Public speech: Science - a critical investment in New Zealand's future
Friday 13 November 2009 at Otago University

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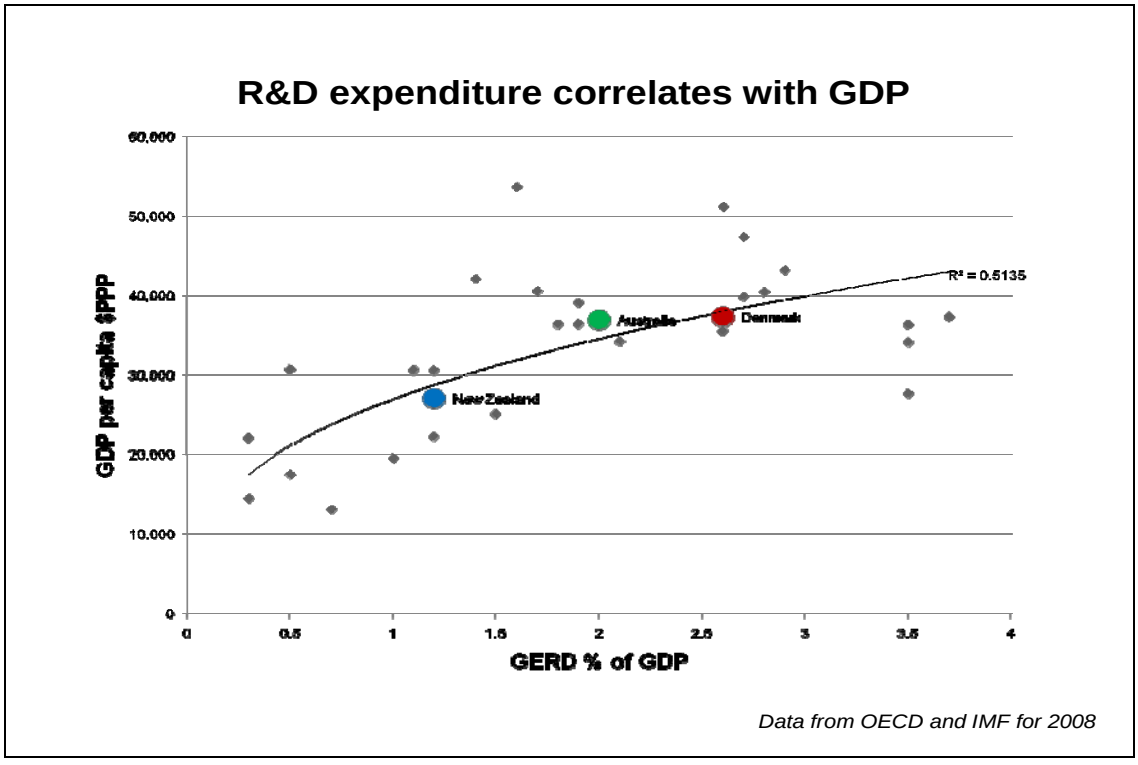
Thank you for the opportunity to speak.

It would escape no-one's attention that there is a more intense focus on the science system now than there has been for well over a decade. That attention is very healthy, for I think it reflects a growing realisation that science expenditure must be seen as an investment in our country's future rather than viewed as a cost. But, like any investment, there needs to be clarity over its purpose. That is why in my early months in my new role I focused on asking three questions:

- Why should New Zealand undertake research?
- How should a small country distant from markets and global populations undertake research?
- How should we take that research to scale?

Science adds value to New Zealand in many ways – a knowledge-based society will be more ambitious, more prepared to face the challenges ahead, more able and willing to address issues of social development and environmental protection, and certainly more productive.



