Science New Zealand

Science that delivers for New Zealand

1. New Zealand's current and future wealth and wellbeing depend on scientific knowledge and derived applications *that deliver to New Zealand needs*.

2. New Zealand's current and future needs are the focus of the Crown Research Institutes, and their 4400 staff (FTE).

3. Crown Research Institutes contribute to evidence-based policy, strategy and science-based solutions for public and private sectors. They are at the heart of New Zealand's economic, environmental and social progress. They do this through:
   - high quality science;
   - close connection to the needs and strategies of central and local government, firms and sectors throughout New Zealand; and
   - connectedness to scientists and users of science throughout the world.

Science New Zealand

Science New Zealand is an incorporated society established in February 2008. Its members are the Crown Research Institutes. It works constructively with others that have scientific research interests, such as universities and polytechnics, research associations, professional and business groups, and government agencies.

Its mission is to foster appreciation of the value of science and technology for New Zealand; and to provide a forum in which Crown Research Institutes can work on issues of common concern.

The Science New Zealand Board comprises the chief executives of the Crown Research Institutes. It meets 6 times a year. The chair is elected each August and is currently Dr Andrew West, chief executive of AgResearch. A small secretariat is based in Wellington.

Crown Research Institutes have myriad scientific and business relationships within New Zealand and globally. These include subsidiaries, partnerships, incorporated and unincorporated joint ventures, business development and of course scientific research relationships.

Science New Zealand has an intimate knowledge of the 21st century's highly networked model of global relationships with partners and clients.

This knowledge is brought to bear on the single over-riding issue: maximising benefit to New Zealand from our scarce scientific resources.

Executive Summary

Science and technology matters for New Zealand

1. Boosting productivity growth so as to raise income per capita sustainably is the most important economic challenge for New Zealand (*OECD Review on Innovation in New Zealand, 2007*). This is primarily (but not solely) an RS&T challenge, and one focussed on delivering for New Zealand.

2. Scientific knowledge is important and it can be very profitable. Other countries believe this and back investment into science study, careers, infrastructure and commercialisation to maximise this potential.

   - New Zealand's investment (1.17 per cent of GDP) is about half the OECD average, with government funding 75 per cent of the OECD average for governments and the private sector one-third the average.
   - New Zealand is not growing, attracting and retaining the scientists and technologists needed to spur or underpin desired national wealth and wellbeing.

3. A world-class science system for New Zealand will balance its investment to achieve three things:
   - deliver on New Zealand's existing needs;
   - explore the future and create choices; and
   - reach into the blue skies around areas of excellence.

Science and technology produces benefits for New Zealand

4. New Zealand's economy is intensely science-dependent although this is little-acknowledged. More than two-thirds of merchandise exports come from the primary sector ($25bn) and tourism brings in a further $8.8bn. Both depend upon air, water, landscapes, grasses, soils, forests, coastal and marine environments.

5. These resources and the capabilities developed around them provide a rich base for much of the processing, manufacturing (from industrial to pharmaceuticals) and business services that create two-thirds of GDP.

6. New Zealand's biologically-based economy is under challenge from other suppliers, limits to natural resources and from changing market expectations around integrity of both products and supply chains (including environmental issues). The good news is that New Zealand is a world-leader in such knowledge areas, although under-resourced for current and future needs.

7. New Zealand's economic profile has changed little in 20 years. While RS&T has maintained the nation's competitive edge, both sustained additional investment and improved processes are needed to help lift the nation's OECD ranking.

8. The nation faces some critical issues; science is the necessary and vital contribution to their resolution. They include:

- productivity growth; international competitiveness, linkages and connections to capture spillover benefits; higher value outputs (including weightless products and services) that overcome the constraints of distance; climate change; land and water use, constraints and depletion; energy; biodiversity; biosecurity; food security; social cohesion.

Priorities to deliver maximum benefit to New Zealand

9. The Crown Research Institutes are committed to research which benefits New Zealand; aligns with government and national needs; and looks 'beyond the horizon' to lead or create new growth sectors and ensure current sectors maintain their competitiveness and grow new opportunities.

