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SUBMISSION

Submission to the

# Review of Tasmania's genetically modified organisms (GMO) Moratorium

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# Submission to the Review of Tasmania's GMO Moratorium

The Australian Academy of Technology and Engineering welcomes the opportunity to participate in the Tasmanian Government's review of the moratorium on the cultivation of genetically modified organisms (GMO) and specifically to address issues relating to term of reference (c): research and development relevant to the use of gene technology in primary industries.

The Australian Academy of Technology and Engineering is a Learned Academy operating as an independent, non-political and expert think tank that helps Australians understand and use technology to solve complex problems. We bring together Australia's leading experts in applied science, technology and engineering to provide impartial, practical and evidence-based advice on how to achieve sustainable solutions and advance prosperity.

The focus of this submission reflects our expertise and considerable experience in science, research, technology and its translation to innovative agricultural practices. As such, we only address the question on potential innovations likely to be available for commercial adoption by 2025.

## Issue: Research and development relevant to the use of gene technology in primary industries

The Australian economy faces unprecedented disruption due to emerging technologies and global trends. This disruption will impact jobs at every level in the economy and will occur at an exponential pace. Failure to be prepared will risk a decline in many aspects of our Australian way of life and society. We need to identify and encourage best-practice technology adoption, utilisation and invention.

The development of biotechnology and molecular biology, such as gene sequencing, has had wide application to regulate and control plant traits. Gene technologies based on DNA molecular markers, transgenic technology and gene expression technology have been widely used in agricultural production in the last twenty years. They have been shown to improve agricultural yields and quality, reduce the environmental impacts of modern farming practices, reduce losses caused by various biotic and abiotic stresses promoting the broader utilisation of germplasm resources, improve breeding efficiencies and strengthen the regulation of plant growth.

Modern gene technologies already have a history of wide use and a growing importance in achieving the sustainable development of agricultural products. The Academy argues that from a scientific point of view it is the safety of the resultant product that should be regulated, rather than the technology that produces the crop/product.

The Academy notes the emergence of a range of new gene editing technologies with agricultural application, which could lead to benefits such as enhancements in food quality, removal of allergens, increased resistance to pathogens, enhanced yield and reduced environmental impact. These advanced precision gene editing technologies allow the high precision addition, detection or

replacement of gene segments or fragments. This enables the introduction of desired genetic variants (or suppression of undesirable ones) and has the potential to improve drought and disease resistance, decrease the use of fertilisers, herbicides and pesticides, and increase nutritional profiles. These gene editing technologies, as opposed to gene insertion technologies, should be placed in a different regulatory category from GMOs to permit their early adoption.

Agricultural products produced by gene editing techniques that are analogous to classical mutagenesis (chemical or radiation) and/or conventional selection of natural crop variants are currently appearing in global markets. Certainly the evidence is clear that continuation of the Tasmanian moratorium is depriving Tasmanian farmers of benefits being achieved by farmers in other non-moratorium Australian states.

Extensive genetic variations have been introduced by a range of previously available conventional breeding techniques that have historically been accepted without the need for regulation. The Office of the Gene Technology Regulator (OGTR) has recommended that some forms of simple gene editing that do not use a template for repair (for example SDN-1 (site-directed nuclease type 1)) should not be regulated, while other gene editing technologies will still be regulated as GMO. Some examples of this range of technologies are listed in the **table** below**.**

These regulatory developments, and the timeframes for recommended changes to be implemented, mean that new gene edited crops that will be available soon internationally may still be regulated as GMO in Tasmania. These crops will not be able to be grown or used in Tasmania if the moratorium continues, depriving Tasmanian farmers the ability to be competitive in global markets and hence resulting in economic loss for Tasmania.

If the Tasmanian Government is inclined to retain its current GMO prohibition, it should immediately consider regulating these new gene editing technologies – that do not involve insertion of exogenous genes – separately from the 'traditional' gene insertion GMO technologies of the past 30 years. These new crops are only now becoming available, led by a soybean that produces oil that has no trans fats. Hence the timing to ensure Tasmania's agrifood sector's competitiveness and growth via these new technologies is pressing.