Slide 1

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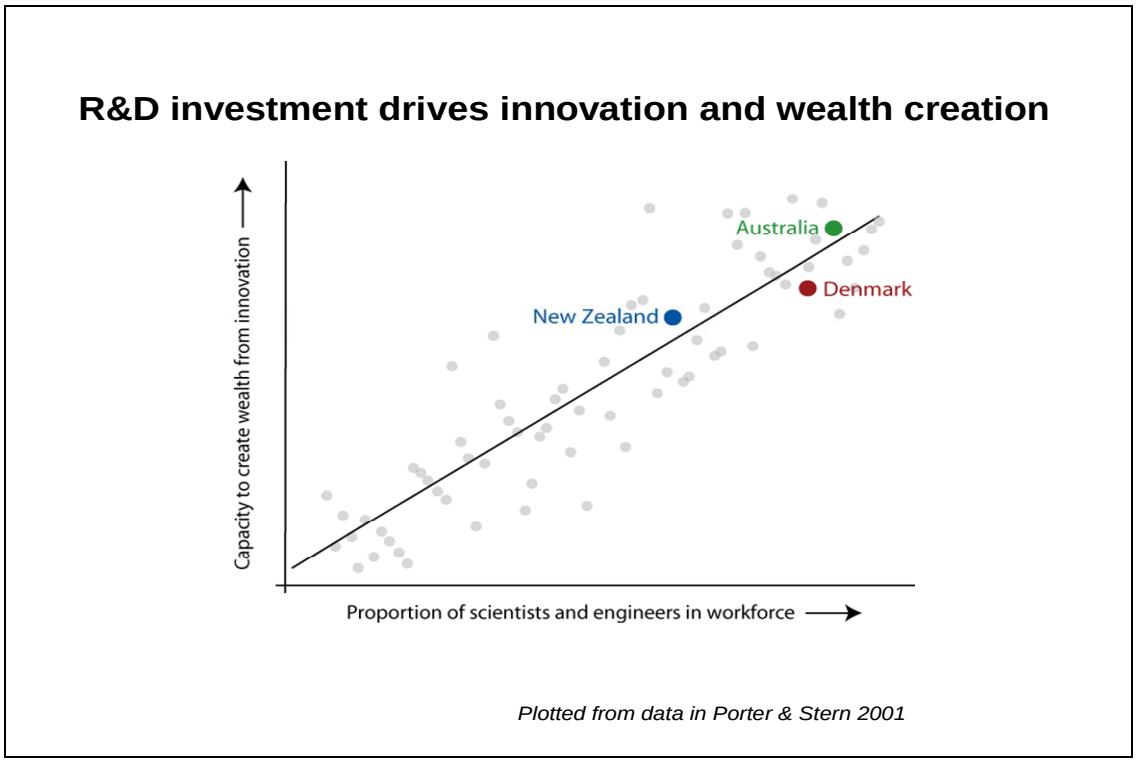

Slide 2

I am not going to show much data but these two slides are telling – they show the relationship between a nation's investment in RS&T and its productivity and innovative capacity. What is clear is that the relationships are quite linear: nations that invest more in RS&T are the most productive and innovative.

As the Prime Minister has made clear, our low productivity is at the heart of our national challenge. I do not want to fall into the old trap of association and causation, but while in the past it has been argued that this relationship reflects the fact that more productive countries can afford to undertake more RS&T, the view now would be essentially unanimous that there is a causal relationship in the other direction, namely that investment in RS&T drives innovation and productivity. And we all know that New Zealand has had incomprehensibly low investment in RS&T over many decades.

This is not something new; it is something we have always lived with. Why is this the case – is it that we are a young country which has not learnt to value intellectualism, is it that we are too egalitarian, or is it that we were too lucky as a country in the immediate post-war period and we established other priorities that set a spending pattern that has been hard to shift? But perhaps it is not so simple.

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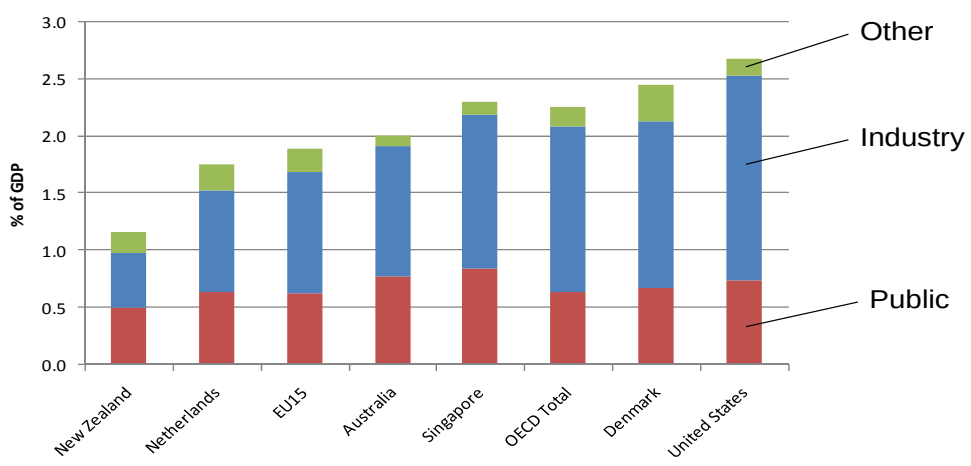