10. Excellent RS&T is essential, but not sufficient, for innovation-led growth. Innovation is much more than simply "commercialisation". Innovation requires a mix of invention, technologies, organisation, relationships and business models. That requires skilled people alert to national needs and global opportunities, closely linking business, education and research communities, looking beyond today's needs to the next generation. With New Zealand as their primary focus, Crown Research Institutes have a unique role and responsibility in the system.

11. Science New Zealand proposes three priority actions to maximise their benefit and that of the nation's scarce science resources:

i) Reform and streamline the funding system

- To accelerate innovation through even deeper end-user linkages; faster and more efficient decision-making utilising strengths of the CRI governance model
- To recognise the unique roles and responsibilities of the different players within a national science system
- To get more science, for the same investment by reducing bureaucracy

ii) Sustain the research workforce and infrastructure

- To ensure New Zealand has the science, engineering and technology graduates it requires at appropriate levels, quality and quantity
- To retain in, and attract to, New Zealand highly-skilled people in the face of a global talent war
- To maintain contemporary scientific equipment and facilities.

iii) Establish an Office of the Chief Scientist

- To strengthen the science voice within and across the whole of government
- To strengthen evidence-based policy making
- To provide an authoritative voice to the public on scientific issues and the importance of science to New Zealand, and build public engagement and support
- To encourage intelligent regulation and responsiveness to the priorities and concerns of government and society
- To rationalise government investment across votes.

Why science and technology research matters for New Zealand

A drive to do better

1. The 2007 OECD Report on Innovation in New Zealand bluntly warns that the most important economic challenge for New Zealand is to raise income per capita sustainably by boosting productivity growth. That is an RS&T challenge as much as it is a skills challenge.

2. RS&T is not sufficient by itself. It is, however, a core element in innovation, productivity and enhanced wealth and well-being.

3. New Zealand does not have to be a proving ground. There is ample evidence of the success of an RS&T-based response in very many differing social and economic contexts around the globe.

4. Denmark is an example of national commitment, vision and leadership:

   i) With a population of 5.5M, it has become a star performer in the OECD, climbing steadily up the table of GDP/head.
   ii) It began by making sure macroeconomic conditions were right, and then it focused hard on developing knowledge-based industries, under a strategy owned by the Danish Globalisation Council chaired by the Prime Minister.
   iii) The strategy calls for world leading education, strong and innovative research and more high-growth startups. Denmark is increasing R&D expenditure to 3 per cent of GDP (more than double that of New Zealand).

5. New Zealand is facing issues which will define the wealth and wellbeing of its people in the medium and long-term. They affect this nation's currently declining prosperity relative to others; as well as the sense of national pride and identity.

6. The critical issues for New Zealand include productivity growth; international competitiveness, linkages and connections; higher value outputs that overcome the constraints of distance; climate change; land and water use, constraints and depletion; energy; biodiversity; biosecurity; food security; social cohesion.

7. These are interlinked issues. They require a cohesive, sustained, vigorous and imaginative approach that not only clears the undergrowth of compliance and transaction constraints, but shifts thinking and generates action that is pragmatic, productive and relevant. Science based on New Zealand needs, as part of a coherent system, is a critical part of the response.

8. Government's leadership role sits alongside financial investment and national strategic oversight. It should seek a national consensus that growing economic wealth is consistent with maintaining and improving the things New Zealanders value the most (quality of life; the environment; education; and health services). Surveys such as the 2004 GIAB Survey on Values indicate that New Zealanders do not value growth, and that growth is seen by many as potentially or even probably detrimental.

9. Yet similar nations are showing that growth is consistent with and indeed essential to protection and enhancement of those values. Sustained preferential investment into research, science & technology has transformed their society's wealth and wellbeing within a single generation. They take for granted the need to invest in RS&T as a vital part of healthy, sustainable, vigorous innovation.

Economic fundamentals

10. New Zealand's economy is still principally based on natural resources and landscape. The value of exports per tonne has barely risen since 1989.

    Thanks to science and technology developed specifically for New Zealand, the nation's primary producers are the most efficient in the world, and the tourism sector is well-regarded. This creates a safety net for severe downturns (although always at risk of catastrophic biosecurity failure and subject to negative and positive effects of climate change).

