Science&Technology AUSTRALIA

Submission:

Third Review of the Gene Technology Regulatory Scheme

10 November 17

To the Legislative and Governance Forum on Gene Technology,

Science & Technology Australia (STA) appreciates the opportunity to make a submission to the Third Review of the National Gene Technology Scheme.

STA is the peak body for scientific and technological societies and associations. The 68,000+ scientists and technologists represented by STA have a strong interest in a robust and fair regulatory system, and we are proud to make this submission on their behalf.

The potential for gene technology to change the world we live in for the better is profound, however it is important we do this work in a way that is ethical and responsible. The rapid evolution and enormous impact of CRISPR genome engineering define it as a transformative technology. The current legislation fully covers all the potential risk of the technology and its development in the near future.

The key points in our submission are:

1. CRISPR/Cas9 and related genome engineering approaches are a transformative technology whose actions STA believes fall under the auspices of the Gene Technology Act (2000)
2. The GM status of organisms produced by CRISPR genome engineering should be assessed using the exiting definitions of GMOs which exist in the Gene Technology Act
3. Any changes to the Act should not compromise the capacity of Australian researchers to utilise this technology
4. Any risk management strategies, if required, should be undertaken on a case-by-case basis using evidence-based approaches that do not hamper Australia's competitive position
5. Regulation and legislation must be flexible enough to provide guidance to researchers working with rapidly changing technology
6. Education for decision-makers and the general public will support evidence-based (rather than fear-based) decision-making
7. Regulators must be supported with sufficient resources to ensure their work is able to keep pace with the sector they regulate
8. Existing legislation adequately regulates genetic modification including activities associated with newer genome editing technologies
9. Australian legislation should be benchmarked against other countries to ensure international competitiveness
10. Increased vigilance and enforcement of unregulated importation and experimentation is warranted
11. OGTR must continue to address mistrust and misinformation in the community about genetic modification in science and technology and its regulation

This submission has been prepared in consultation with a working group drawn from relevant STA member groups (listed below). We thank them for their work in preparing the submission.

STA and the working group welcome any further enquiries from the Forum as the Review progresses.

Kind regards,

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Working Group Members

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Overview

The rapid development of gene technologies - both in Australia and internationally - is almost unprecedented in the history of humankind. These new technologies promise great rewards, but also pose significant challenges.

Recent scientific advances now make it possible to more efficiently and precisely alter the genome of plants, animals, and microorganisms to produce desired traits. These genome editing technologies are relatively easy to use and can be applied broadly across the medical, agricultural and environmental sectors, with potentially profound beneficial effects on human and animal health.

One of the greatest benefits of these developments is the increased precision and efficiency in our ability to alter the genome of plants, animals and microorganisms. However, there are also potential risks and uncertainties, including how the technology affects individual genomes (including germline transmission), its potential environmental and ecosystem impacts, and ethical considerations.

Accompanying the enthusiasm and excitement around the potential promise of these technologies are questions about whether the existing Acts, as well as the Office of the Gene Technology Regulator (OGTR), are prepared to ensure the safety of regulated products that use this technology. Providing appropriate and balanced regulatory oversight for applications involving an emerging technology is not a new challenge. However, the potential breadth of applications and the fundamental nature of altering the genome call for the participation of multiple constituencies in considering the most effective regulatory policies to address any potential risks.

A balance must be struck between providing the freedom to explore the opportunities that arise from new gene technologies, while also ensuring safety and integrity is maintained. It is Science & Technology Australia's position that the status of organisms produced by these new technologies falls within the existing definitions of genetically modified organisms.

Science & Technology Australia is the peak body for scientific and technological societies and associations. The 68,000+ scientists and technologists represented by STA have a strong interest in a robust and fair regulatory system, and we are proud to make this submission on their behalf.

Please find specific feedback from STA's working group regarding the system of gene technology regulation in Australia.