Source: OECD Main Science & Technology Indicators database for 2007 or latest year

Slide 3

This slide tells you something else – our total national investment in RS&T is poor but proportionately our public sector investment – the red segment of the bar – is quite high because our private sector RS&T spend – the blue segment – is very low indeed. And OECD figures suggest that it is the private sector spend that has the larger impact on productivity. Hence the politicians dilemma – why is it that our private sector spend on RS&T is so low? Now perhaps the question is not what it seems – a low public sector investment over many years with inappropriate incentives in place might disincentivize the private sector from seeing RS&T as important because there is insufficient ideas flow. A public sector too focused on the private sector might displace private sector involvement.

Or is it simply that our mix of firms is such that we do not have the large firms in the defence and pharmaceutical sectors that drive so much RS&T elsewhere? There are some data that suggest that public sector science is pretty well translated into the private sector if one corrects for the missing big firms. Or have we got institutional blocks at different levels which limit public to private transfer of knowledge and thus limit the capacity of companies to take it to scale?

These questions are very hard to answer but they are important to be able to answer if we are to have a coherent science strategy. This issue of scale is critical. New Zealand cannot thrive with just one Fonterra; we need to see greater productivity extending beyond our shores in several domains. Seeing where that productivity growth will be is complex, for we face the peculiar challenges of distance, size, and lack of internal markets.

We have to become clever about using our resources – our well educated people, our ability to grow grass and ruminants, clean water, our minerals, our closeness to Australia, our strengthening umbilical cord to Asia. We have to work out where will our capacity to export will really grow – will the food industry in 20 years be focused more on food for health, what can we do with our mineral resources, our iron sands, how should we respond to global warming , how can we export services better, what will be

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the role of advanced ICT? We need to become clearer about that science we can do well on our own and that where taking it to scale will require partnerships from an early stage.

Will we do better trying to grow a hi-tech industry on our own or, in an age of parallel discovery, will we do better by partnering from the discovery stage?
If we are inventing something, there is a high probability that so are the Singaporeans or the Chinese or the Americans – should we be seeking more formal and closer ties with other research communities from the earliest stages?

Our experience in the nascent pharmaceutical sector tells a story. We have had several clever ideas which have led to start-up pharmaceutical companies. Most have hit the wall – lack of capital, marginal clinical studies not meeting regulatory requirements, insufficient basic science to persuade a big partner to take it on, inexperienced (in sector terms) management. Would we have done better to exploit our fantastic discovery biology and used formal stable partnerships with other players from much earlier stages – would some of those ideas made it to market? Perhaps so.

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Strategic principles for publicly funded science (1)

General principles

1. The science system will be based on scientific excellence and impact.
2. It will invest where research can advance New Zealand's economic performance, productivity and future development and assist in developing our social fabric and protecting our environment.
3. It will recognise New Zealand's particular sectoral and societal interests (which to some extent have been given definition by the shape of the CRIs.
4. It will recognise the need for New Zealand to develop a full scientific value chain from discovery to exploitation (domestically and internationally) with long-term returns and value for New Zealand.
5. It must be flexible and responsive, because science by its very nature is serendipitous, generates unexpected results, moves fast and results in new opportunities and disciplines.
6. Science that does not show promise and pathways to results will not continue to be publicly-funded over time.

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Strategic principles for publicly funded science (2)

Principles underlying priority setting

1. Investment in the training, development and retention of outstanding scientific talent will ensure the capacity for the most innovative scientists to contribute to their fullest potential. This requires appropriate infrastructure and critical mass.
2. Priority will be given to investment where New Zealand has competitive advantage. That advantage is in part already defined sectorally, but beyond that New Zealand, as a small country with advanced science capabilities, has unique, but as yet untapped, potential for multidisciplinary research.
3. Priorities also have to reflect the different types of research providers and the need to sustain a balanced programme from discovery to exploitation.
4. Priority will be given to assisting international partnerships in both scientific research and in accessing science infrastructure in domains where clear advantage can be obtained for New Zealand.