11. High commodity prices in recent years have disguised the structural weakness in an economy concentrated on volume rather than value. Demand for New Zealand's commodity exports will continue, but emerging players in Eastern Europe and South America are also becoming smart at producing similar commodities. Therefore price competition will limit both returns and growth and New Zealand's economic performance will continue to drift downwards in comparison with other OECD countries.

12. A more immediate threat to New Zealand's competitive capacity is Australia. Its proximity, prosperity and lifestyle is sucking talented workers and good firms out of New Zealand; and is also enabling greater control of the New Zealand economy by Australian interests. The 30 per cent gap in living standards will grow unless New Zealand's relative productivity rises.

Doing things differently

13. New Zealanders are a highly talented and hardworking people. New Zealand can emulate those small societies which have transformed their people's prospects within a generation. It only requires to understand what they have done, and develop an appetite for real change, rather than for just talking about it.

14. Successful small economies have one central theme: they seek to grow and capture value in output and exports so as to raise living standards *and* become more sustainable.

15. Value is created by innovating, by 'doing things differently'. Underpinning innovation is the application of knowledge and skills, which in turn is underpinned by advanced education – particularly around science, engineering and technology (SET) - *and* by intense scientific research.

16. Successful economies do not debate this; they take it for granted. SET education and research is seen as core infrastructure, essential to outperform competing nations across economic *and* social measures.

17. New Zealand has a small but highly capable science sector, with scientists of international calibre in many fields. In areas such as primary production and environmental sciences, New Zealand has a greater and more vital interest than other nations, and often a higher quality. New Zealand needs to protect and grow this resource, and increase its effectiveness.

18. The power of science for New Zealand can be unleashed by adopting smarter policies, increasing our focus and giving the players more capacity to take risks.

Benefits for New Zealand

19. Research Science and Technology adds value in the political, economic, social and cultural, and environmental areas. RS&T:
    - Reveals new and better ways of doing things as well as creating new products and processes. It opens new possibilities, including markets
    - Informs of the impacts of economic activity on the environment and society. This is essential to sustainability;
    - Allows government and businesses to have meaningful dialogue with their global counterparts. This is critical to shaping global policies and securing sound agreements. This includes issues such as food security, climate change, hazards, water and atmospheric issues, biosecurity and terrorism;
    - Improves national, economic and social security. A better understanding of threats and hazards better enables defence, mitigation and adaptation. Much of this rests on collection and analysis of data over many decades;
    - Enables development of evidence-based policy and intelligent regulation.

20. New Zealand's economy is intensely science-dependent. More than two-thirds of merchandise exports come from the primary sector ($25bn) and tourism brings in a further $8.8bn. Both depend upon air, water, landscapes, grasses, soils, forests, coastal and marine environments. Much export manufacturing derives from skills, products or processes derived from primary sectors or developed to service them.

21. New Zealand's biologically based economy is under challenge from other suppliers and from changing market expectations around integrity of both products and supply chains (including environmental issues). Continued intensification of commodity production to retain current national incomes is not sustainable without substantial change to practices, products and productivity.

22. The good news is that New Zealand is a world-leader in such knowledge areas, although under-resourced for current and future needs. As Lord Robert Winston notes, this provides a base for high-technology, high-value services and products the world needs in areas such as health, pharmaceuticals and neutraceuticals.

A complementary national innovation system

23. RS&T is a critical part of innovation. In the 21st century, innovation requires interacting knowledges, delivered via close linkages and collegiality. It insists upon feedback loops, well-resourced capabilities, and interactivity. It benefits from the unique roles and responsibilities of each player, creating a matrix of innovation across education and training, research science and technology transfer, and business.

24. Treating all entities (e.g. CRIs, universities and research associations) as if they are identical 'science providers' lets the competitive funding environment reshape the national science system on a laissez faire basis. This undermines the roles and responsibilities of each. The system, despite some welcome change, still encourages entities to collide rather than collaborate, as they seek to maintain their viability.

25. In recent years Crown Research Institutes have modelled behaviours which link national capabilities to national needs and build communities of interest across tertiary education, science research and technology transfer, and sectors. There has been considerable success, but an improved environment will enable more.

