VOICES FROM THE GROUND

Public Engagement in the Regulation of Agricultural Gene Editing

A BIGGER CONVERSATION

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A Bigger Conversation
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Foreword

When it comes to discussions and decisions around the food and food systems, citizens (the "general public") are, arguably, the largest stakeholder group and at the same time the most marginalised.

It is unarguable that citizens should have a say in what they grow and eat and yet, whilst some suggest that through the marketplace is the best way for citizens to express their preferences, purchasing power is a very limited kind of power.

It comes at the end of the food chain when all of the big decisions, those decisions that shape how we farm, the levels of transparency in the food system, the trade-offs we are willing to make (or more accurately others are willing to make on our behalf) have already, in some cases irrevocably, been made.

Public consultations are often used as a proxy for public involvement. But as the recent UK public consultation on the regulation of genetic technologies so decisively showed, they are often nothing more than tick box exercises where public opinion is noted – and then ignored.

For instance, in that consultation 85% of all respondents expressed the view that gene edited organisms should be regulated in the same way as all other GMOs. Less than a year later the government produced a draft bill proposing to create a new category of GMO, which does not exist anywhere else in the world, the so-called "precision bred organism" and remove virtually all regulatory control from these organisms, on the farm and in the marketplace.

This response essentially scorned and laughed at citizen unease with genetically engineered crops and foods, by choosing to call them by another name and then making them harder to find in the food system.

Civil society groups, especially those that specialise in issues around genetic technologies, can use their specialist knowledge and public mandate to represent the public view. But the reality is that they too, are often excluded from any meaningful input into government decision making.

This picture is not unique to the UK. It is currently being repeated in the European Union as it too considers the future of regulation for genetically engineered crops and foods – and of course is an historic pattern in the battles around regulation in the Americas and elsewhere.

To be sure, bringing the public into the conversation is not a panacea. It is also not easy or fast. It comes with no guarantees. It requires our institutions to hear, but also act, on views that may run counter to their policy goals. It is, nevertheless, essential in a democratic society.

We, therefore, undertook this literature review to better understand how and where citizens are being involved in the regulatory discussion around genetically engineered crops and foods, and to seek practical, replicable examples of how it can be done.

There is an overwhelming amount of literature on the necessity and on the benefits (and risks) of public engagement in the regulation of agricultural genetic technologies.

A vast amount has been written on the optimum moment to bring citizens into the discussion, on what constitutes the "right" kind of citizen for inclusion and on the necessity to be sensitive to the language differences and differences in priorities that exist between citizens, policymakers and scientists. From this, we can trace the history of citizen engagement in this complex science.

However, specific examples of citizen engagement in action, rather than abstract thoughts about why citizen engagement is important, are limited

In part this is because our governments are not structured in such a way as to involve citizens in actual detailed decision-making and in part because those with the greatest decision-making power are reluctant to share it. We have sought to highlight how this can be changed

This lack of "institutional reflexivity", the ability for large institutions to reflect and be self-critical and to use those reflections as a catalyst for change, is a major barrier to public engagement.

Other barriers exist too; and dominant narratives taken up throughout establishment institutions and media to the point of becoming "groupthink", is a major one. The narrative around genome editing – suggests that it is purely a scientific issue that only scientists possess knowledge to navigate it – is an illuminating example.

Many social scientists and ethicists have pushed back against this narrative, pointing out that how we farm, how we shop and how we eat are underpinned by moral and ethical, social and cultural values and beliefs and that all of these have a legitimate place in decision-making around regulation. Credible arguments which have made little penetration.

It is a disturbing aspect of this power imbalance that, when public engagement reveals, as it almost inevitably does, a resistance to the idea of growing or eating genetically modified plants or animals, this resistance is not taken at face value.

Instead is interpreted as a lack of understanding that can be corrected through a program of education directed by the same vested interests who wish to see a more liberalised marketplace for genetically engineered organisms.

That this "deficit model" still holds any sway is as remarkable as it is frustrating.

In the end, the habits, hierarchies and power structures that prevent citizen engagement, are deeply ingrained. Disdain for anybody outside of these structures is endemic but policymakers' reluctance to engage with citizens has also been fuelled by an activist community prone to exaggeration and caricature.

The gulf between these two positions is so wide that it is nearly unnavigable. Indeed, trying to bridge that gulf is one of the reasons why we initiated A Bigger Conversation.

We remain committed to finding common ground and expanding the conversation to include a much wider and more meaningful range of "stakeholders".

It is easy to invoke the demand to "hear the voices from the ground" and act on what they say. Far more difficult to create the conditions to bring this about. This aims to be a contribution to this creation.

It is clear to us that unless this happens, conflicts over technologies, their regulation and the hidden values that shape them, will blight these technologies, thwart any benefit they may have and, crucially, further degrade democratic and civilised governance of our society.

Pat Thomas and Lawrence Woodward
Directors
A Bigger Conversation

‘Educating’ the Public – a Deficient Approach

Citizen, or public, engagement with science and technology aims to involve society at large in the development of scientific technology at any step. This involvement can happen at any point along the development timeline from conception to release and ongoing assessment.

The notion emerged in earnest in the 1970s when the US National Science Foundation surveyed the public’s knowledge of science.