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Strategic principles for publicly funded science (3)

Operational principles

1. The science system must be transparent and responsive with minimal compliance costs. It has to be regulated by appropriate scientific evaluation and accountability, allowing effective oversight and outcome focus.
2. It will comprise a mix of competitive and strategic funding tools and a balance of basic, applied and translational research appropriate to an overall strategy and appropriate to national size.
3. To foster efficiency, emphasis should be given to where a multi-organisational approach is possible so that critical mass can be achieved, duplication is avoided, advanced infrastructure can be developed, and latent and real synergies across partners can be exploited.

Slide 6

So with that lengthy introduction let me turn to the various initiatives underway.

First and arguably the most important is the consultative document on strategic priorities for the science sector issued by the Minister of Research, Science & Technology. The document has three sections. The first and the one I want to focus on is a list of thirteen strategic priorities – they are listed on these slides. This is a very positive step – for the first time in a long time there is clarity as to where the science system is to be positioned and the paper makes some very important points.

It acknowledges that the science system has been over-competitive and that this has had counter-productive effects. It looks towards a better balance of approaches. It acknowledges at the start the value of science beyond direct economic productivity for public good, for environmental protection, for social development.

Its first principle establishes the basis of investment – excellence and impact. I want to focus on that word *impact* because it is a word that may well get traction. As many of you will know, the UK is replacing its version of the PBRF with what they will call the Research Excellence Framework. A fundamental difference between the two is the introduction of the concept of impact.

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Slide 7

A key set of words is that the REF should "continue to incentivise research excellence, but also reflect the quality of the researcher's contribution to public policy making and to public engagement and not create disincentives to researchers moving between academia and the private sector".

It goes on to say "The assessment of research outputs will depend on three factors: ***output quality*** assessed by traditional measures, ***impact*** which is defined as economic, social, public policy, cultural and quality of life impacts, and a concept of ***environment*** – that is, the quality and sustainability of a unit's research environment, its vitality and wider engagement beyond the institution and discipline".
These are important concepts and show a maturation of global thinking about the place of a modern university and science system.

In a different set of words the Minister's consultative document is setting out a similarly evolving set of concepts about the strategic priorities underpinning how New Zealand should undertake research. It also makes the argument for simplification and rationalisation and I expect we will see moves in that direction in due course. Indeed, the second part of his paper describes current science funding in a more transparent, simpler and strategic manner. But the document also makes another critical point.
We cannot do everything. We are only 4 million people and we have to make some choices.

That is why we have priorities. That is why we have to scenario test where major research investment is likely to have greatest impact. But again the document shows a realism which has for some time been lost – the system must be responsive and flexible and acknowledge the essential role of basic research and serendipitous research findings.

But again we have to get real as to where are the likely research domains that will transform New Zealand for we need a transformational rather than an incremental strategy. Food of course, but in what way – how can we return more to the farmer, how do we deal with the challenge of pastoral emissions?

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Can we transform our service sector to export more services, how can we extract value from our mineral-rich and water-rich land yet protect the environment, could we find a manufacturing niche? In twenty years we could well be primarily an exporter of ideas, but how to do we capture value?

And the priorities list goes further; it sees the importance of international strategic partnerships , it recognises that for too long our research providers have been focused on institutional health and bottom lines, rather than seeking synergies through inter-institutional activity. It highlights the need to have a "New Zealand Inc" approach and give priority to exploiting the latent synergies that exist across institutions. But how do you do that but maintain institutional health?

The CoREs were a good first move in that direction, FRST platforms are another – this is a fundamental shift in thinking beyond institutional boundaries. It is the only way we will get to scale.

