HARNESSING
BIOTECH
Harnessing Biotech

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Professor Sir Peter Gluckman, former Prime Minister’s Chief Science Advisor

Biotechnology has the potential to deliver enormous benefits for New Zealand, from combatting climate change and making advances in health science to lifting agricultural productivity and boosting exports. Breakthroughs in gene technology ranging from gene editing (GE), which allows precise changes within individual genes, to genetic modification (GM), which adds or removes DNA from the genome, are being used around the world to help solve health, economic, and environmental challenges.

Gene technologies have been used in New Zealand laboratories since the 1970s. But restrictive rules drafted in the 1990s have made research outside the lab all but impossible in this country. For example, Kiwi scientists have been forced to go offshore to conduct field trials of genetically modified grasses designed to reduce methane emissions in livestock.

Countries like Australia, Japan and the UK have safely embraced gene technologies, while the EU is liberalising its rules. But New Zealand effectively bans gene technologies outside of labs. Genetic science has advanced considerably in recent decades, notably with the invention of the CRISPR technique which allows precise changes to individual genes.

The world has moved on. But New Zealand’s outdated rules mean we are being left behind. As the Prime Minister’s Chief Science Advisor Professor Dame Juliet Gerrard said recently,

"It's a bit like having an act which imposes a greater penalty on electric cars than petrol cars because electric cars were not invented in 1998.”

New Zealand can be a world leader in reducing agricultural emissions and other innovations to benefit health, nutrition and the environment with rules that are fit-for-purpose in the 21st century. It is time for New Zealand to responsibly open up access to the benefits of gene technology.

National’s Harnessing Biotech Plan:

1. End the effective ban on GE and GM in New Zealand.
2. Create a dedicated regulator to ensure safe and ethical use of biotechnology.
New Zealand’s biotech rules are out of date

In New Zealand, gene technologies are regulated by the Hazardous Substances and New Organisms Act 1996 (HSNO). HSNO allows genetic research in laboratories, which has occurred in New Zealand since the 1970s, but field trials and applications of gene technology products outside the lab require approvals. The Environmental Protection Agency (EPA) has approved fewer than ten GE or GM products for release outside labs.³ No commercial GE or GM crops are grown in New Zealand, and no fresh produce based on gene technologies are sold here.

HSNO was last amended in 2003. In the two decades since, tremendous advances in biotechnology have been made. In 2012, the ‘CRISPR’ process was announced which allows precision editing of individual genes without introducing new DNA into the genome.⁴ Advances in GM technology have also occurred. Overseas regulators have adopted a risk-based approach, taking into account scientific advances. Many countries including Australia, the UK and Canada allow research and use of GE and GM technologies outside labs. The US, Japan and Argentina do not regulate GE at all.⁵ Even the historically cautious EU is set to liberalise gene technology rules.⁶ Regulators have recognised the lower risk of processes which add no new DNA to the genome and get similar results as traditional selective breeding.

GE and GM crops are widely used around the world. For example:

- Australia has three genetically modified crops: cotton, canola and safflower. Their first modified crop, an insect resistant variety of cotton, was commercially sown in New South Wales in 1996.
- Canada grows modified crops including canola, soybeans, grain corn and sugar beets. Since the introduction of GM crops to Canada 20 years ago, it has become the fourth leading producer, behind the US, Brazil, and Argentina.

Globally, 2.7 billion hectares of land was planted in GE or GM crops between 1996 and 2019, 100 times the area of New Zealand.⁷

As other countries plough ahead and reap the rewards of biotechnology, New Zealand is rapidly falling behind. Under the current law, an organism with a single edited gene is subject to more restrictions than a chemically toxic, exposed or irradiated organism with thousands of random mutations which can be released into the wild.

For example, HSNO has made gene editing research to limit the spread of wilding pines all-but impossible:

“[W]e are caught with an [Environmental Protection Agency] requirement that the experimental trees are destroyed as soon as the cones appear, so we can’t confirm we are producing sterile trees. But without that proof we are not going to be allowed to release them. That is crazy.”