Role of the Business Sector

26. New Zealand cannot transform its economy without transforming its business sector. The business sector is notable for the preponderance of small firms. Small firms in most economies have a low expenditure on R&D, so it is unsurprising that New Zealand's R&D is about one third of the average in the OECD, and a much smaller fraction of that found in high-growth economies.

27. In terms of using the knowledge generated by R&D, the picture is mixed.
    - There are some well-organised, export-oriented sectors which have a good appreciation of how R&D can add value. They have internal capacity to conduct or contract R&D, can act collectively, and have effective relationships with external R&D sources such as CRIs.
    - There are thousands of firms doing no R&D and with little capacity to contract it out. Their level of innovation is low and sporadic.
    - A third group of firms thrive in global markets via superior technology. There are too few of these: their aggregate turnover is less than $2B.

28. CRIs have shown leadership in areas such as horticulture, forestry, aquaculture, conservation management and agriculture to help coalesce small entities around larger sectoral science strategies. It has taken considerable investment of time and money to bring parties together. This demonstrates CRIs' concern with the longer term health of the sectors, rather than short-term revenue garnering.

Role of the universities: research-led education

29. The Education Act indicates that the core business of New Zealand's eight universities is "more advanced teaching ... to develop intellectual independence"; with "research and teaching closely interdependent".

30. About 25 per cent of university activity is devoted to research. Scientific research is a subset of that. Science student numbers are a small element of the total student population. An even smaller subset is engaged in areas of crucial and specific relevance to New Zealand needs.

31. A core university role is basic research. Often driven by the investigator's curiosity, it builds the global knowledge pool and is ideal for training new researchers. University research teams are usually small, projects tend to be of relatively short duration, with little or no requirement on the individual, department or university to align with national needs (e.g. in areas of research or in graduate

numbers in crucial areas). ‘Research excellence’ is based on advancing global knowledge and academic peer review.

32. Current policy settings (especially via the Performance-Based Research Fund - PBRF) have encouraged academics to maximize international publication and to compete more aggressively for research funds beyond the PBRF, Centres of Research Excellence (COREs) and similar tertiary-only sources.

33. Meanwhile, the link between organisational workforce planning for future RS&T needs and TEC investment appears weak. CRIs are heavily reliant upon overseas recruitment at PhD level.

Role of the Crown Research Institutes: benefit New Zealand

34. The CRI Act (1992) states that the purpose of CRIs is to do *research that will benefit New Zealand*. They are national, working across the country. They must promote and disseminate knowledge and technology to end-users. CRIs must be socially and ethically responsible and pursue excellence in all aspects. CRIs must do all this whilst remaining financially viable. Quality, utility, relevance and viability are key attributes.

35. The target return on equity is 9 per cent, but few achieve this regularly. CRIs are not profit maximisers. Often, benefit to New Zealand is best served by technology transfer to a sector rather than via creation of companies or subsidiaries. About half of CRI revenues come from government sources (varying from CRI to CRI). Nearly all is from contestable funding or procurement processes.

36. The CRIs are the only dedicated research organisations owned by the people of New Zealand through Parliament, aligned to achieve national science and technology goals, and mandated by their Act to do research of benefit to New Zealand. CRIs deliver for New Zealand domestically and globally, partnering or assisting government and business. They think and operate nationally.

37. The research agenda of a CRI is a formal strategic direction set by its Board, having regard to the operating framework statement issued by shareholding ministers. However, CRIs have relatively little discretionary funding, so funders have an inordinate role in shaping strategy. The research agenda combines the allocations of the funding agencies, the needs of end-users and sectors, and the CRI’s own view derived from its science and global market knowledge of ‘over the horizon’ needs for New Zealand. All staff operate within this corporate strategy.

38. CRI-based research is dominated by large teams and long-term programmes. The horizon of research application is typically 5-15 years, although this comes under pressure from two sources:
    - pressure from sectors and firms to solve more immediate problems and
    - insufficient duration of investment and scale of funds needed to deliver on the long-term outcomes.