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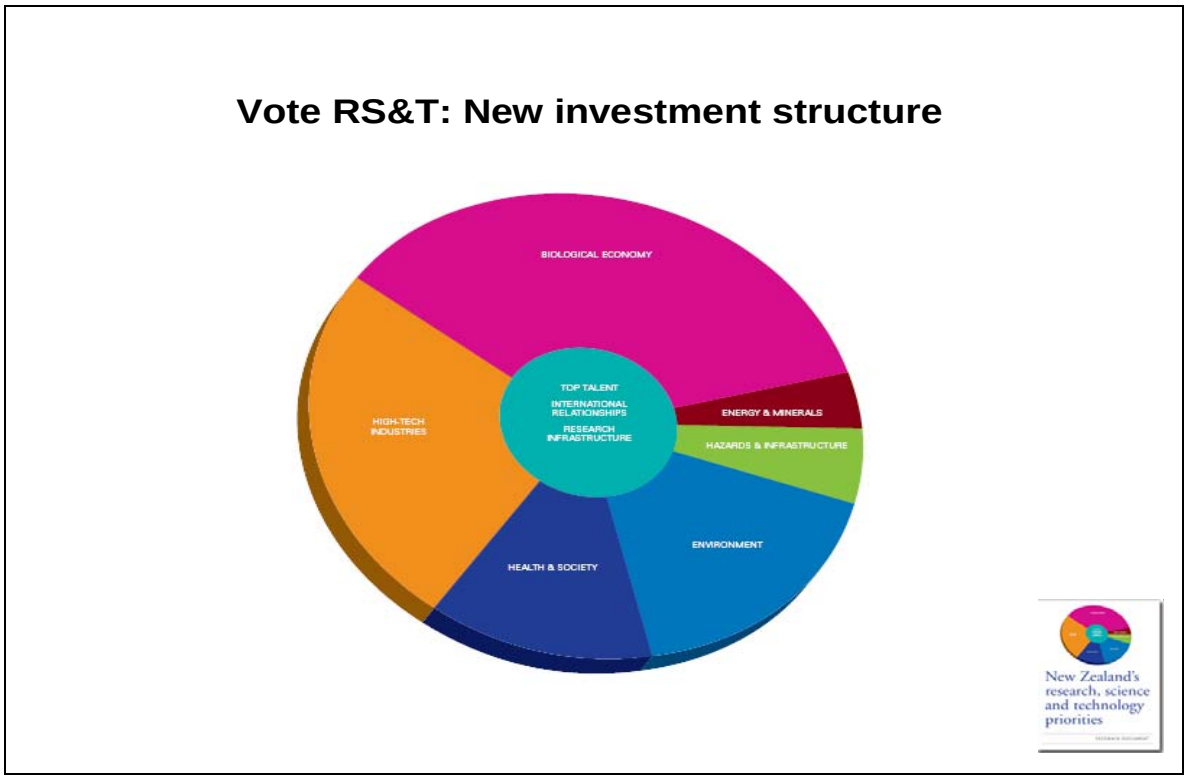

Slide 8

The third part of the document highlights areas where there is work to be done. It is the bullseye in this figure, which is a description of the science system as it stands now.

The outer ring shows where the state largely spends its money, but it is the bullseye that we have to address: how to retain and recruit entrepreneurial talent, how to sustain an infrastructure and how to leverage science not just nationally but so we are relevant to the world and so our knowledge based industries can get to scale.

We have a very run-down infrastructure and increasingly there are areas where major infrastructure is needed. We have deficient capacity to use modern imaging to study livestock, we have obvious gaps in high performance computing, are we truly equipped for the bioinformatics age. When I compare what we have across New Zealand to what is in Singapore, we are not in the same league, although we have some very good individual capacities. Our deep sequencing capacity nationally is less than what might be in one small laboratory overseas.

We do not have a clear approach to infrastructure and what principles should operate – infrastructure without running costs and allowance for depreciation has no value. What should we do together with Australia – the synchrotron is an example of a joint infrastructure – or should we have national resources, for example a national high performance computing centre.

How should infrastructure be governed and how should we cover the costs – these are issues that merit reflection and the Minister's document heralds the work that needs to be done.

