

Response to TE ARA PAERANGI FUTURE PATHWAYS GREEN PAPER.

Genomics Aotearoa.

This document was developed by Peter K. Dearden with feedback from the governance and science leadership of Genomics Aotearoa. Any correspondence should be addressed to [Privacy - 9\(2\)\(a\)](#).

Thank you for the opportunity to respond to the green paper. We have some relatively short initial feedback from Genomics Aotearoa itself, but many of our researchers are engaged in providing feedback through a number of routes and we are in discussions with research organisations similar to ours as another way to provide what we hope is helpful feedback.

About us.

Genomics Aotearoa is an MBIE funded platform (through SSIF) that involved 9 CRIs and Universities in a collective effort to improve the use of Genomics and Bioinformatics in New Zealand. Genomics Aotearoa seeks to improve infrastructure in this area particularly by building capacity and capability in Genomics and Bioinformatics, and making that capacity available nationally. This involves not only providing a national bioinformatics infrastructure (in collaboration with NeSI), providing training and database infrastructure, but also increasing the pool of competent genomic scientists and bioinformaticians in New Zealand through addressing problems of importance to New Zealand. Much of this work is carried out in partnership with Maori in areas of Health, Primary Production and Environment. I have attached our annual report for 2021 to give you some idea of the range of activities we are involved in. Much of the feedback presented below comes from our experience in operating the Genomics Aotearoa platform and thus is focussed on areas pertaining to that.

General Feedback

Good science, which makes an impact in the world, doesn't come from nowhere. The ideas that are actualised and make an impact on our lives, such as whole-genome sequencing for Covid strains, new methods to improve production animal breeding or the transistors that make your smartphone work, come from a long chain of science and innovation. On the way through this chain new ideas, applications and knowledge are generated; but often not in a linear, understandable way. A good science system needs to recognise the importance of this

entire workflow, from novel blue-sky idea to implementation. Along the way, it also has to recognise that this is, on the whole, an infrastructure of people, and to find ways to get the best out of those people; to enable them to change the world for the better.

The green paper is very good at pointing out where improvements can be made in the New Zealand Science system, and the direction of travel indicated in the document is exciting and interesting and carries aspects of supporting the whole science system. It is important to realise, however, that there are some excellent aspects of our current science system which shouldn't be neglected. These come from long consultation and deep thought about how to get the best from our science system and we feel need to be protected as other changes occur.

Some current highlights of the science system we feel work well in generating, developing and implementing research are:

1) The current contestable system, with a range of funding bodies with different agendas, does, in our opinion work to support science excellence. This is particularly important if, as suggested, major funding is directed to priority areas. Marsden funding is vital to generate new science and ideas and HRC and MBIE Endeavour provides support to implement ideas in areas of importance. The MBIE Endeavour funds have opened up more translational science to a range of organisations and driven collaboration between Universities, CRIs and industry. This has, on the whole, worked well, and ensured that the whole process, from novel ideas, through development to implementation, can be supported in a joined-up way.

2) The funding of Rutherford Fellowships goes some way to supporting key people to produce impact. While this scheme has been effective, it needs to be expanded to support people at all stages of their careers as a way to ensure we are investing in the people who will deliver relevant and important science.

3) The Strategic Science Investment funds platform funding, focussing on providing infrastructure (in many different forms, see below) has been effective in providing key infrastructures, that support research and implementation. This thinking, alongside contestable funding, has ensured we are able to use the best of modern technology to address questions of importance to New Zealand, that will not be addressed elsewhere in the world.

4) All science systems depend on people. New Zealand is lucky to have an outstanding science workforce that is more than capable of increasing output and impact, given the opportunity. Our scientists are, on the whole, motivated, passionate and knowledgeable. We need to ensure that any future science system recognizes (and attracts) the talented people we need. This is, as the green paper states, not just about the people being workers in a science system, but being leaders as well. Too little leadership of our research institutions is drawn from the outstanding scientists contained in them, and too many of our science institutions are led by non-scientists and people who don't understand science.

A fundamental weakness in NZ's science system is the low level of funding. We hope that the changes that spring out of the Green paper come with increased funding. While there is a clear commitment to increase science funding to 2% of GDP, the aspiration that the private sector plays a bigger role in this has had little impact on the science system. Any science system in which funding levels are low is going to be non-collaborative, not focussed on important goals, poor at implementing research and focussed on institutional (or even individual scientist) survival. All organisations in the science system suffer from a dearth of funding, senior PIs spend their time writing grants to attempt to keep on the best of their staff, institutions squabble over how much funding comes to them in a limited collaborative grant, and scientists are limited to who they can collaborate with, because of the high costs of staff, and the limited funding in grants. Much of this would be solved by an increase in funding, and an increase in the amounts in awarded grants. Let's make delivery of the key knowledge and technology that transforms New Zealand the key outcome driving science, not the day-to-day struggle to fund good ideas and people.