39. CRIs are as much part of the national infrastructure as the defence forces. They comprise a “standing army” of high quality researchers grouped around areas of national significance, aligned with government needs and looking longer term with a clear ‘New Zealand benefit’ focus. The government has a strategic interest in

ensuring a critical mass of capability, particularly human skills and core resources such as databases and collections, that are not totally reliant upon fashionable international trends in science, academic measures, or short-term science purchase decisions. Short-termism has led to capabilities being stranded without sufficient funding, even though important to the nation. Current choices can scuttle the ability to respond to future, but still definable, needs.

40. CRIs are extremely vulnerable to shifts in funding quantum and priorities. They lack the funding resilience that comes from having other revenue sources such as teaching. Assets such as staff, equipment and laboratories are very specific to their task; the revenue risk required to maintain such assets is too high. Thus the 2007 *OECD Review on Innovation* recommended CRIs have up to one-half of revenue as core funding.

R&D Tax Credit

41. The R&D Tax Credit commenced 1 April 2008 with the purpose of increasing the disturbingly low level of private sector investment in RS&T. As indicated above, the culture of New Zealand does not fully recognise the economic, environmental and social value that RS&T delivers to the nation.

42. The CRIs supported the introduction of the R&D tax credit, seeing it as a mechanism with the potential to change the R&D culture of New Zealand business. It encourages boards and management to regularly address the R&D component (or lack thereof) of their business. It indicates that every business has the potential to engage with R&D. This attention is likely to increase both the quantity and the quality of R&D investment. Government has an interest in promoting such private sector culture change, whether by this or another mechanism.

43. Regardless of the mechanism chosen to encourage private sector R&D, some issues arise:

- The IRD projects the tax credit will cause a near-trebling of R&D expenditure by 2012. New Zealand is unlikely to have the scientific workforce to deliver on that level of increase (regardless of what sparks it) unless firms work in conjunction with CRIs and universities to ensure the country has the necessary quantity, quality and relevant skilled researchers, research services and research management expertise.

- Neither CRIs nor universities are set up to work with small firms or on low-grade problems. It is not an efficient use of equipment and time. While CRIs have tried working via polytechnics to remedy this gap, more needs to be done to ensure that R&D aspirations are adequately met.

Maximising CRIs benefit to New Zealand

44. Government has improved the stability of CRIs' revenue in recent years via addressing purchase arrangements as opposed to ownership routes. Thus Capability Funding has been increased (exclusive to CRIs but competitive between them) and Negotiated Funding (introduced for limited areas of research, and not exclusive to CRIs).

45. These changes are welcome. Nonetheless, issues remain, particularly in the ownership realm. These include the following:

- **Capital asset replenishment**
  There is urgent need for capital asset replenishment to restore or develop significant assets, including buildings (some go back to 1899). This is vital to both attract and retain staff and to maintain the ability to do high-quality science. CRIs have had little or no such investment, yet entities neither owned nor directed by government receive multi-million capital injections from the taxpayer. The Crown has stated it will be the only owner of CRIs in perpetuity. It is therefore the sole source of equity which growing entities need periodically.

- **Retaining the value of science programmes over time**
  Rising costs (particularly international science equipment and salary inflation) and heightened competition means the CRIs are finding it increasingly difficult to deliver excellent science, maintain capability, and earn 9 per cent post tax RoE. Set prices force CRIs to plan to lose half the researchers over an 8-year programme, even though long-term negotiated programmes are by definition of national importance.

- **Commercialisation**
  The appetite for risk around commercialisation needs review. CRIs are required to develop ideas; to transfer and disseminate them; and to extract a commercial return in doing so. However, CRIs receive little funding or specific investment for commercialisation per se. There is sometimes significant risk to the balance sheet from what can be long-term investments if maximum value to New Zealand is to be achieved.

  Commercialisation routes include licensing, start-ups, spin-offs and various partnering arrangements. It is easy to set up companies and then spin them off without regard to their long term viability. The CRIs, however, are tasked to ensure the technology is transferred to benefit New Zealand. Risks can arise when an idea is clearly worth pursuing, but New Zealand end users are not yet willing to invest; or the CRI is developing a new sector. The shareholder's ambivalent appetite for risk affects CRI strategies.