In a similar vein, the Public Understanding of Science report by the Royal Society in 1985 influenced the nature of citizen engagement in the UK in its early stages (The Royal Society, 1985).

While the concept of engagement suggests a two-way dialogue, this is not always the case. From the beginning, citizen engagement with science was a way of informing or educating people about science. This was largely based on the premise that if people are more knowledgeable about a particular scientific development, they will be more receptive to it as well (Price, 2021).

This has been called the “deficit model” which posits that people who do not accept the science are largely ignorant or do not understand it properly (and, therefore, need educating by so-called experts).

The deficit – and by extension, the Public Understanding of Science – model is, however, out-dated (Hartley and Millar, 2014) and problematic.

It firstly assumes a homogenous public, even in regard to those who do not accept a particular area of science or technology. This view is not only reductive, it also disregards the diversity and internally contradictory nature of society, and so misses key points of departure, tension and conflict.

In addition, the deficit model operates in a single direction; communication goes from the scientists to the public, who are a “*passive audience soaking up “the facts*” (Price, 2021: 4).

It also ignores a myriad of determining factors in the scepticism of a specific scientific development, including disinterest, corporate mistrust, feeling side-lined, ethical and value-based judgements, different imagined futures and concepts of sustainability, lack of access to scientific advances, and more nuanced personal, community-based and societal concerns and considerations.

The GM example

This approach has frequently been found to be inadequate in, for example, the public acceptance of genetically modified organisms (GMOs) around the world, including in the UK, “*because scientific evidence on harms does not exhaust the issues that society deems to be important*” (Macnaghten and Habets, 2020: 355).

The broad umbrella of genetic engineering (more commonly called genetic modification, or GM) technology, includes subsidiary and associated technology like gene editing, synthetic biology and gene drives, all of which result in novel organisms that have not existed before and might not otherwise exist.

Its historically controversial nature makes it a particularly rich platform from which to examine the need for the public to engage with its science, aims and values.

Some of that controversial nature is reflected in the Cartagena Protocol on Biosafety to the Convention on Biological Diversity, which applies the Precautionary Principle – practising caution and refraining from adopting technological innovations when scientific knowledge on its potential for harm is absent – to applications of new technologies.

The Protocol, coordinated by the UN, is especially directed to GM technology and is designed to give parties powers to ban “living modified organisms”, a term which can be used interchangeably with GMOs.

It came into force in 2003 and has currently been ratified by 173 parties including the UK and the EU[1]. In regard to citizen engagement, Article 23(2) of the Protocol states:

1 https://bch.cbd.int/protocol/default.shtml, accessed on 22/09/22.

"*The Parties shall, in accordance with their respective laws and regulations, consult the public in the decision-making process regarding living modified organisms and shall make the results of such decisions available to the public*." (Secretariat of the Convention on Biological Diversity, 2000: 18).

GM Nation?

The controversy over public engagement in the regulation of GMOs was well illustrated in the UK's 2003 GM Nation? debate, which was conducted by the Government to engage a broad section of the British public in the future of GM crops and food.

Nearly 20,000 people attended meetings – "*a level of public consultation that has rarely been equalled*" anywhere else (Bodiguel and Cardwell, 2010: 35).

It has also been called "*influential*" by the House of Commons Science and Technology Committee (Science and Technology Committee, 2011: 61) and as having "*a significant impact on public policy*" by some (Sciencewise, 2011: 34).

Although it produced an "*unequivocal message… of overwhelming public uncertainty*" (Jacoby, 2004: 135), it did little to impact government policy which, ostensibly, was what it was intended to do (Mayer, 2004). Is this kind of outcome inevitable? Or is there potential for optimism?

The independent, UK government-funded Sciencewise programme adopts public dialogue to inform policy-makers on science and technology.[2] Sciencewise has gained support for its role in providing "*assistance to policy-makers to carry out public dialogue to inform their decision-making on science and technology issues*".

The House of Commons Science and Technology Committee urged the Government to continue its support for the independent body as it was "*central to ensuring that [public discourse's key role in informing policy] is ingrained in the policy-making process*" (Science and Technology Committee, 2011: 77).

Saunders (2018: 3) called it "*a great opportunity … to rethink the role that the public should play in shaping science, research and innovation*".

2 https://www.gov.uk/government/collections/sciencewise-public-dialogue-on-science-and-technology, accessed on 22/09/22.

However, Sciencewise has not escaped criticism, particularly in terms of translation to government and policy responses. According to Chilvers and Macnaghten (2011: 3), Sciencewise "*has been at the forefront of public dialogue*" and marked "*a more mature phase of government thinking towards ublic engagement*"[3].

However, while Sciencewise has publicly been applauded for engaging the public in scientific debates, its influence at a policy level is questionable[4].

This feeds into the disconnection between the public climate and political rhetoric in the UK. In his first speech as Prime Minister in 2019, Boris Johnson made his position very clear on supporting GM crops in the UK. He said, "*Let's liberate the UK's extraordinary bioscience sector from anti-GM rules. Let's develop the blight-resistant crops that will feed the world*"[5].