-New Zealand Forest Owners Association⁸
Researchers who have developed innovative products here in New Zealand labs are forced to rely on overseas infrastructure to trial their research. For example:

AgResearch, a Crown Research Institute, developed a new-generation rye grass in a New Zealand lab with the potential to lower livestock emissions by 23 per cent and increase drought resistance. However, AgResearch was forced to go to the United States to conduct field trials.

Auckland research company Lanzatech left New Zealand in 2014 in part due to New Zealand’s overly restrictive rules. According to co-founder Dr Sean Simpson:

“Shifting the company from Auckland to Illinois was a commercial necessity, reflecting the relative cost of doing business, proximity to projects of scale, the difficulty of attracting key technical staff to New Zealand and the country’s regulatory barriers to using genetically modified organisms – a key element in Lanzatech’s bio-fuel production.”

Lanzatech is currently valued at over NZ$1.3 billion.

Because of our restrictive biotechnology laws, New Zealand is not capitalising and converting its R&D efforts into commercial enterprises that are so desperately needed to grow the economy.
Harnessing biotech

National believes it’s time to update New Zealand’s biotech rules and embrace technologies like gene editing to help combat climate change, advance health science, and boost economic growth. Our Harnessing Biotech plan will unlock the benefits of modern gene technologies while safeguarding public health and safety.

1). End the effective ban on GE and GM technologies in New Zealand

Genetic editing and other types of genetic modification are powerful tools that require regulation. But our current rules, which amount to an effective ban, are among the most restrictive in the world.12

National will update the rules to allow for greater use of GE and GM, while retaining strong protections for human health and the natural environment.

National will introduce dedicated legislation that provides for the use of gene editing and modification in New Zealand. The legislation will:

- Manage risks to people and the environment rather than the details of methods for gene editing or modification. This means regulation can keep pace with future advances while ensuring technology is used responsibly.
- Consider scientific, ethical, social, cultural and economic consequences of research and applications of gene editing or modification.

In addition, National will update other legislation affecting biotechnology to ensure different Acts use consistent terms, work together coherently, and avoid duplication of regulatory activities.

However, National will retain existing prohibitions on certain applications of gene technology including human cloning and human embryonic GE or GM.

2). Create a biotech regulator to ensure safe and ethical use of biotechnology

In addition to updating New Zealand’s biotech legislation, National will establish a dedicated biotechnology regulator to oversee the regime and manage ethical concerns while allowing New Zealanders to access the benefits of advanced biotech.

The biotech regulator will regulate all forms of gene technologies and non-GE/GM biotechnology. It will decide approvals for imports, trials and commercial use, taking that role from the EPA.

The new regulator will be based in the Ministry of Business, Innovation and Employment (MBIE). As a Departmental Agency, it will be independent of Ministers and MBIE with its own board, similar to Callaghan Innovation.

The biotech regulator will work closely with the EPA, Ministry for Primary Industries, Food Standards Australia New Zealand, the Ministry of Health, and the public.

This regulatory model is based on the Gene Technology Regulator in Australia. This model provides for independence without the added cost of a new standalone department.
3). Streamline approvals for trials and use of non-GE/GM biotech

Biotechnology, including non-GE or GM technologies, has enormous potential in areas like climate change, human health and agricultural productivity. If New Zealand wants to grasp this opportunity, we need to empower Kiwi scientists to make the most of the major advances that have occurred in this field over the past several decades.

While other developed countries have found a way to safely move ahead with research and commercial applications of biotechnologies, approvals for in-field trials and use of technologies and products in New Zealand can be slow.

A methane inhibitor called Bovaer which has the potential to lower livestock emissions by 30 per cent faces a four-year approval process. Delays like this are totally unacceptable in the face of New Zealand’s significant commitment to achieve net-zero emissions by 2050.

If we want to achieve our climate goals without decimating our primary sector, which is already one of the most carbon-efficient and sustainable in the world, New Zealand needs to move with pace to catch up with the rest of the developed world when it comes to the use of biotech.

To deliver the step-change New Zealand needs, National will:

- Streamline the approvals process for trials and use of non-GE/GM biotech for emissions reduction and other purposes. The biotech regulator will be tasked with reducing delays for the safe introduction of biotechnologies into New Zealand.
- The biotech regulator will approve trials or use of non-GE/GM products that have already been approved for trial or use by at least two other OECD countries (or the EU and at least one OECD country outside the EU).

