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Supporting Chemical Sciences

Tēnā koutou,

Thank you for the opportunity to contribute to Phase 1 of the Science System Advisory Group's review of the science, research and innovation sectors. I'm writing on behalf of the New Zealand Institute of Chemistry (NZIC).

NZIC is the professional society of chemists that operates throughout Aotearoa, representing chemists from industry, Crown Research Institutes, Independent Research Organisations, business, government, legal, analytical and educational sectors (secondary and tertiary staff and students). We hold that fundamental disciplines such as chemistry, biology, geology and physics are of utmost importance in building a technology- and science-based economy, enabling mission- and application-focussed outputs.

Please find our responses below to some of the questions posed by the Science System Advisory Group.

Question set 1 – The Science, Innovation and Technology System.

What future should be envisaged for a publicly supported science, innovation and technology system?

The goal of NZ's public research, science, technology and innovation system must be to support the fundamental disciplines and studies that provide the groundwork for a successful economy and education system, while also enabling applied research, development and delivery of outcomes that benefit our society, environment and economy.

Support and funding for discovery-led and basic research is something that only the public system can deliver. Healthy fundamental disciplines such as chemistry and physics are needed to support the applied sciences, engineering and innovation sectors. Such fundamental work must be strongly underpinned by government strategy, baseline funding and the education system. A long-term approach is needed to define science, research and innovation strategy. For instance, the Australian Academy of Science is developing decadal (10-year) plans for scientific disciplines. We note that chemistry has been identified as one of the three "vital scientific disciplines in Australia" (Decadal plans for science | Australian Academy of Science). This longer timeframe is essential to observe trends and achieve benefits from research strategy and funding. The Royal Society of NZ Te Apārangi is an asset that should be supported as a key player in achieving these goals, by linking government with institutions that deliver research outcomes.

Outcome-directed research, development and innovation will be built upon discoveries made in the fundamental disciplines and, more immediately, upon the human and infrastructural capabilities that are developed by excellent STEM education and by performing discovery-led research. Careful strategic visioning is required to ensure the future we seek: an Aotearoa whose economy, environment and society is sustained

and enhanced by thriving businesses and communities that are underpinned by science and technology.

A robust education system is essential for building a strong research and innovation economy. Ensuring that NZ schools can employ teachers trained in their specialist STEM fields will improve the uptake of these subjects by students, leading to more school leavers who can progress into further study and careers in these fields. Tertiary education is instrumental in extending the capability of the workforce across all sectors and is absolutely crucial for sustaining and growing the tech and innovation areas. Therefore, NZ's economic success depends on maintaining a strong and healthy university system. To achieve this, increased resourcing and support of both secondary and tertiary education, together with improvements to the school curriculum and assessment framework, are essential. We are encouraged by the recent changes to the ongoing process for refreshing the NZ School Curriculum and hope that the revision of the timeline will allow proper consideration of the current and proposed future system in light of NZ's educational goals, while also allowing time for consultation with subject matter experts, employers and other stakeholders (including groups such as NZIC).

What are the opportunities, challenges and barriers that need to be addressed to build a more thriving research, science, innovation, and technology system that delivers positive sustainable growth and prosperity for New Zealand?

While acknowledging that fiscal and operational details are stated as not in scope for the current stage of the review, we remain convinced that financial and legislative support of the science, research and innovation sectors is key to the success of any strategic consideration. Both short- and long-term plans will require adequate funding and incentives. New Zealand remains poorly funded relative to international norms. The percentage of GDP spent on research and development (R&D) in NZ was 1.1–1.5% during 2001–2021. In a similar period, the OECD average was nearly double (2.1%–2.7%). For countries that are technologically advanced and economically successful, such as Sweden, Japan, Switzerland and Korea, public and private investment is much higher (3.4%–4.9% in 2021) (https://data.oecd.org/rd/gross-domestic-spending-on-r-d.htm). This highlights the challenge and opportunity to enhance the capacity of both public and private support of R&D in Aotearoa.

For Aotearoa to truly be a knowledge- and science/technology-based economy, enhanced public investment in education, tertiary research and crown research is essential. This is an opportunity for NZ at this juncture with the current review of the research, science and innovation sector. While increased public spending will cost the country in the short-term, there is strong evidence that long-term prosperity and advanced economies are achieved through such investment (see the OECD data linked above, for example).

The goal of a 'knowledge-based economy' for New Zealand has been sought for many years, arguably without real success. Reform of primary and secondary education in a way that fosters the learning about science and social science (including history and economics) is needed, and we acknowledge the current ministerial efforts in this regard. Recognising the benefits of intellectual pursuits, a love of knowledge and technical skills are critical aspects of our education system. Fundamental capability in reading, writing and mathematics fostered during early education is essential to the development of interest and skills in STEM subjects through secondary school. By increasing the number of school-leavers able to undertake further study and

employment in these areas, we position our nation for achievement of a knowledge-based economy.