This promise was solidified in the 2022 Queen's Speech that stated, "*Legislation will unlock the potential of new technologies to promote sustainable and efficient farming and food production*."[6]

This was an explicit nod to the Genetic Technology (Precision Breeding) Bill, which will decouple techniques like gene editing from restrictions imposed by GMO regulations, and so fast-track their applications to British agriculture.[7]

If citizen engagement for GM regulation has been insufficient and ineffective in the UK, are there other countries that have done better?

Which Countries Engage with Citizens?

The substantial number (173) of parties who have ratified the Cartagena Protocol may be considered a positive indicator of the international scope of engagement in the regulation of GMOs.

3 https://www.theguardian.com/science/political-science/2015/mar/27/lets-keep-talking-why-public-dialogue-on-science-and-technology-matters-more-than-ever, accessed on 24/09/22.
4 https://blogs.lse.ac.uk/impactofsocialsciences/2013/11/21/science-wise-citizen-engagement-evidence, accessed on 24/09/22.
5 https://www.fwi.co.uk/news/eu-referendum/boris-johnsons-vows-to-liberate-uk-from-eus-biotech-crops-stance, accessed on 22/09/22.
6 https://www.gov.uk/government/speeches/queens-speech-2022, accessed on 22/09/22.
7 https://niab.com/news-views/news/news-new-genetic-technology-precision-breeding-bill-will-support-more-sustainable, accessed on 22/09/22.

However, this does not necessarily represent the extent of engagement – including citizen engagement – that actually occurs. Governments have responded differently to the challenge in terms of how they interpreted and implemented their commitments (Newell, 2010).

In reality it is almost impossible to accurately judge how many of the signatories to the Convention fully abide by what they have signed up for.

Today, as some countries have begun to review regulatory provisions for newer technologies such as gene editing, some signatories appear to consider elements of the Protocol "optional" or up for debate.

The Aarhus Convention of the United Nations Economic Commission for Europe (UNECE) also makes special mention of requiring public participation in the decision-making on GMOs "*to the extent feasible and appropriate*"[8].

The Convention, which grants the public rights regarding access to information, public participation and access to justice, in governmental decision-making processes on matters concerning the local, national and transboundary environment was set up in 1998 and there are currently 47 parties to it.

The EU has been explicit in its obligations to consult the public in proposed cases of "*deliberate release into the environment of GMOs*"[9] (see also Bodiguel and Cardwell, 2010).

The African Union has similar obligations in accordance with its African Model Law on Safety In Biotechnology, which makes specific mention of GMOs. In Article 5(4), it states, "*The Competent Authority shall, in making or reviewing its decision, take into account the views and concerns of the public*"[10].

Another example of multinational agreements that cover the use of GMOs is the Genetic Resources Policy Initiative (GRPI) project, which experimented in participatory policy processes to strengthen capacity in decision-making on genetic resources (Wale *et al*, 2009). It was implemented in six countries (Egypt, Ethiopia, Zambia, Vietnam, Peru and Nepal) and two sub-regions (West and Central Africa, and East Africa).

National examples

At a national scale, Norway is often highlighted as a good example of public participation in regulating GMOs (Binimelis and Myhr, 2016; Macnaghten and Habets, 2020). It has pioneered a more progressive approach as the first country to include broader issues in its GMO assessment process.

At present, it is "*one of the countries with the most experience on implementation of these issues*" (Binimelis and Myhr, 2016: 1). Individuals, institutions and NGOs can participate and contribute their perspectives in the assessments of GMO release cases.

As a beacon of what is possible, Macnaghten and Habets (2020: 353) argue that "*the application of the Norwegian level-based regulatory framework can help move the focus away from assessments on safety to a tiered assessment of socio-economic considerations, and that a framework of responsible innovation can help transform the cultures and practices of research*".

In other words, Norway represents the next stage in public participation of regulating GMOs by moving away from merely discussing risk-assessments and towards a more holistic governance framework.

Another example of participatory governance of GMOs can be found in Denmark; specifically the Danish Consensus Conferences, organised in the mid-1980s by what was originally called the Danish Technology Board (DBT), an independent body established by the Danish Parliament (Scheufele *et al*, 2021: 4) to assess technological innovations and their impact for Danish society.

As its name suggests, it used consensus conferences but also other citizen engagement mechanisms as a means of advising the Danish Government. These have been used, for example, "to offer opinions on regulatory and ethical aspects of genetically modified foods" and "produce recommendations on genetically modified plants".

8 https://unece.org/environment-policy/public-participation/public-participation, accessed on 24/09/22.
9 https://europeanlaw.lawlegal.eu/deliberate-release-of-genetically-modified-organisms, accessed on 24/09/22.
10 https://biosafety-info.net/articles/policy-and-regulation/africa/model-law-for-safety-in-biotechnology-for-africa, accessed on 24/09/22.

In 1999, the resulting recommendation from the Danish Consensus Conference on Genetically Modified Foods was not "*of a complete ban [on GMOs], but rather of very strict regulation*"[11].

A citizen jury on GM crops – "New GM Crops – New Debate" – was held in 2005[12]. The majority of the jury were positive about the novel crops and recommended that they be permitted to be grown in Denmark, albeit under strict control[13].