Funding

The new biotech regulator will have an initial budget of $5 million per annum, with funding reprioritised from the EPA budget. The biotech regulator will earn additional revenue from user fees.
**Benefits of biotechnology**

Embracing advances in biotechnology and updating our biotech rules will allow New Zealand to make faster progress in solving the major challenges we face, from combating climate change to improving human health, boosting agricultural productivity, and safeguarding water quality and our natural environment.

**Combatting climate change**

To meet our global commitments on climate change, New Zealand will need to address the issue of agricultural emissions – particularly methane from livestock and carbon from fertiliser. To achieve this without decimating our primary sector will require serious scientific breakthroughs.

There are great opportunities to use biotechnology to improve feed, methane inhibitors and livestock to transform farm productivity while reducing emissions and other environmental effects. Kiwis have developed GM grasses that reduce methane output in livestock – but New Zealand’s rules mean they are unable to be used outside the lab.

Outside agriculture, Kiwi company Lanzatech has developed GE microbes which can convert pollution from factory smokestacks to low-emissions fuels. Similarly, sterile exotic trees have the potential to reduce wilding pines and increase carbon capture by diverting energy from reproduction to tree growth.

**Advancing healthcare**

Gene editing has the potential to deliver vast benefits for human health, including treatments for cardiovascular diseases, cancer, and blood disorders such as sickle cell anaemia. For example:

> Consider the remarkable story of Alyssa, a 13-year old from Leicester in the UK. She had an aggressive form of leukaemia. Chemotherapy and other treatments had failed. Scientists used a technique called ‘base editing,’ a form of GE which was only invented 7 years ago, to give Alyssa modified T-cells to hunt down and kill the cancer. It worked. Alyssa was cured and is alive and well.

**Safeguarding the natural environment**

Aside from climate change, biotechnology can support other environmental goals. For example, gene technologies can support the development of crops that are resistant to pests without the need for chemical pesticides, reducing runoff to keep local waterways clean.

**Lifting agricultural productivity**

Gene technology research is unlocking ways to safely accelerate the growth of crops, which, if adopted here, could substantially improve New Zealand’s primary sector productivity and boost our export earnings.

For example, researchers are currently investigating ways to shorten the time for commercial apple trees to reach production after being planted from five years to less than a year.

Even small boosts to productivity and yield can deliver strong economic benefits. It is only through a strong economy we can lift incomes and afford better public services.
Support for better rules

For years, senior scientists, public research institutions, and industry leaders have voiced concerns about New Zealand’s outdated and restrictive rules. There is now widespread support to update these regulations to make them fit for purpose.

“[O]ur current legal and regulatory frameworks are not fit for purpose... Hypothetically, if CRISPR-Cas [gene editing] were used to cure your grandmother’s cancer, a case could be made that she was a new organism and therefore if she lived, she could not leave containment. These anomalies need addressing.”

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“Leaving a public conversation for too long (e.g. 2-3 years away) could mean that New Zealand risks missing opportunities, playing catch-up on the international stage, and facing increasing compliance issues from GMOs indistinguishable from conventionally developed organisms.”

Ministry for the Environment

“Most international jurisdictions have made it much easier to use and trial the results of gene editing. Some recognise that changes made by gene editing could be achieved naturally, and so do not label it as genetic modification... New Zealand risks falling behind if sectors are unable to fully realise the benefits on offer. Bringing the regulations up to date would be a game-changer in helping to advance the wellbeing of New Zealanders and the country.”

Science New Zealand representing Crown Research Institutes

“New Zealand needs to be cleaner and greener in the future. I totally agree with that image... Fighting back on climate change requires technology. Gene editing is revolutionary for plant biology. We can go in and make slight new variants of key genes, and then the resulting plant is better. Coping with climate change. It could be higher nutrition.”

Dr Andrew Allan, Professor of Biological Sciences, University of Auckland

“Historically gene modification has been an emotive and polarising issue. However, the benefits that gene editing can bring to society demand that we re-examine our position. We need to provide a legislative framework that allows for risk-tiered regulations to govern current and future biotechnological advances.”