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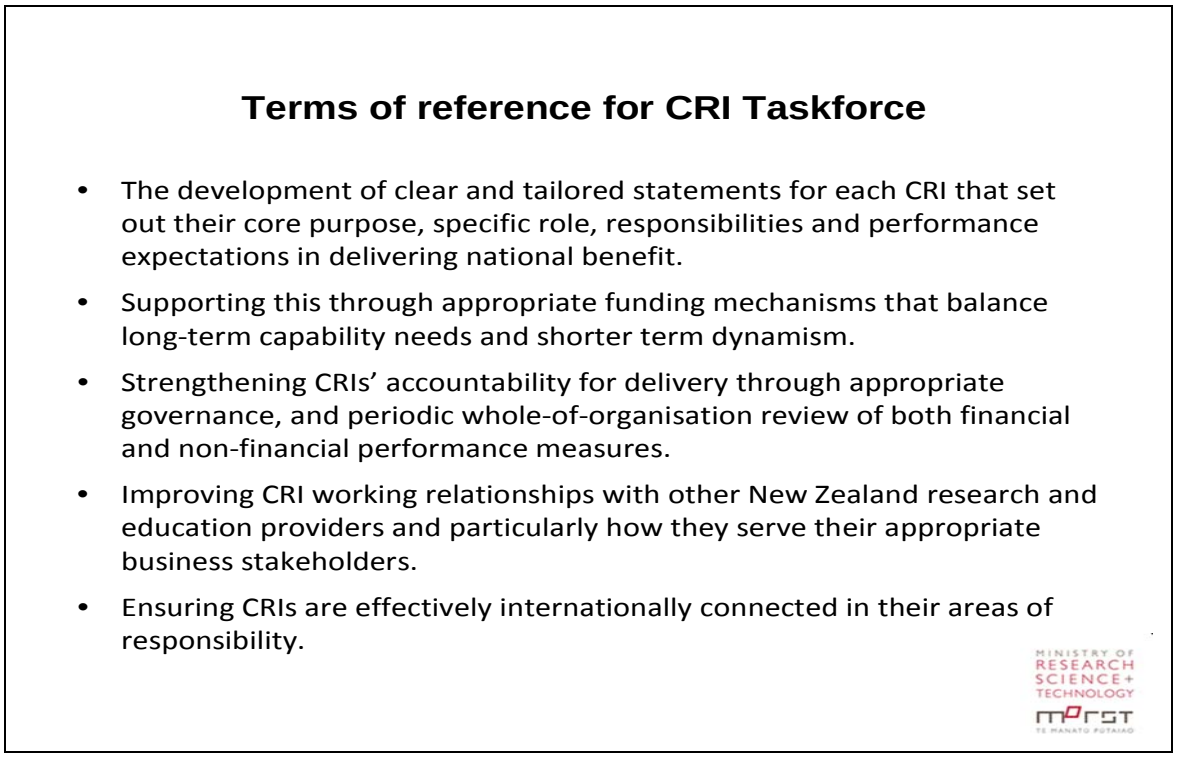

Slide 9

The second major effort underway is the CRI Taskforce and this too is linked to the strategic priorities paper I have just discussed. Do we have the balance of interests right – have we compromised the capacities of CRIs to deliver with narrow performance measures, a lack of scientific advisory boards, and an over-competitive funding system?

CRIs boards are unclear about their missions and even if they were clear they have little capacity to control their destiny as they do not control their funding – they are essentially acting as research hotels. Yet their missions could be easily defined – to support their sectors with the medium and long term research that is required for those sectors to thrive, and to provide shorter term assistance to firms.

But should CRIs be primarily about open or closed innovation? Have we impeded the private sector uptake of knowledge with premature closure of innovation? One of my current work programmes is to look at these issues of open versus closed innovation in the public sector.

This issue extends beyond a narrow focus on intellectual property. In many jurisdictions, including the UK and Singapore, public funding comes with the obligation to share materials and data yet there are many examples in New Zealand where the culture of competition has led to duplicated research within the public domain or valuable research just unable to be done. You may be surprised how rapidly big industry is recognising the ecological value of open innovation.

I cannot comment more on the CRI Taskforce other than to say it is a major and important exercise and hopefully will lead to a much improved ability of the CRIs to deliver quality research, to support their sector and to be nimble, flexible and responsive and most importantly of all to be *research* institutes with better links to universities and firms.