Although a Danish online news piece declared the end of GM crops in Denmark in 2013[14], in reality, there is a marked polarisation of views on the acceptability of GMOs in the public domain in Denmark (Borch and Rasmussen, 2005; Toft, 2000).

This could perhaps be a sign of the high level of citizen engagement (Bussu, 2015), or at least the DBT's appreciation of the diversity of public views rather than a homogenous public with a single view that is sustained over time.

In total, the DBT organised more than 20 consensus conferences between 1987 and 2011. It was dissolved by the Danish Government in 2011. It's successor, the Danish Board of Technology Foundation, still holds consensus conferences but it is a private body not a public one.

Another country worth mentioning is New Zealand where a "*distinctly participatory approach has been adopted*" (Bodiguel and Cardwell, 2010: 18). This includes the establishment of an Independent Biotechnology Advisory Council to consult citizens on biotechnology matters. In addition, the Royal Commission on Genetic Modification is an independent body that looks at the risks and benefits of the technology through the lens of wide public interests (ibid; see also Newell, 2010).

However, for a more critical perspective on public participation in governance of GMOs in New Zealand, see Kurian and Wright (2012), who point out the "*delegitimization of public perspectives*" by the Environmental Risk Management Authority.

11 https://participedia.net/case/6968, accessed on 24/09/22.
12 https://tekno.dk/project/new-gm-crops-new-debate/?lang=en, accessed on 24/09/22.
13 https://participedia.net/case/6969, accessed on 24/09/22.
14 https://www.dr.dk/nyheder/indland/nu-er-det-slut-med-genmodificerede-afgroeder-i-danmark, accessed on 24/09/22.

In its 2015 comparative review of different countries' efforts towards public engagement in science, Sciencewise gave particular recognition to Norway, Denmark and the Netherlands as having actively inclusive political systems.

It also noted that after lagging behind for several years, the UK had seen the growth of a wide range of organisations and institutions, including research councils, independent research organisations, science museums, universities, civil society organisations, trusts and think tanks, that were championing public engagement (Bussu, 2015: 3).

In the intervening years this diversity of actors has not necessarily brought public engagement in science and technology into common practice, nor has its potential to shape and inform policy been fully realised. Post-Brexit one could argue that the UK's public engagement agenda has in many respects slipped backwards.

Nevertheless, several organisations and alliances in the UK, mainly in the third sector, continue to do good work on engaging the public to inform decision-making at a policy level. Examples include the Nuffield Council on Bioethics[15], Involve[16], Democracy R&D[17], mySociety[18], the UK Open Government Civil Society Networks[19] and Nesta[20].

When are citizens being involved?

Historically speaking, GM as a technology has largely been developed without the involvement of public engagement.

This has however proven to be problematic and a cause of what can be seen as "downstream" controversies and conflicts, such as protests and vandalism on GM research trials in the UK[21]. Another example is mad cow disease and the uncertainties surrounding the link between bovine

15 https://www.nuffieldbioethics.org, accessed on 24/09/22.
16 https://www.involve.org.uk, accessed on 24/09/22.
17 https://democracyrd.org, accessed on 24/09/22.
18 https://www.mysociety.org, accessed on 24/09/22.
19 https://www.opengovernment.org.uk, accessed on 24/09/22
20 https://www.nesta.org.uk, accessed on 24/09/22.
21 http://news.bbc.co.uk/1/hi/sci/tech/7529590.stm and https://www.bbc.co.uk/news/science-environment-18140957, accessed on 24/09/22.

spongiform encephalopathy (BSE) and Creutzfeldt-Jakob disease (CJD).

It has also fed into a "*crisis of confidence*" in government's ability to identify and manage risk and respond to social and ethical dimensions of science and technology (Chilvers and Macnaghten, 2011). To address this, academics and analysts are largely in agreement that public engagement needs to happen early, or "upstream", in the development of GM technology.

Wale *et al*, (2009: 16) stated that the "*participatory process should start right from the very beginning considering various factors during the planning*".

Scheufele et al. (2021: 3) warned that "*involving publics "too late" in the development cycle of new technologies signals a disregard for the significant investment societies make in public and private research infrastructures*".

In addition: "*The worldwide controversy on genetically modified (GM) crops indicated that consultation processes occurring after a technology has been developed and commercially released can be used by those in power to create an illusion of public consent for the new technology … some have suggested that all such engagement should occur upstream – that is before the technology has been developed – as this would allow the technology to be shaped through public involvement*" (Singh, 2008: 27).

A case for early engagement

The key, then, is upstream public engagement.

The Nanojury UK, which took place in 2005, is an example of how this can work well. It was designed by Doug Parr of Greenpeace UK, together with materials scientist Mark Welland, of Cambridge University's Nanoscience Centre as "*an attempt to allow open discussion of the policies and developments in nanotechnologies through a deliberative jury process*" (Singh, 2008: 28).

It provided space for citizens – a diverse group of 25, some of which were randomly selected from the electoral roll and others from different community organisations in West Yorkshire – to have a say in the technology before it was developed and so participate in its shaping. Parr noted, "*We want to provide an opportunity for people to give their perspectives on nanotechnology at a time when we hope they can still make a difference*"[22].