New technologies

Developments in genetic technologies have great potential to solve some of the most pressing problems faced by the human race. Two developments in

particular – CRISPR and gene drives – will play an increasing role in how gene technology works to address them.

- CRISPR/Cas9 and related genome engineering approaches are transformative technologies which STA believes fall under the auspices of the Gene Technology Act (2000)
- The GM status of organisms produced by CRISPR genome engineering should be assessed using the exiting definitions of GMOs which exist in the Gene Technology Act
- Any changes to the Act should not compromise the capacity of Australian researchers to utilise this technology
- Any risk management strategies, if required, should be undertaken on a case-by-case basis using evidence-based approaches that do not hamper Australia's competitive position

CRISPR

CRISPR as a mechanism to modify the genomes of organisms represents an exciting and transformative approach, with likely application to a number of different fields including basic research, biomedical discovery, addressing environmental challenges, creating biofuels, disease modelling and treatment and the development of new agricultural approaches.

This submission considers the act of genome cutting and editing mediated by the actions of the Cas9 or other CRISPR systems effector proteins to constitute a "technique for modification of gene" which falls under the Gene Technology Act (2000).

Although this submission considers the act of genome engineering by CRISPR to fall within the auspices of the Gene Technology Act (2000), the potential outcomes of any CRISPR mediated genome engineering are diverse and depend on the nature of the modification induced by the experimenter.

In considering whether the application of CRISPR to modify the genome represents the production of a Genetically Modified Organism (GMO) we believe the current definitions of a GMO are instructive. In particular, for those CRISPR experiments in which no "foreign nucleic acid (non-homologous DNA usually from another species)" is inserted into the resultant mutant organism, then the produced organism should not be considered a GMO.

In cases where foreign DNA is introduced into the heritable genome (LoxP site, protein tags, marker genes, Cas9 effectors delivered by plasmid etc.) then the resultant organism should be considered a GMO. On balance we consider that the GMO status of the produced organism should be considered independently of the use of CRISPR to generate said organism. That is, consideration should be "technology agnostic" and made primarily on the nature of the modification.

In so much as we consider CRISPR to be a form of gene technology, we do not consider that it should be treated differently to any other approach aimed at modifying the genome.

The rapid evolution and enormous impact of CRISPR genome engineering define it as a transformative technology. The benefits this technology would bring to Australia are immense. The current legislation fully covers all the potential risk of the technology and its development in the near future.

It would be particularly unwise to, in any way, define or regulate this engineering approach differently to other technologies that achieve the same end result. To do so could considerably affect Australia's competitive position within a number of fields and it would significantly hamper the development of new approaches to study, modify gene function, to treat and cure diseases, to control the propagation of infectious diseases or pests and to improve the productivity and safety of agricultural products.

It is also vital that the management of the risk in the development CRISPR genome editing technology must be based on evidence. For example the public perception of the technology does not acknowledge the centuries of domestication and breeding of crops or animals that have resulted in genetically modified food.

An evidence-based approach to the technology, and a prioritisation of broader education and awareness campaigns to promote this evidence, would enable the dissipation of any potential fear surrounding the technology and would allow it to gain wide public and political support.

Gene drives

CRISPR driven gene drives use CRISPR technology to favourably bias the inheritance and propagation of a gene or genetic trait throughout a population, to an extent not achieved through normal (Mendelian) mechanisms of inheritance. Engineering such approaches have been proposed as a mechanism by which to prevent the spread or viability of insects carrying pathogens, restricting invasive species and for eliminating or adding traits in populations of organisms.

With respect to the Development of CRISPR mediated "gene drives' the Gene Technology Act (2000) should be formulated to consider international guidelines being developed to manage the implementation of this technology.

In particular, the recently guidelines released by the OGTR aimed at Institutional Biosafety Committees considering gene drive projects (appended).