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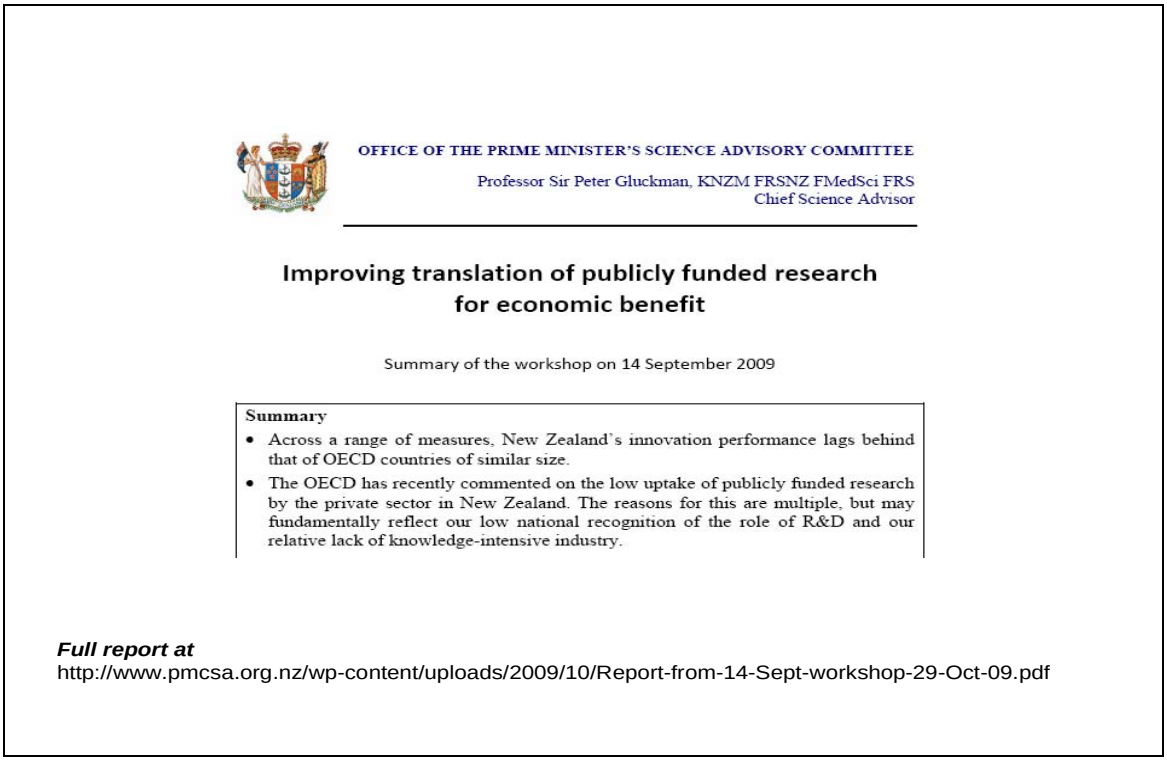

Slide 10

The third effort underway relates to what I have already spoken about – the deficiency in private sector RS&T. I have just released a report that examined the barriers to private uptake of public sector RS&T. There are many and I will not bore you with an iteration of what is in my report – it is of course on our website. But essentially it is in part cultural – university and CRI researchers live to different rules and incentives to those in the private sector, time horizons are different, the linearity of objectives is much less for the academic.

We have had so little churn between the public and private sector that the issue is worse here than in many countries and we need to find ways to enhance that churn.
As a result, companies tend to come to researchers late to solve a particular problem rather than an early dialogue about where science is going and how it might transform their firm. There is debate as to the extent to which the PBRF inhibits academics from entrepreneurial and commercial activity – the concern may be overstated and it need not –but there can be no doubt that university promotion systems and grant assessments from bodies such as the HRC can disadvantage those with heavy commercial involvement. We need to find ways through that.

A large part of my report focuses on the issue of technology transfer – the export of knowledge out of CRIs and universities to business. Part of that must be through open innovation. There is also the issue of whether sometimes the fiscal incentive favours internal effort for too long. But the real issue is the lack of expertise in technology transfer – this is a particular skill and we have few practitioners of it in New Zealand.

We also have no differentiation by domain – a deal in biotech is very different to a deal in software. Other nations have tended to consolidate this activity in different ways – through hub and spoke models or centres of excellence. We cannot possibly have thirty effective technology transfer operations in the public sector. We need translators in every institution but the real high-level expertise in deal making and in IP management may need more sharing. Work is needed here.