Upstream engagement can be an important part of "*the new scientific governance, as a way of embedding public concerns and values into the scientific process, as an instrument to help avoid downstream controversy, and more recently as part of a wider set of governance responses and mechanisms*" (Chilvers and Macnaghten, 2011: 3).

The inflexible institution

This suggests a need for citizen engagement to be embedded and institutionalised, which points to a larger issue of scientific institutional reflexivity (Smith *et al*, 2021; Wynne, 1993), *i.e.* practices, frameworks and cultures that ensure that institutes can monitor and question themselves, and, at the same time, always reserve room to revise, adapt and change according to shifting concerns and circumstances.

Examining reasons for action in a scientific or laboratory setting would bring up questions of which research projects were pursued, why and possibly how.

According to Smith *et al*, (2021: 740), institutional reflexivity, at a pre-engagement stage, has "*allowed policy-makers to reflect on their institutional position and enrich decision-making at a time when they faced pressure to legitimate decisions with engagement*".

It should be noted that institutional reflexivity is probably a bigger challenge than effective public engagement. It is also an ethical exercise, which, if done properly, likely requires "*the participation of social scientists and philosophers at the laboratory level*" (Macnaghten and Habets, 2020: 8).

There is, perhaps unsurprisingly, some resistance to this in the technological sciences (Macnaghten and Chilvers, 2014).

Nonetheless, it is vital that scientific institutes give considerable weight to implementing reflexivity

22 http://news.bbc.co.uk/1/hi/sci/tech/4567241.stm, accessed on 24/09/22

also as a means of supplementing and/or improving public engagement. As Smith *et al*, (2021: 741) argued, "*institutional reflexivity can enhance the theory and practice of engagement in science policy*".

For further reading on institutional reflexivity as part of a framework to make science more responsible, the Responsible Innovation framework (Stilgoe *et al*, 2013) is well worth reviewing.

This outlines key aspects of a new more responsive governance of science and innovation including:

1. Anticipation – improving foresight and systematic thinking, consider contingency and work towards desirable futures;

2. Reflexivity – not only self-referential critique, but also connecting institutional practices to values and assumptions, and being aware of the limitations to knowledge and understanding;

3. Inclusion – striving for openness, diversity and representation, particularly in positions of influence or power;

4. Responsiveness – capacity to adapt or change when faced with different or opposing external forces, such as shifting public attitudes and circumstances.

How are citizens being involved?

The previous section described how encouraging upstream citizen engagement needs to be matched by institutional space for participation.

This, in turn, requires reflexivity on the part of scientific bodies, including making institutional "*criteria, norms, values, standards, and knowledge… inclusive of more than technical and scientific discourses*" (Kurian and Wright, 2012: 17).

Macnaghten & Habets (2020) further recommend that institutional space should allow public engagement to be two-way – akin to a dialogue or conversation – and wide-ranging, incorporating broader socio-economic concerns and impact of new technology.

In the conclusions and recommendations of its 2011 report, The UK's Science and Technology Select Committee was in agreement with this stance, calling for a "*far broader, more substantive and inclusive public conversation*", noting:

"*There is a need to reframe and widen the public debate to encourage a more productive conversation about what we, as a society, want from our food supply and what sort of agriculture we would like that supply to be based upon*." (Science and Technology Committee, 2011: p42):

Beyond nurturing conversations between citizens and scientific experts, institutional space can also allow for proper debate, contestation and sometimes conflict, to fully respect and take differences seriously (Kurian and Wright, 2012). An important question then is, what is the best way to facilitate public engagement of science?

Sciencewise, (2011: 3) explains that a good starting point is for policy-makers to ask themselves why they want to engage the public, and it is only then that "*the purpose is decided, the process, design, commissioning body, material and language used to describe the engagement must be consistent with this*".

As a policy-maker, do you want to engage citizens, for example, in order to inform them better about the science, to elicit opinions and perspectives on the acceptability of a technology, or to guide or co-create the development of an innovation?

Methods of engagement

In terms of specific modalities of public participation, there are many, "*ranging from small-group processes of invited public dialogue in the form of focus groups, consensus conferences, deliberative mapping, and citizen assemblies … to innovations in more formal governance arrangements in the form of multi-stakeholder partnerships, citizen forums, the inclusion of lay members on scientific advisory committees, user-centered design, and other hybrid mechanisms*" (Macnaghten and Habets, 2020: 360).

Other examples include "multi-criteria mapping" (Dietrich and Schibeci, 2003: 396), as well as "*citizens" inquiries, reconvened deliberative groups, deliberative panels, national public conversations, self-*

managed group discussions, facilitated public events, regional workshops, outreach workshops, brainbox workshops, online consultation, blogs, and open access events, alongside non-deliberative interview, electronic voting and opinion poll survey techniques" (Chilvers and Macnaghten, 2011: 12).

Rather than go into depth about the differences between these forms of public engagement, this review highlights a couple of instances of using particular modalities.

As mentioned earlier, the Danish Consensus Conferences were perceived to be an effective way for citizens to participate in the regulatory process. Drawing on a consensus conference held in Australia in 1999, Dietrich and Schibeci (2003) note:

"*It provides sufficient time and educational resources to allow a small group of lay people to develop enough scientific and technical proficiency with which to enter into discussion with experts, while providing them with the autonomy to draw discussions with these experts beyond the normal narrow technical boundaries typical in technology policy formulation.*

"It also provides an opportunity for experts and policymakers to understand that community concerns that are often dismissed as being founded on ignorance, fear of change, and narrow self-interest are, in fact, often highly reasoned and articulate but draw into policy debates matters that are routinely omitted by the nature of political and policy discourses."