- **Governance**
  Governance mechanisms are not being best-used. It is sub-optimal to appoint competent directors to the Boards of CRIs and then micromanage through various agencies. Similarly, eliminating unnecessary and onerous layers of review and monitoring will improve CRI performance, enable more science for the money and reduce a major reason for low staff morale.

46. So, while government research purchasing has evolved to incorporate platforms and longer term programmes, greater quality, value for money and relevance is still possible. It is timely to review the business model under which CRIs operate, and to enable optimal performance. Enhanced devolution is compatible with performance-based accountability.

Collaboration among the players

47. A striking feature of small successful economies is the high level of trust and cooperation which exists among the business sector, the universities and research institutions. This is partly cultural and partly based on policy.

48. New Zealand, by contrast, has had many years of tight research funding, coupled with a highly contestable allocation system. Competition has been the ethic, as opposed to excellence, relevance and demonstrable ability to deliver. This environment has been exacerbated by permitting one group ring-fenced funding via Vote: Education but also access to Vote: RS&T. Despite sincere efforts to overcome it, institutional competition has tended to drive the players apart, on occasion led to predatory behaviour, and fostered costly duplication of resources and fragmentation of effort.

49. The issue of duplication and even competition also arises with Government departments. There has been a build-up of operational research capability within some agencies, seemingly to avoid paying the full costs of research. This is a false economy in terms of quality of research or maximising its value (requiring global and national networks and intellectual property management skills).

50. The system needs to reflect the different roles and responsibilities of all players – including private enterprise, charitable trusts and research associations – in a coherent national science and education system.

51. There is a widespread desire to increase collaboration, despite the barriers. All players believe more can be done to maximise use of the national capability, ensure adequate infrastructure and attain competitive salaries.

Making the system work better

52. Science, its people and its institutions, have served New Zealand well. However, performance can and should be improved, to enable more science for the same investment as a start. The government science system needs reform. It has drifted and fragmented, and lost its coherence and alignment. There are more policy-makers, but less clarity of purpose and priorities.

53. The keys are insight, leadership, management, confidence and collaboration:
    i. *Insight,* so that New Zealand's decision-makers understand the power of science and fix it firmly on their agendas
    ii. *Leadership*, so that there is a clear national strategy and alignment of resources across government, and supportive relationships with the education and business sectors
    iii. *Management*, so that research is pursued in the right topics at the right time and with high efficiency

iv. *Confidence*, so that science careers are attractive, scientists feel valued, and investments are made in world-class facilities
v. *Collaboration,* so that the various players understand their roles and work together.

The productivity of science

54. Government can increase the impact of science simply by improving its science policies: New Zealand can get more from its current science investment through less bureaucracy. A high-trust, more agile and dynamic investment framework is more in tune with the rapidly changing world. It will, however, allow for appropriate performance and accountability mechanisms.

55. New Zealand's science research resource is small yet of high quality. It is vital that this group's productivity is maximized and they are freed from wasted effort and frustration to spend more time doing science.

56. Productivity can be raised by simplifying the funding system, by reducing transaction costs, and by further stabilisation of funding. In short, the system is over-managed, and would benefit from devolution: pushing more decision-making and monitoring out to the competent research organisations.

Fragmentation of the science agenda.

57. There has been a proliferation of science funding schemes both within Vote: RS&T and across other Votes. There are 30 non-departmental expense lines in Vote: RS&T alone. New schemes have been added in preference to enlarging existing ones or compensating for cost increases so as to maintain value. Similar RS&T goals are funded from different Votes. While officials attempt to align research programmes across votes, the task is unnecessarily complex and wasteful, and they are conflicted across their agencies.

Transaction costs

58. Over the last decade the cost of policy advice and contract management in Vote: RS&T has risen from $8M to $35M. It is not apparent to the science community and end users that a commensurate amount of extra value has been created.

59. Furthermore, increased bureaucracy in Ministries and at the funding agencies demands that scientists spend more time away from the laboratory, responding to requests, policy interventions and reports. This knock-on effect is routinely overlooked but is a source of much frustration.

60. At another level, the funding agencies, particularly FRST, have developed a fine-grained framework for allocating funds which, in effect, gives them authority over the science strategies of the research organisations. Small buckets of money, narrowly prescribed tenders, excessive reporting and lengthy timelines are significant morale-busters leading to lower productivity and staff turnover. There is some acknowledgement of the need to change; this needs to be given impetus.