Future-proofing the system

- Regulation and legislation must be flexible enough to provide guidance to researchers working with rapidly changing technology
- Education for decision-makers and the general public will support evidence-based (rather than fear-based) decision-making

It is vital that any regulation or legislation is flexible enough to encapsulate any potential future developments in gene technology, which are very likely. This will allow for quicker responses from regulators, and it will mean broad guidance for researchers is in place when they encounter aspects of their work that is not specifically referred to in the Act.

As mentioned above, managing fear of these technologies is important too. Much of the public's perception of gene technologies is based on the assumption that genetic manipulation and selective breeding is new, when in fact humans have been genetically modifying food for centuries through domestication and selective breeding. Education for decision makers in the first instance, and for the general public more generally, will allow for less bias and more evidence-based treatment of gene technology over time.

Regulation and Legislation

- Existing legislation adequately regulates genetic modification including activities associated with newer genome editing technologies.
- Benchmark Australian legislation against other countries to ensure international competitiveness
- Increased vigilance and enforcement of unregulated importation and experimentation is warranted
- OGTR must continue to address mistrust and misinformation in the community about genetic modification in science and technology and its regulation

Genetic modification, and the associated possibilities and risks, are likely to remain contested within the broader Australian community.

Positive steps towards addressing issues of regulation and legislation could include benchmarking Australian legislation against other industrialised countries, in an effort to keep Australia competitive and up to speed with other international leaders.

It will also be important for regulators to address any issues of inconsistency or different interpretation of regulations among Australian states and territories.

In communicating these regulations effectively, we can also combat issues of mistrust and misinformation in public discourse.

The OGTR has a key role in providing this information and advice to the public about GMO regulation and needs to be appropriately supported in order to do so.

Of particular public concern is the possibility of genetically manipulating human embryos using genome editing technology. Current legislation (*Prohibition of Human Cloning for Reproduction Act 2002*), already prohibits the genetic manipulation of the genome of a human cell (embryonal, foetal, sperm or egg) in such a way that the alteration is heritable by descendants of the human whose cell was altered. This does provide scope for genetic manipulation of non-reproductive cells; and indeed, in other countries such as China, the UK and the USA, genome-editing of immune cells is being trialled as an immune-cell based therapy. Any clinical trial in Australia that would involve the use of any genetically modified human cells would require permission from the OGTR, Institutional Human Research Ethics Committees and the Therapeutic Goods Administration (TGA).

Given the recent success of genetically modified immune cells to combat a type of leukaemia, there maybe an increase in clinics across the globe claiming to offer a myriad of treatments outside regulated practices. OGTR should work with other government agencies to ensure that appropriate information and warnings around the risk of prematurely accessing gene therapy that is yet to be approved by regulators.

With the increasing accessibility to gene editing technology outside of traditional, institutional and commercial laboratory settings, there is also an increasing risk of accidental or deliberate production and release of GMOs by "citizen scientists". Reagents and instructions for performing gene synthesis and editing are available through overseas suppliers. Although these activities are covered by existing quarantine and gene technology legislation, increased vigilance and enforcement of unregulated importation and experimentation is warranted. These risks may also play into community fears around the more contentious aspects of the technology if there is a perception that it is being performed in unregulated "backyard labs".

While the responsibility around some more contentious issues such as genetic modification of human embryos falls under the remit of different legislation and other government agencies, and is specifically prohibited in Australia, concerns around misuse of gene technology may need a coordinated public engagement strategy that spans all aspects of genetic modification, to ensure misinformation does not distort or prevent progress in the field.

Funding and meeting demand

- Regulators must be supported with sufficient resources to ensure their work is able to keep pace with the sector they regulate

It is important that as gene technology grows in Australia, regulators and researchers are sufficiently supported to ensure their respective work continues at matching pace.

Where there is an increase in the work required of regulators, it is important that funding and resourcing is quickly provided to match this growth.

This will support Australian researchers to maintain their place as global contributors, while maintaining the credibility and integrity of the research they conduct.