The Nanojury example was based on the citizen jury modality in which an assembly of randomly selected people, representing society at large, deliberate on a particular societal issue or concern.

It has been praised for the way it engaged directly with communities, using a "*community development model, a model which identifies the needs of people and attempts to respond to these needs*" (Singh, 2008: 30). This meant moving into "*community centres, youth clubs, places of worship, pubs, football pitches, parent and toddler groups*".

Who gets involved?

In the absence of an engaged community, the larger question of how to invite and/or attract citizens also needs consideration.

As an example, the National Institute for Health and Care Excellence (NICE) advertises for citizens to join a committee for guidance and standards, and "*offers payment (known as honoraria) to individual lay people whose input at a meeting has been specifically requested, such as membership of a NICE committee*" (NICE, 2015: 19).

This has implications for demographic representation and brings up the issue of people's motivation for joining such committees. Nonetheless, there are no obviously better alternatives.

For example, randomly selecting people from the electoral roll and requiring them to participate – similar to a jury summons – is likely to be socially unacceptable if not legally impossible to impose.

The question also arises, what role should governments play in public engagement exercises and programmes?

In the case of gene editing, Burall (2018) suggested that governments should contribute support but not necessarily direction. This was also the view of the Science and Technology Committee (2011).

Instead, Burall advocates for a consortium model of initially 10-15 organisations with a vested interest in the science or technology, "*such as research groups, the World Health Organization, national farmers unions, activist groups, pharmaceutical and agricultural companies and institutions focused on development, such as the Gates Foundation*".

The consortium would be coordinated by a dedicated party – e.g. the Nuffield Council on Bioethics in the UK – that would mobilise members and uphold inclusive and open dialogue, transparency of information and processes, and other ethical codes (ibid; Kofler *et al*, 2018).

Thus, governments – at local, national and international scales – could be more important further downstream in making informed policy decisions, rather than in public engagement, which would be facilitated by a more collaborative, multi-stakeholder effort.

Rather than "*being (or of being perceived as) merely symbolic exercises in legitimation [of the state]*" (Kurian and Wright, 2012: 2), this would ensure that such exercises would be more deliberated, meaningful and draw upon a larger range of positions and interests.

Such a model was proposed in Jasanoff & Hurlbut (2018), in what was called "*a global observatory for gene editing*". This was described as an international and interdisciplinary observatory for the diversity of views on genome editing that exist globally.

It would provide a forum for debate and consensus-making, which would actively encourage neglected and marginalised viewpoints.

The observatory has recently been established – in September 2020 – by academics at the Harvard Kennedy School, Arizona State University and the University of Wisconsin-Madison. It has held several "convenings", produced research and written commentaries ("interventions") all designed to challenge the "*dominant approaches to evaluating the meaning of human genome editing and related technologies*" as "*overly narrow*" and inadequately engaging "*across social and intellectual divisions*"[23].

Citizen agency

As previously noted, for public engagement to be effective, it should not simply be used for communicating the science and encouraging its acceptability, but to contribute to shaping policy about whether the science is acceptable, and ideally be used as a means of encouraging meaningful participation in the development of science and technology.

Examples of modalities, such as consensus conferences (e.g. the Danish Consensus Conferences (Scheufele *et al*, 2021) and citizen juries (e.g. the Nanojury UK (Singh, 2008), have been shown to be compatible with this when the appropriate infrastructure and ethical standards to ensure broad and diverse engagement are taken seriously (Burall, 2018; Jasanoff and Hurlbut, 2018; Kofler *et al*, 2018).

23 https://global-observatory.org/2021/02/24/origins-of-the-global-observatory, accessed on 24/09/22.

Besides direct participation in citizen engagement of science, there are more societally embedded ways in which people can shape science.

It is often argued that as citizens in democratic states, people can use their voting power to elect politicians and participate in referendums according to their outlook. It could be argued therefore that "*representative democracies like the United States… already have administrative and legislative structures in place to accommodate citizen feedback*" (Scheufele *et al,* 2021: 1).

The World Bank produced a policy research paper on "Citizen Engagement in Rulemaking Evidence on Regulatory Practices" (Johns and Saltane, 2016). It scored the extent to which rulemaking processes are transparent and participatory in 185 countries; USA came out on top (scoring 6/6) and Norway was ranked as good but not great (scoring 5.6).

However, countering this, Scheufele et al. (2021: 1) argued that "*the challenges posed by postnormal scientific developments such as CRISPR [the most popular form of gene editing] demand new and more effective infrastructures for citizen engagement that go beyond classical modalities of civic participation*".

Power through purchasing or protest?

In capitalistic society, regardless of how limited the options are for meaningful and effective public engagement, an important way for citizens to participate in the regulation, or acceptability, of science – particularly in the case of GM products – is as consumers (Bodiguel and Cardwell, 2010; Newell, 2010).

