appropriately, advisory), and the qualities of the establishment Adviser.

International relationships

Science is an international pursuit. This is as true for those driven to advance the store of global knowledge, as for those working with an objective of advancing research to benefit New Zealand.

Science New Zealand fully supports the value of international science relationships with science researchers, research organisations and innovative businesses and sectors. These assist development of access to ideas, facilities, investment and networks.

Science New Zealand also believes that more can be done to utilise the high level of global connectivity already undertaken by New Zealand's science researchers and associated people (for example, in technology transfer and commercialisation and new business development areas).

Crown Research Institutes staff are some of the most widely travelled and globally connected people in their respective sectors. CRIs and their sector partners have long recognised the value of this knowledge, insight and connectedness; much is embedded in the ideas, discussions, products and processes for sectors. We believe that more utility can be gained, however, for both sectors and for government agencies. A constraint has been how to cover the costs of providing staff for such interaction.

This constraint, and also one on joining international programmes, will be able to be better managed within larger, longer term funding contracts based on delivery of outcomes. The Crown Research Institute can make the decision.

Crown Research Institutes are now less inclined to divide their work into domestic and international. They see that being international is a critical means of delivering on their core purpose of research to benefit New Zealand.

The Prime Minister's recent announcement of the global research alliance on agricultural greenhouse gas emissions is an example of where New Zealand's national interest objectives can be advanced via science-based activity.

Science New Zealand supports the examples given in the feedback document regarding promoting and supporting New Zealand's RS&T capabilities internationally. We note that the general principles will provide a sound context within which to identify priority areas and activities.

Research Infrastructure

The full cost funding model has significant benefits in terms of accountability, transparency and financial discipline. There are, however, instances where there is an identifiable, soundly based need across the science research communities to have a particular item of equipment which is beyond the resources of any one research organisation to purchase and/or operate.

Discussion between research organisations (or other users) and the Government (as the likely principal funder or underwriter of such large purchases) is the best means to identify cost, where the cost will fall and usage allocation.



Science New Zealand wishes to comment particularly on two matters:

i) Backbone (databases, collections, research assets)

These are the assets of the nation. Many have been systematically collected and collated with some reaching back to James Cook's voyages at least. They continue to be vital reference and working assets for New Zealand's science research. They are not museum artefacts; nor are they able to have any nominal value realised through sale.

The collections were assigned to various CRIs in 1992 with the proviso that the data is freely available and that CRIs do not have exclusive access. They are held in stewardship, and appear as assets on their books. Most were transferred from DSIR or the original science organisation at nil value, and – with the current approval of the Office of the Auditor General – remain as nil value. The CRI provides maintenance and development, with Government assisting under current agreements. CRIs believe that backbone assets are best located alongside researchers who most use them, and also develop them.

Science New Zealand agrees that they are vital elements of national infrastructure, and will be pleased to work with Government on their status and the associated costs.

ii) CRI Capability Fund

The CRI Capability Fund is the sole fund exclusively assigned to the Crown Research Institutes collectively. It is currently allocated on a formula which links to each CRIs government-backed research revenues.

It is a strategic fund which also has an 'emergency response' element. One of its purposes is to allow a CRI to support for a team of researchers which has been non or underfunded. Its genesis is in recognition that central funding agencies, at some steps remove from the science and insight into future possibilities will occasionally underfund or not fund a science capability which the CRI considers to be of national importance. The fund offsets the power of a monopoly purchaser.

By definition, a CRI cannot predict when it might need to use the Capability Fund as an emergency fund. This constrains its ability to use the Capability Fund as strategically as it might otherwise to, for example, fund latent research needs which are beyond the current interest of its sector. This is a constraint upon the CRIs role in providing stretch and challenge to existing sectors, and looking beyond immediate and medium term needs for New Zealand.

Science New Zealand strongly supports the intent to develop a greater level of strategic funding to assist business planning for Crown Research Institutes. The mechanisms for achieving this will be assisted by the deliberations of the CRI Taskforce which has been charged with strengthening CRIs.

The feedback document notes the importance of the work of the CRI Taskforce. Science New Zealand will engage with that process.

Science New Zealand notes that the *OECD Review of Innovation Policy: New Zealand, August 2007*, recommended that "Crown Research Institutes should be provided with more core



funding, of say one third or one-half of their total budget.” This “would enable longer term research with a wide range of potential beneficiaries and for which the CRI itself can best judge the likely benefits, research staff etc.”

7. How funding and investment agents will give effect to the priorities

Science New Zealand endorses the view that the Minister and the funding and investment agents have different roles in implementing the science priorities. It is important the Government's priorities are stated and funded at both the outcome areas and the major domain levels.

It is the task of the FIA to determine the best proposals to fulfil the Government's priorities.

Science New Zealand welcomes the intent to publish a Statement of Science Priorities setting out principles and priorities for funding as part of the Budget process. The 3-5 year timeframe is suitable, accepting that within that it is likely that the Government will signal far longer timeframes for certain areas of investment.