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The related activity is that of business assistance – there is work under way led by the Ministries of Economic Development, RS&T and Treasury in this area and I cannot comment further.

The issues go beyond affordability and include issues of principle – for example should it be a broad entitlement through tools such as tax breaks – or is a more discretionary grant-based approach needed. The policy issues are complex.

The Prime Minister has repeatedly stated his belief that science is central to New Zealand's innovation strategy. The issues I have discussed above show that a systematic approach to look at science is underway. And science is multisectoral – virtually every ministry has some role in science or should have and many are science funders. Clearly as this country can afford to it must invest more but the issue of ho w, where and why require answering first. We cannot squander this opportunity.
There are two other domains I want to touch upon.

The first is that of evidence and policy. Science does not make policy, but science provides knowledge and knowledge must inform policy formation. Without knowledge one falls back on dogma. I am determined to improve the use of evidence in informing policy, and the PM has agreed to a pilot project – namely to explore the evidence that might inform how to improve the transition of young new Zealanders through adolescence.

My goal is to try in an unbiased way to look at the evidence that explains why New Zealand adolescents have such a high morbidity –second only to the USA – and to identify what we know about childhood and adolescence which might impact on policy setting in health, education, social welfare and justice that might lead to better outcomes. The evidence will be reviewed without bias and used to inform a report on what it implies either for policy action or more research. I expect some counter-intuitive and challenging results.

I have established a working group chaired by Harlene and involving about 15 leading academics in education, mental health, social sciences and biology to assist on this year-long project. Beyond that I hope to explore the uptake of protocols used in the UK where there are independent science advisors in every department of state to assist in policy formation and which have become part of the cabinet process.

Related to this is the quality of policy formation and operational research within the ministries – it is an area where in the UK the Chief Scientist has a role in quality enhancement.
Climate change represents a particular challenge. New Zealand is the only Annex 1 country with the major part of its emissions being pastoral. We and the developing world have to address this challenge and the PM has announced his desire to see a global alliance address this issue with New Zealand taking a lead role particularly in the area we just have to address – ruminant emissions.

We should not underestimate the importance of this scientific challenge – it will emerge to be an area impacting on many dimensions of science. The form and shape of the alliance is yet to emerge and it will be an area where institutional interests will have to be submerged for national interest. I emphasise this again because science in New Zealand has harmed itself perhaps inevitably with its strong focus on institutional health rather than what the science can deliver.

And global warming allows me to segue nicely into my last point. The nature of science has changed. In the public mind the science of the 1960s was about certainty – maths, physics and engineering. In 2010 science is about uncertainty – it is about complex systems – ecological systems, global climate, human reproduction, nutrition and disease, regenerative medicine, genetic modification, evolution, viral epidemics, nanotechnology.

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Much of our science is almost incomprehensible to ourselves – how many papers in *Nature* or *Science* can you comprehend if they are not in your discipline and even if they are they can still be hard. The science we do impacts on people's lives – and we cannot always predict how. Science is no longer done when the paper is published, science is only done when there is a consensus between scientist and public and that is not always easy to achieve.

Look at the folate debacle. Scientists have to spend more time learning to communicate across disciplines and between themselves and the public, and that means listening as well as telling. The age of the patronising scientist is gone.

But as we engage with the public more we face another problem – that of hyperbole, that of over-stating what we have done and its implications. How many times have we cured cancer? We do not serve the public well by being immodest, we somehow have to get the media beyond breakthrough stories or the self serving stories we have all used to get publicity for our institutions or to influence a grant process.

It is difficult because our media loves breakthrough stories but science does not move in a series of breakthroughs – it is slow and non-linear, yet consensus and new understandings somehow emerge. Transmitting that to the public and thus to the politician is a skill and we need a new kind of partnership between academics and the media. But this is difficult given the smallness of our domestic market for news and current affairs. It is a challenge I will be picking up next year.

The science system will not change overnight, but things are changing. My biggest fear for myself is the expectation that accompanied my appointment. My role is limited – I am an advisor- perhaps my most important my job is to raise questions – that is what I have tried to do today.

Thank you.

ENDS

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