In the UK, GM tomato paste initially outsold its non-GM equivalent by 200%, presumably because they were 18% cheaper (Burke, 2012).

Another mechanism for people to participate in the process of regulating GMOs is by protesting. Bodiguel & Cardwell (2010) argued that protests have had a greater effect on GMO regulation than more legitimised or mainstreamed forms of public engagement. These can take various forms like public demonstrations to create noise and visibility of issues and viewpoints that are otherwise felt to be underrepresented by protesters.

Protests can also take the practice of direct action. For example, between 2000-2010 nearly all 54 GM crop field trials in the UK were vandalised.

Although a sacrosanct "right" in democratic countries, protests operate by disturbing and disrupting the status quo and always raise vivid debates about appropriateness and effectiveness.

People turn to protest, and sometimes even violent protest, when they do not feel heard and when the experience of inequality and deprivation and feelings of injustice, moral indignation become overwhelming.[24] Despite their controversial status, the wider influence of protests should not be underestimated.

Related to this, it is interesting to note that when anti-GM protesters in the UK have been taken to court, there has been a high acquittal rate when faced with a trial by jury, whereas the opposite is true when juries have not been given the deciding factor (Bodiguel & Cardwell, 2010).

This likely follows from juries and protesters being reflective of each other in important ways, *e.g.* in terms of public representation.

Engaging civil society as a proxy for citizen views

Civil society organisations, or NGOs, in particular, but also other representative bodies like potentially the media[25], can at least partially fill in this gap by serving as citizen proxies and pressuring policy-makers and scientific developers. Indeed, Newell (2010: 473) applauded the role of civil society organisations, describing them as constituting "*an effective presence in global negotiations*".

Macnaghten and Habets (2020: 355) contend: "*NGOs – and later other actors including the media – … operate at the interface between governments and concerned publics*".

They continue: "*NGOs mobilized public support through a range of broader arguments: that GM foods would lead to an inevitable loss of consumer choice, that decisions had already been taken outside the public sphere, that GM crops would lead to the corporate control of food systems, that GM crops and foods would benefit only multinationals and large-scale farmers, that the technology was "unnatural" and that there would be probable unpredicted effects beyond the reach of risk science*".

NGOs are also in a unique position to be able to draw from the local, situated knowledge and perspectives of their members while also implementing less orthodox approaches to directly addressing society and enacting change, such as public campaigns and protests (Ferretti and Pavone, 2009).

This can lend such organisations ethical and values-based insights, capacity to critically engage with questions of power, and a means for public participation of science, all of which can broaden the debate and discussion, and enact political change (Helliwell *et al,* 2019).

Inevitably, this leads to publicity – for good or ill.

In the case of the FlavrSavr tomato, aggressive newspaper campaigns against GM food led to consumers no longer purchasing the GM tomato paste and the retailers, Safeway and Sainsbury's, removing it from their shelves (ibid; Price, 2021).

This counted as a 'win' for civil society but the spectre of "*frankenfood*" had a long half-life which made productive engagement between "sides" increasingly difficult.

Getting the balance right between citizens and professionals

This review has mainly discussed the importance of including citizens in the regulatory process of GM, rather than just relying on academics, professionals or experts. This is because "experts" are, in the main, already sufficiently, and potentially, overly, represented.

24 https://blogs.lse.ac.uk/politicsandpolicy/how-effective-are-protests, accessed 25/09/22

25 Perhaps it goes without saying that there is a tension and inconsistency between the role of the media/journalism to hold the powers that be to account and a media outlet's vested interests. See Cook et al. (2004) in references for an analysis of how different newspapers were skewed in their reporting of the GM Nation? debate.

Nonetheless, it is important to note that both lay people and experts need to be included in a balanced configuration. As Kurian and Wright (2012: 17) explained, "*good decision-making must involve both the public and experts in processes where meaningful deliberation can take place and inform in material ways the decisions that emerge from public institutions*".

Aside from the reasons already discussed, such as informing policy and facilitating public acceptance, it is important to engage the two groups – citizens and professionals – as a good in itself, *i.e.* "*to bring science and people closer together*" (Price, 2021: 6).

Doing so can facilitate both active citizenship and science as a public good. This can better embed or entangle science with society, and so multiply their interactions.

The assumption here is that this would help develop a more socially-conscious science and a more scientifically-informed society, and so a greater appreciation of science governance as a whole (Chilvers and Macnaghten, 2011).

Bringing citizens and experts closer together can, additionally, broaden the discussion by including value-based judgements, as well as expose "*value-laden framings and assumptions*" (Science and Technology Committee, 2011: 64) that are hidden by a veneer of apparently objective and neutral scientific rhetoric.

In this sense, it can encourage institutional reflexivity (the importance of which was described earlier) in order to "*enable groups of people, often incumbent in positions of power, to examine the institutional configurations shaping their decision-making, consider the assumptions that sit behind said configurations and understand their impact on practice, and explore how alternative assumptions and commitments may produce different practices*" (Smith *et al,* 2021: 744).

On the other hand, including value-based inputs coming from different walks of life can help incorporate local knowledges, contexts, identities and concerns, and culturally-mediated lived experiences (Price, 2021).

This can throw up new desires, alternatives and uncertainties, as well as the potential for further innovation.