Dr Hilary Sheppard, Senior Lecturer, School of Biological Sciences, University of Auckland

“New Zealand’s current GMO legislation is putting a handbrake on some [health] research.”

New Zealanders for Health Research
“If we look at the challenges in New Zealand compared to the US and UK environment, things are so much easier to get done there... That’s a big departure for the EU to re-assess their rules. Previously NZ has been able to say ‘We are following the EU model’, but now the EU is moving and we are not even having the conversation.”

**Dr Alec Foster, Scion**

“Gene editing is a very precise approach to modifying a genome, more precise than anything else we can do, and can result in exactly the same result as normal mutations that can occur naturally but very rarely. New Zealand already accepts much less precise approaches to modifying plants such as radiation mutagenesis.”

**Dr Elspeth MacRae, Chief Innovation and Science Officer, Scion**

“We are already out of step with the world, and even more so if the EU changes its stance. Gene editing is regarded as a GMO here, where other countries separate it out from that.”

**Professor Richard Newcomb, Chief Scientist, Plant and Food**

“They want to talk about New Zealand's use of GM tech, but we need action, or we will be left far behind. Future generations will not be interested in staying in Aotearoa if we don’t use cutting edge technologies. We will see more brain drain, and New Zealand will miss out on the fourth industrial revolution... If New Zealand wants to reach its goals to reduce net greenhouse gas emissions... we must do something different.”

**Dr Zahra Champion, Executive Director, BiotechNZ**

“Farmers are intensely interested in further reducing their world-leading greenhouse gas emissions footprint per kilogram of food produced, but the Federation has been saying for several years now that we need new tools to do so... Genetic modification is one of those new technologies that offers exciting potential.”

**Federated Farmers**

“It’s not like we cannot undertake genetic manipulation in New Zealand. We can, and we do. We don’t want to do it at a certain scale. And I can’t understand the justification for that. It’s technical masochism. We’re going to build a little bit of it, but when it gets really exciting, we’re going to stop. If this could turn into something, we’re not going to do it.”

**Dr Sean Simpson, Co-Founder, Lanzatech**
Key issues

What is biotechnology?

Biotechnology involves the use of living organisms, cells, and biological systems to develop new technologies and products that improve our lives in various ways.

Some of the key technologies used in biotechnology include genetic engineering, gene editing, tissue culture, fermentation, and bioprocessing.

What is gene editing and genetic modification?

Gene editing is a much more precise and targeted technique, while genetic modification involves introducing new genetic material into an organism's genome.

Gene editing involves making precise changes to the DNA sequence of a particular gene, using technologies such as CRISPR/Cas9. This allows for targeted alterations to specific genes, without affecting the rest of the organism's genetic makeup. Gene editing can be used for a variety of purposes, such as correcting disease-causing mutations, improving crop yields, or creating new medicines.

Genetic modification, on the other hand, may involve introducing or removing a whole gene in an organism's genome. The inserted generic material may be from the same species to create multiple copies of the gene, or from another species. This may be done in multiple ways. Genetic modification is increasingly used in agriculture in many countries to create crops that are resistant to pests or have other desirable traits.

What are the advantages of biotechnology?

Biotechnology has the potential to deliver enormous benefits for New Zealand, from combatting climate change and making advances in health science to lifting agricultural productivity and boosting exports.

Gene editing has the potential to deliver vast benefits for human health, including treatments for cardiovascular diseases, cancer, and blood disorders such as sickle cell anaemia.

There are great opportunities to use gene technologies to reduce our agricultural emissions by creating modified grasses which will reduce the methane output in stock.

What other countries are using gene technology?

Most countries around the world are now using gene technology including Australia, the UK, Canada, Japan and the US. The EU is also liberalising its rules for gene technology.

Is genetic research taking place in New Zealand now?

Yes. Genetic research has been undertaken in New Zealand laboratories since the 1970s. However, it is all but illegal to take this research outside laboratories which means New Zealand scientists have to conduct trials overseas.