61. Government should look to an advantage of the CRI model: Crown ownership and the governance of the CRIs can deliver a trifecta: lower costs at the centre, alignment with strategic national needs, and rigorous oversight.

A More Stable Funding Environment

62. In certain output classes of Vote: RS&T a proportion (up to 30 or 40 per cent) of FRST's funding may be applied to large, multi-year negotiated research programmes of particular importance. Negotiated funding is open to any research provider. The CRI Capability Fund is the sole funding limited to CRIs, albeit contestable between them. Both funds are welcome. While they bring some greater stability, as yet there is no sign that transaction costs will reduce and the extent of stability remains relatively low.

63. Retaining the value of a long term science programme over its contract period is a vital system issue. A programme can lose half its workforce over an 8-year period when funded at the same dollars. This exacerbates the effects of a constant global talent war for top quality people. Government has recognised similar pressures upon tertiary institutes, and now provide annual pay supplements. The same pressures argue for a similar response for CRIs.

Attracting and keeping top talent

64. The most critical asset in the national science system is a trained, skilled and enduring workforce. Because of the long lead-times involved, it needs urgent attention.

65. New Zealand's human capital base is under a three-pronged attack:
    i) there is an ageing science workforce;
    ii) in some specialist areas of national importance, expertise seems likely to disappear altogether;
    iii) a fierce international talent war has already commenced.

66. CRIs have concern about their specific future workforce needs, especially in environmental science and engineering disciplines. It is important that CRIs and universities work collaboratively to increase the quantum by attracting, growing and retaining sufficient numbers in the areas relevant to New Zealand.

67. To service existing and future needs, CRIs currently:
    - fund professorial chairs and scholarships to drive more relevant training;
    - host and supervise 400 PhD candidates and 150 MSc students at an unrecompensed direct annual cost of $7million.
    - increasingly recruit from overseas (57 per cent of PhD recruits in the last two years are recruited offshore).

68. Too few academics are teaching in areas of core relevance to New Zealand's science-based wealth and well-being, and there is too little student interest in these areas. This is a national economic issue. CRIs are keen to play an even greater part in developing the workforce for New Zealand needs, provided the economics are addressed.

69. Recruiting from offshore is not sustainable, particularly as the global talent war intensifies. Overseas institutions are already recruiting New Zealand's scientists, particularly those in the newly urgent fields of climate and environment.

70. In order to dissuade scientists from moving overseas, pay and conditions need improving.

- Scientists are about 15 per cent below the New Zealand average salary in relation to other professions requiring the same degree of education and training.

- This is not a problem which the 'market' will solve, simply because the market is largely (directly or indirectly) the government. It needs to be addressed as part of a review of the CRI business model.

71. Similarly situated workers have received pay rises supported by Government. These include doctors, nurses, teachers, police, armed services, public servants and (although not part of government) tertiary employees. The need to close the 15 per cent pay gap has seen CRIs making some scientists redundant so as to increase the pay of those remaining.

Office of the Chief Scientist

72. Small, successful economies tend to place science close to the centre of government.
    - Finland, for example, has the Prime Minister's Science Council. Under the Prime Minister, this comprises the equivalent of New Zealand's six 'innovation agencies' (MoRST, FRST, MED, NZTE, TEC and MED).
    - A structured programme at this top level builds RS&T into the heart of Finland's innovation culture, with impressive results. A similar arrangement exists in Denmark (Danish Globalisation Council).

73. The CRIs favour the creation of an Office of the Chief Scientist within the Department of Prime Minister and Cabinet. Such a move would enjoy widespread support in the science sector. Similar offices exist in many other countries.

74. The Chief Scientist would articulate the benefits science can bring to national well-being, will ensure science has a voice in government decision-making (assisting evidence-based policy development), will have an overview of public expenditure on science and ensure alignment across Votes, will monitor and communicate 'returns to science', and will have a public communications role for science issues.

75. The Office would complement the role of other agencies, such as the Ministry for Research Science & Technology, which have a Vote responsibility.