Feedback on Research Priorities

We support the establishment of research priorities, alongside excellence, and are indeed thinking about how to reorganise Genomics Aotearoa's activities around key national research priorities. Priorities in science are difficult, from their development to their implementation. Many of the National Science Challenges, CoREs and SSIF platforms are directed at national priorities so there is much experience, both positive and negative, that can be drawn on from their governance groups and management to inform future strategy and policy.

The statements in the green paper around what a priority is (1.2.1) are excellent and we support this direction. The key here is to provide a home where researchers can bring their expertise to join a collaboration to address the priority, not a mechanism to fund their own research programme, contestable funding should be in place to support that. Also important is to avoid 'capture' of such priorities to one research organisation, and use of the priority as a way to fund business-as-usual research, which should be funded out of Core funding. We would argue that focussing, and funding properly, a small number of key issues in a priority, will be far more effective than trying to fund a plethora of activities. If priorities are to work to benefit New Zealand, they need to be focussed, and funded.

In response to the types of focus of research priorities (1.2.2), we think these need to be flexible. The funding of a technology platform (such as Genomics Aotearoa) can provide a huge boost to the implementation of research in a mix of areas, but focussing on a 'wicked problem' is equally valuable. Ensuring links between priorities is key here, technologies and ideas developed in one should be available to ensure strategic advantage to New Zealand.

The two questions asked about setting research priorities (1.3.1, 1.3.2) are best addressed by a small group of experts, including policymakers, scientists, health, business and overseas experts. This group needs to consult widely and be supported by high-quality information and analysis. This group should reflect the Te Tiriti by incorporating partnership. Partnership, consistent with Te Tiriti, in areas critical to Maori is, in our experience both crucial and enabling.

Question 1.4.1 asks about the operation of national research priorities. We support collaborative leadership teams including appropriate partnership structures in areas where Maori have an interest. We suggest that the most effective way to ensure impact is to delegate funding to the priority. With clear strategic direction and clear desired outcomes, we should trust research professionals to determine how to deliver. A high trust environment is far more likely to produce innovative research and solutions to the priorities set. We have great research scientists in the country, the challenge is to get them to bring their skills to the problems faced- but once you have done that, trust them to do it. This applies to institutions as well, with good leadership with an in-depth knowledge of science, they should be trusted to set strategic direction.

Feedback on Te Tiriti, Mautauranga Maori and Maori Aspirations

Genomics Aotearoa recognises the key importance of Maori aspirations and engagement in the science system. Trust must be built, and capability enhanced such that these aspirations can be achieved, and in being achieved build the capability and capacity that are required for future Maori aspirations. In the past few years, GA has been moving towards workable solutions that support and enhance these aspirations, and we know that many other institutions have been doing the same. There are thus models and approaches that have been tried, not all successfully, to get this aspect of the science system right. We think it is worth drawing on these models while thinking about this area.

For Genomics Aotearoa, where Maori have critical interests, we have established a co-governance model and partnership at multiple operational levels. We would suggest that partnerships are used strategically in this way to ensure mātauranga Māori is enabled and protected where it can benefit science outcomes, excellence is fostered, and appropriate routes to engagement are at the heart of decision-making in the science sector.

Feedback on Funding

Alongside the aspiration for increased funding, discussed above, we welcome discussions on funding core functions (3.2.1). Genomics Aotearoa has developed a national infrastructure so we can keep genomic DNA sequences of importance to New Zealand within our borders. This

allows us to, at least partially, support the aspirations of Maori data sovereignty, of clear importance to building trust in a science system. Currently, almost all genomic data is held in the US and Europe with effectively open access, but there are questions about how long such arrangements will remain, and how safe such data is. We strategically need our own databases (not only for genomics), and they need to be supported long term. The same applies to our scientific collections, whether in scientific institutions or museums, these are crucial to our long-term monitoring of the environment, our understanding of the past, and our response to challenges such as climate change. We must have robust, long-term, stable funding to support these if we are to get the best value from them.

The idea that base grants (3.3.2) may be useful for funding institutions in the future is a good one. Crucial here is an expectation that quality research will result. We would argue that monitoring outputs, both publications and impact will be critical to ensure the best value from base grants.