A ‘diversified economy’ is built on innovation in the STEM disciplines and incentivisation of industry that develops and uses such innovations. Our government must motivate a move away from exporting primary products (e.g., ground-water, milk, and ‘raw’ trees) in favour of higher-value products and services, for which scientific underpinning is essential. This cannot be achieved by a research strategy alone but requires investment in the underlying research and development, as well as incentivisation of industry and start ups that perform outcome-focussed R&D.

Our biggest challenges (e.g. climate change, loss of biodiversity and health) require an interdisciplinary approach and a combination of research, development and innovation with both political and societal will. These types of issues cannot be addressed by science alone but invariably have a political and educational component. This means, for example, that research undertaken in support of ‘national science challenges’ cannot be assured of achieving the environmental or societal outcomes posited unless scientific outcomes are capitalised on by legislative measures and social demand.

Question sets 2&3 – Public Research Organisations and The Innovation System.

New Zealand has a legacy of very successful and interrelated educational, tertiary research and crown research institutes. This resulted in excellent scientists and innovators who have achieved at the highest levels internationally, and a thriving chemical industry that was underpinned by the DSIR. Unfortunately, the corporatisation of the CRIs and universities over the decades has led to competition between these institutes at the business level. This discourages the cross-sector collaboration that is needed to achieve effective implementation and positioning of important discoveries.

It’s important to note that researchers and scientists in these institutes and organisations still do our best to collaborate collegially, and success is still possible and evident. For example, the current MBIE funding system does encourage collaboration between tertiary research and Crown or industrial R&D, and the CoREs are extremely effective at linking scientists at multiple universities in a whole-of-NZ approach. The key point, though, is that we could do more and better if our measures of success were based less on short-term financial profit-making and more on knowledge value. Decreasing the corporate over-management of tertiary and Crown institutes and minimising bureaucracy should be goals of this review.

It is timely to review the performance and capability of the CRIs in relation to the economic, environmental and societal needs of the country. Research institutions tend to evolve organically over time, and NZ must ensure that current CRI priorities match the needs of the nation. There are also areas of overlapping work between CRIs. An example that has been the subject of public comment is an apparent overlap between NIWA and the Meteorological Service. Avoiding duplication of effort by decreasing competition and increasing collaboration between such institutes seems a worthy outcome of this review process. CRIs should be mandated to address specific areas of applied research and funded to that end. The commissioning of research programmes could be undertaken by each CRI, rather than through an external bureaucracy. This would not prevent collaboration with universities or other

government agencies, if that was appropriate to the research envisaged. Reconsideration of how Callaghan Innovation can more effectively provide the required connections between government, CRIs, universities, innovators and industry would therefore be valuable for this review.

We believe that New Zealand doesn't need another advanced technology organisation doing applied and developmental research – that is a core function of the existing CRIs. Arguably, not all the functions and capability of the disbanded IRL are achieved in the current model, which could be a consideration here. The distinction between public- vs private-good facing research organisations is distracting and unnecessary. NZ does not need further layers of segmentation, and indeed should be decreasing current separation mechanisms.

Increased ties between CRIs, IROs and universities could be achieved through encouragement of internships for senior undergraduate and co-supervision of postgraduate students.

Relating to the concurrent review of the tertiary sector and the comments above, the importance of healthy, well-funded universities to a successful knowledge-based economy cannot be overstated. A stronger level of baseline funding is needed to avoid the recent downsizing and loss of expertise caused by short-term drops in student numbers. Incentivising decreased bureaucracy and reduced competition, together with increased interconnectedness between the tertiary institutes, is essential to successful scientific education, research and commercialisation. Fundamental disciplines (such as chemistry and physics) have a place at all/most universities to provide central scientific knowledge and underpin the specialist subjects that add individual "flavour" to each institution.

Universities already share intellectual property (IP) between the researcher and the organisations, and there are effective mechanisms to share knowledge and IP between tertiary institutes. Research organisations (e.g., CRIs) should be encouraged to implement similar arrangements.

KiwiNet provides useful processes for translational research. Increased incentivisation of investment in science and technology innovation would further enhance the pipeline from discovery to implementation and economic benefit.

Question set 4 – Contestable Research

Given a limited budget, government contestable funding should strongly support what only the public system can contribute: funding for basic, fundamental and discovery-led research, in addition to facilitating cross-institutional and inter-disciplinary translational research. Providing incentives for businesses to undertake highly applied R&D and to partner with research institutions could take the form of modification of tax or business legislation rather than direct funding.

Ngā mihi nui,

Joanne Harvey, NZIC President.