New and emerging gene technologies will provide Australia a renewed opportunity to participate in global biotechnology, especially as these technologies are more precise and have fewer off-target effects. While gene technology improvements are not a panacea for all the challenges that the agribusiness sector faces, the adoption of available and emerging gene technologies presents many potential benefits. The Australian agribusiness sector must continue to adopt new gene technologies to remain globally competitive and maintain its comparative advantage, gained from many years of embracing and adopting science and technology innovation.

| Technology | |
|---|---|
| Disabled Cas9 enzymes (dCas9) | Disabled Cas9 enzymes (dCas9) bind to DNA using their specific guide RNAs but do not cut the DNA. These disabled enzymes can then be used with other proteins such as transcription factors to up or down regulate other genes containing the specific target sequence or they can be fused to DNA modifying enzymes that can convert one DNA base into another (called base editing). This generates potential new uses for the gene editing machinery in both plants and animals beyond the initial application of making double stranded breaks and repairing them with or without a DNA repair template.[1] |
| Cas9 ribonucleoproteins | There are a number of systems for the delivery of Cas9 ribonucleoproteins (RNPs) into cells, including transient (viral) delivery systems or systems involving in vitro assembly of RNPs and injection into cells.[2] This gene editing system does not require the initial production of a transgenic cell or organism and does not integrate any novel DNA into the final host.[3] Genome outcomes are similar to existing methods involving transgenics, with a higher specificity due to the rapid turnover of the RNP complex relative to that produced in a transgenic organism. |
| RNAi technology | RNA interference (RNAi), also known as gene silencing, is a way of reducing or switching off the activity of genes. RNAi gene silencing technology is enabling researchers around the world to protect plants and animals from diseases, and to develop new plant varieties with beneficial attributes.[4] The technology holds much promise as a therapeutic agent to control disease and prevent infection in plant and animal cells. It can be integrated into the organisms' genome or applied exogenously as synthetic RNAs. |
| Oligo-directed mutagenesis, SDN-1, SDN-2 and SDN-3 | The technology /techniques are analogous to natural mutagenesis, i.e. oligo-directed mutagenesis (ODM), site directed nuclease 1, 2 and 3 (SDN-1, SDN-2, SDN-3). |
| Plasmid vector techniques | A vector, like the plasmids of Agrobacterium tumefaciens may be used to introduce the gene or genes of interest stably into the plant DNA. The resulting cells are then screened to identify those that have successfully expressed the new trait for agricultural production. Many of the commercially released GMO crop plants currently grown in Australia were generated through this process. |
| Particle bombardment techniques | The DNA to be introduced into plant cells is coated onto tiny particles, which are then physically "shot" into the plant cells. Some DNA is incorporated into the DNA of the target plant. This method has often been used to produce GMO cereals such as maize. |

[1] Thakore P.I. et al. Editing the Epigenome: Technologies for Programmable Transcriptional Modulation and Epigenetic Regulation. Nature Methods, 2016, 13(2):127-137. Doi:10.1038/nmeth. 3733.
[2] Sojung, K., at al. Highly efficient RNA-guided genome editing in human cells via delivery of purified Cas9 ribonucleoproteins. Genome Research, 2014, 24(6):1012-1019. Doi:10.1101/gr.171322.113
[3] Zong, Y. at al. Precise base editing in rice, wheat and maize with a Cas9-cytidine deaminase fusion. Nat. Biotechnol. 2017, 35:438-440. Dol:10.1038/nbt.3811.
[4] See, for example, Brodersen, P. and Voinnet, O. The Diversity of RNA silencing pathways in plants. Trends Genet., 2006, 22(5):269-280.

## Concluding remarks

Genetic modification and editing technologies hold exceptional promise in their application to the agriculture sector. Given their rapid development and potential to create extensive economic and environmental benefit, it is important that the Tasmanian agriculture sector is able to access these innovations.

The current GMO moratorium denies the Tasmanian agriculture sector access to existing and emerging technologies that can enhance profitability, increase resilience and provide a safe, reliable and affordable food supply, with increased environmental sustainability. These emerging technologies simply involve gene editing, not the insertion of whole genes, and are similar to classical mutagenesis. Furthermore, other Australian experiences (such as in South Australia) have demonstrated that the maintenance of a GMO-free regulatory environment does not lead to substantial price premiums for GMO free commodities.[5]

The Academy would be pleased to provide further information to expand on these views and Fellows of the Academy are available to assist the Review as required.

[5] Anderson, K., Independent Review of the South Australian GM Food Crop Moratorium, accessed 18 April 2019 at https://www.pir.sa.gov.au/__data/assets/pdf_file/0006/339225/Independent_Review_of_the_South_Australian_GM_Food_Crop_Moratorium.pdf