Feedback on Institutions

We welcome discussions about the nature of institutions involved in the science system. As Genomics Aotearoa we are an exemplar of how University, CRI and Industry researchers can work well together through funding stimulus and with the right drivers (4.4.1). We focus on building capability which is sympathetic to the broad mission/priorities. The building of capacity is clearly of huge value to New Zealand Science, especially as it links across institutions, building a national team in particular areas. We think this could be a model for the future state of the science system and support these ideas as expressed in the green paper. To achieve this we are very careful to ensure that each type of research institution is not competing by recognising that implementation research and stakeholder engagement is often best undertaken by CRIs, rather than Universities and that the capacity for new knowledge and idea generation rests mainly in Universities. By recognising strengths and weaknesses in different institutions the full pipeline of science can be supported. Hard infrastructure needs to be developed in the same way. A hub-based model bringing together expertise, including that in universities, is crucial to build a collaborating and effective science system.

All of this has to be managed and governed in ways that are open to collaboration, and outcome-driven. Inevitably institutional structures will produce boundaries to effective collaboration, and platforms such as Genomics Aotearoa are often in conflict with these structures (though not the scientists we work with). Any priorities based approach needs to find ways to lower those boundaries. Platform funding, such as ours, or Priorities, may be one effective way to build broader collaboration and impact, but it must encourage scientists and researchers to work together to push the science, rather than just building institutional resources.

Scientists are far more often loyal to their fields of expertise than to their institutions. Using this to build a collaborative science system may be very effective.

Crucial to revised, or new, institutions are the principles of partnership (as discussed above), which, we believe, should be enabled to develop Te Tiriti-enabled institutions (4.5), and Maori research excellence

Feedback on Research workforce

The issues identified are key ones and must be addressed. Any planning around future workforce must take a pipeline approach. This is how we, in Genomics Aotearoa, have addressed capability development. As stated in the Green paper, the number of PhDs graduating is not really a problem, the lack of post-doctoral opportunities is. We have concentrated on building our funding around postdoctoral research, trying to give them opportunities, and allowing them to lead to ensure they get the credibility necessary for jobs in research in New Zealand. Such drivers could easily be built into base grants (5.3.1), for example, and be a key outcome for National Priorities (5.2).

While we have focussed on Postdoctoral researchers, this is not the only problem. Mature and effective science systems usually have mechanisms for fellowships supporting outstanding researchers at all levels. This allows such individuals to more easily be involved in research priorities and frees them from the constant need to apply for grants. We think such fellowships, supporting outstanding researchers at all levels, is a key component of a future science system.

Feedback on Research Infrastructure

Infrastructure is necessary, but not sufficient, to build an excellent science system. At Genomics Aotearoa we often talk about an infrastructure of people. It is the capability and capacity of those people, alongside the compute resource of NeSI and research institutions, which is transforming the way we do genomics in New Zealand. It is crucial that infrastructure and work force are not divorced, sometimes because complex equipment required highly skilled operators, but also because the development of that personnel capability is immensely valuable. The example of our genomic sequencing of COVID strains is a good one; it springs from built capacity by Genomics Aotearoa and many others, the routine use of complex infrastructure for other purposes, and the key personnel with the connections, experience and ability to get it in place. It is important to ensure that decisions made a government level capitalise on collaboration and structures created rather than fragment them. Government departments sometimes need to step back and trust the

scientists, international advisors and governance groups to make the right decision. Not to do so undermines the mission.

NeSI, REANZ and Genomics Aotearoa are all SSIF investments that deliberately build infrastructure, both in terms of people and equipment, but do so in different ways. The models for their governance and management differ, and yet they work closely together to ensure the delivery of each of their imperatives. That group provides three different, but effective, ways of delivering an infrastructure outcome in the New Zealand Research environment (6.2.2). The way Genomics Aotearoa works, building infrastructure by doing research on key priorities, shows how these approaches can be melded with a National Priority approach. Rather than separating out infrastructure and priorities, we think a better approach is to use the priorities to identify needed infrastructure, thus ensuring we are not building technical capability without need.

Closing Remark.

Good science and a good science system are critical to the future state of New Zealand. The Covid pandemic has shown us the importance of standing science capability and capacity. Climate change is only going to make that more clear. The key to getting benefit from science in New Zealand is a focus on delivering impact and outcomes on the defined missions that matter to Aotearoa and the communities we serve. Science delivery entities need to be part of a coherent, aligned value chain of delivery with those communities, with capability and capacity to do so. This is crucially important for iwi Māori across the spectrum, who have inequitable outcomes in many areas relating to science and science delivery. Getting this right, and delivering equity, as defined by and for Māori - is necessary and critical for the success of all of Aotearoa/New Zealand.