**The Department of the Environment and Energy – Comments on the Discussion Paper: Options for Regulating New Technologies**

The review by the Department of the Environment and Energy (the Department) of the discussion paper prepared for the technical review of the Gene Technology Regulations 2001 (the GT Regulations) has focused on the request by the Gene Technology Regulator (the Regulator) to provide comments on the four proposed options for the regulation of these two new technologies:

- *site-directed nuclease techniques*; and
- *oligonucleotide-directed mutagenesis*.

The Regulator has proposed the following four options for the review of the GT Regulations:

*Option 1: no amendment to the GT Regulations*

*Option 2: regulate certain new technologies*

*Option 3: regulate some new technologies based on the process used*

*Option 4: exclude certain new technologies from regulation on the basis of the outcomes they produce*

As proposed, the Department also provided views on gene drives and other matters referred to in the paper.

***Department's recommendation***

The Department is of the view that there is a case for the Regulations to be amended and recommends the following two options:

- ***Option 2 for animals and microorganisms***
- ***Option 4 for plants***

It is noted that in the discussion paper (page 16) it is indicated that drafting exclusions that do not apply to all organisms is potentially complex. However, it is the Department's view that there are strong scientific arguments and much experience (NAS 2016) to justify a differentiated regulatory response for plants versus animals and microorganisms.

The Department is also of the view that gene drives warrant consideration for any review of the GT regulations.

***Department's evaluation of options 1, 2, 3 and 4***

A synopsis of the Department's evaluation of each option is presented below.

- **Option 1 – No amendment to the GT Regulations**: The Department is of the view that the Regulations may need to be updated to appropriately deal with the potential environmental risks associated with products that derive from certain new genetic technologies. However, the level of regulation should be commensurate with the assessed level of risk posed by each new technology.
- **Option 2 – Regulate certain new technologies**: The discussion paper states: '*Option 2 proposes to amend the GT Regulations so that dealings with all organisms developed*

*using oligo-directed mutagenesis and all site-directed nuclease techniques are regulated under the GT Act.* The Department agrees with both the 'pros' and the 'cons' as noted by the Regulator for this Option.

The changes resulting from some new technologies may potentially generate animals that have commercially/agronomically desirable characteristics, but, as stated in the 'pros', they may also have some unforseen interactions and possible unintentional effects. Also, there is only limited experience with the genetic modification of animals, and as such there are greater uncertainties in the risks in animals as opposed to dealing with plants.

There are also some uncertainties about the outcomes from changes in microorganisms. For instance, small changes in microorganisms may result in an organism that poses a risk to human health, safety, or the environment. Noting that horizontal gene transfer is common in microorganisms and a number of these are pathogens of humans, plants or animals, the regulation of genetic modification is appropriate.

Therefore, Option 2 is recommended to regulate certain new technologies for animals and microorganisms.

- **Option 3 – Regulate some new technologies based on the process used**: This option considers regulating techniques that use nucleic acid templates to guide the repair of DNA breaks made by site-directed nucleases. The paper identifies these techniques as SDN-2 and SDN-3.

  The difference between SDN-2 and SDN-3 lies in the extent of the nucleotide sequence difference between the native target sequence and the repair template. The use of SDN-2 involves changes to one or a few nucleotides, whereas SDN-3 involves inserting a new gene or other genetic elements. We note that it is very difficult, and likely subjective, in deciding the dividing line between the number of nucleotide changes (substitutions, the length of an insertion or deletion) that would be regulated, as opposed to the number of nucleotide changes that would be unregulated. Therefore, this option is considered impractical due to the difficulty in its implementation.

- **Option 4 – Exclude certain new technologies from regulation on the basis of the outcomes they produce**: Under this option, organisms are excluded from regulation if the genetic changes they carry are similar to or indistinguishable from the products of conventional breeding. This would have the effect that dealings with organisms produced by oligo-directed mutagenesis, SDN-1 and SDN-2, would be excluded from regulation.

  A large amount of experience has been accumulated in the conventional breeding of a wide range of plant species, and of particular relevance here, in dealing with plants produced by radiation and chemical mutagenesis. Mutagenesis induced by chemicals and radiation has been used in plant breeding to generate thousands of varieties from many species used for food, feed, fibre and ornamental/recreation amongst other uses (Ahloowalia *et al.,* 2004, Mba 2013, FAO/IAEA database: http://mvgs.iaea.org).

  Oligo-directed mutagenesis and site-directed nuclease techniques have far greater precision in targeting DNA sequences for change. This increased precision is a significant improvement when compared with radiation and chemical techniques used in plants, particularly in significantly reducing (if not removing) the problem of selecting individuals that are not adversely affected by mutations (other than that inducing the desired trait) elsewhere in their genomes.

Finally, amongst all the plant varieties produced by mutagenesis, none has been found to possess any adverse effects (e.g. a food and feed hazard) that have not already been associated with that species (Weber *et al.,* 2012, Steiner *et al.,* 2013).

Therefore, Option 4 is recommended for excluding certain new technologies when used to modify plants.

**Other Considerations**

***Outcome versus process***

The discussion paper states that 'it is beyond the scope of the technical review of the GT Regulations to change the process regulatory trigger in the GT Act to instead focus on properties of the final organism'.

The Department is of the view that there is scope for regulatory efficiencies to be achieved where the properties of the GM product play a greater role in determining the need for assessment and regulation than the process used to create the product (i.e. an organism).

***Gene drives***

Gene drives are genetic sequences that greatly enhance their own spread in a population. In a normal diploid system, each of the two versions of a gene in an individual has a 50% chance of being inherited in the progeny. However, gene drives are genetic systems where this ratio is drastically skewed to the version of a gene that has the genetic sequence of the gene drive, which will be passed on to the offspring (Esvelt *et al.,* 2014, Harvard[1]).

In our view, this technology could potentially pose some risks to the environment based on the speed that gene drives can spread through populations. The use of this technology in laboratories and, in particular, any deliberate releases of the products of this technology into the environment both may warrant consideration in an updated regulatory approach for genetic technologies.

**References**

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[1] https://wyss.harvard.edu/staticfiles/newsroom/pressreleases/Gene%20drives%20FAQ%20FINAL.pdf Accessed on 9/01/2016