For example, Crown Research Institute AgResearch developed a new-generation rye grass in a New Zealand lab that has the potential to lower greenhouse gas emissions from livestock and increase drought resistance. However, AgResearch was forced to conduct field trials in the United States.
**What will change under National’s policy?**

National will introduce dedicated legislation to support greater use of biotechnology in New Zealand while retaining strong protections for human health and the natural environment.

We will be constantly looking at other countries around the world to ensure we have the best practice.

**What safeguards will you put in place?**

National will establish a dedicated biotechnology regulator to oversee and manage ethical concerns while allowing New Zealanders to access the benefits of advanced biotech.

The new regulator will be housed in the Ministry of Business, Innovation and Employment (MBIE). As a Departmental Agency, it will be independent of Ministers and MBIE with its own board, similar to Callaghan Innovation.

The biotech regulator will cover all forms of genetically edited or modified organisms, including approvals for imports, trials and commercial use. It will work closely with the EPA, Ministry for Primary Industries, Food Standards Australia New Zealand, and the Ministry of Health.

**How will the biotechnology regulator work?**

The regulator will be based on the Gene Technology Regulator in Australia.

Scientists will apply to the independent regulator for approval to trial or use biotechnology products in New Zealand. The regulator will rigorously assess each application for risk to human health and safety and the environment. It will write a risk assessment and risk management plan.

The regulator will receive public submissions for a minimum of 30 days on each plan. Experts, stakeholders and any member of the public can comment. All comments will be considered before a final decision.

**Will consumers know if they are eating genetically modified food?**

Yes. National supports food labelling so consumers know what they are eating.
Can you buy GE or GM food in NZ now?

Yes. For example, imported soy-based products are likely to include GM.

How will you protect our agriculture sector against contamination with GM crops?

Crops will only pollinate other varieties of the same crop and will only occur to a significant degree if the crops are sufficiently close, the flowering periods are the same, and the receiving crop has not already self-pollinated. In the United States, there is not a single documented case of an organic farmer losing his or her organic certification due to contamination from a GM crop.

If livestock eat genetically modified grain, will there be GM in the meat we consume?

DNA and RNA are present in all food stuffs. The elements of DNA are broken down on digestion into the sugars that make up DNA and RNA. These are no different in GE or GM products which reorder genetic letters. Thus, no genetically modified DNA is in the meat of animals fed GE or GM crops. It has been estimated that over 70 percent of harvested GM crops are fed to food-producing animals, making the world's livestock populations the largest consumers of the current generation of GM crops. GM DNA has never been detected in the milk, meat or eggs derived from animals fed with GM feed.

What won't be allowed under National's policy?

National's policy retains existing prohibitions on certain applications of gene technology including human cloning and human embryonic GE or GM.
1. This document uses terms which follow overseas conventions:

Gene editing (GE) refers to CRISPR and related techniques.
Genetic modification (GM) refers to methodologies including gene knock out or which introduce new genes from the same species or other species into the genome.
Gene technology refers to GE and GM

Biotechnology is a catch-all term that refers to GE/GM and non-GE/GM technologies and products which harness "cellular and biomolecular processes... that can improve our health and well-being, economy, and environment." See Australian Government Department of Health (2022), "Biotechnology in Australia – Strategic Plan for Health and Medicine," 29 March, link.

2. Advice to the Prime Minister, August 2019, link.


10. As at 10 June 2023, link.


12. For example, see Farmers Weekly, “Methane inhibitors face grind through system,” 1 May 2022, link.


14. The Royal Society Panel in 2019 published “Gene Editing Scenarios in Healthcare” which considered these and other potential health benefits from GE research, link.


17. Advice to the Prime Minister, August 2019, link.

18. TVNZ, 1 July 2018, link.

19. Advice to Minister, 7 June 2018, link.

20. February 2023, link.

21. 25 June 2022, link.

22. 13 August 2019, link.

23. Submission to Productivity Commission, 3 February 2021, link.

24. 12 April 2023, link.

25. 4 October 2018, link.

26. 12 April 2023, link.

27. 1 April 2022, link.

28. 12 April 2023, link.

29. Overdue GM discussion offers GHG solution, April 2022, link.

30. 23 April 2022, link.