The 2011 Science and Technology Committee, noted:

"*The need for value-based considerations to be considered alongside scientific ones has been a strong theme of this report … According to Sir Roland [Jackson, then Chair of the Science in Society Panel, Biotechnology and Biological Sciences Research Council and later Executive Chair of Sciencewise], while the voice of both academia and industry is 'strongly' heard across government, 'we do not hear so clearly in an integrated way the voice of the rest of civil society' which 'tends to have to shout from the sidelines, because it is not involved in Government structures'*".

A NICE balance

In other words, "*lived experiences can complement scientific knowledges*" (Price, 2021: 7). Indeed, it can be argued that the two deserve equal weight.

NICE (2015: 6) effectively did so in its practices:

"*The lay members of NICE's committees have equal status to the professional and practitioner members and their perspectives have equal value when considering the evidence. The views of all members of a NICE committee are given equal weight during discussions about the interpretation of the evidence and the lay members bring a unique perspective. The objective consideration of the evidence, combined with the diverse perspectives of the committee members, ensures that no one 'voice' is able to dominate when drawing up the recommendations*".

Putting citizens and professionals on an equal footing in the public engagement of science, at a minimum, ensures that neither voice is heard louder than the other. This, furthermore, enables value-based considerations to be taken seriously "*to allow others to make decisions according to their own values*" (Macnaghten and Habets, 2020: 361).

To get to the point of reaching a balance between a lay public and experts, and between empirical facts and value-based judgements, further work needs to be done.

Binimelis and Myhr (2016: 19) point to the example of Norway as a case in which "*members of the Board, scientists and stakeholders were involved in the identification of parameters and questions to be included in the guidelines for conducting assessment of sustainability*".

Macnaghten and Habets (2020: 361) go further and explain that "*to operationalize such forward-looking norms and values in practice will require more profound collaboration between the plant sciences and the social sciences (and the broader humanities), alongside a deep and continuous engagement with societal actors at all stages of the research process*".

Thus, the bigger project of developing meaningful and effective citizen engagement of science clearly requires systemic changes, which are likely to be on-going indefinitely as new lessons are learned and more stakeholders become involved.

Taking the point further, Montenegro de Wit (2020) explains that citizens need to be given not just the right or an invitation to be in the same spaces as scientists, but the capacity to create or claim those spaces and so define them on their own terms. This would be part of the larger goal of a deep democratisation of science governance.

Applying lessons from Norway: the case of GM maize 1507

The case of Maize 1507 in Norway provides a profound example of applying the principles of equity between the social and the scientific in the assessment of genetically engineered crops.

In 2017, Norway rejected, by Royal Decree, the import of a GM maize line, among other GM plants (namely, three oilseed rape lines) that were authorised by the EU[26].

Maize 1507, owned by DuPont Pioneer and Dow AgroSciences LLC, is an herbicide tolerant and insecticide-producing strain, able to withstand repeated sprayings with the herbicide glufosinate ammonium[27] and resistant to certain *Lepidoptera* species.

Although the Norwegian Scientific Committee for Food Safety (Vitenskapskomiteen for mattrygghet; VKM) concluded that the GM maize line was safe in regard to health and environmental risks, the Norwegian Biotechnology Advisory Board advised the government to refuse its approval due to overriding issues related to lack of societal benefit, ethical acceptability and sustainable development.

This is noteworthy for two related reasons: the first is that safety risks are not the determining factor for the acceptability of novel organisms in a national food system. The second is that other, more publicly determined considerations, have the veto over safety risks.

In terms of legal regulation, what underpins Norway's broader assessments of GMOs is the Gene Technology Act of April 1993. As outlined by Chapter 1, General provisions, Section 1, Purpose of the Act:

"*The purpose of this Act is to ensure that the production and use of genetically modified organisms and the production of cloned animals take place in an ethically justifiable and socially acceptable manner, in accordance with the principle of sustainable development and without adverse effects on health and the environment*."[28]

The inclusion of determining factors of ethical justification, social acceptance and the principle of sustainable development, along with more scientifically testable adverse effects on human health and the environment, thus make the Norwegian legal process more restrictive for granting permission to the use of GMOs (Kallerud, 2004).

Furthermore, the Act requires a continuous discussion to determine what counts as acceptable to both Norwegian society at the time (the societal utility principle) and the wider world at a longer timescale (the sustainable development principle).

26 https://bch.cbd.int/database/attachment/?id=19306, accessed on 22/09/22.

27 https://www.arc2020.eu/pioneers-gm-maize-1507-a-case-history, accessed on 22/09/22.

28 https://www.regjeringen.no/en/dokumenter/gene-technology-act/id173031, accessed on 22/09/22.

The Norwegian government therefore takes a case-by-case review, which is partly based on public hearings, as part of the findings and advice from the Norwegian Biotechnology Advisory Board (Myhr *et al,* 2020).

In the case of Maize 1507, a national public consultation was carried out in 2003-2004 (ibid, ref 32). A majority of the groups that attended opposed allowing the GMO maize line to enter Norway. This led to the common recommendation – 15 out of 19 people – of the Norwegian Biotechnology Advisory Board in 2013 to place a ban.

This was based on the "*importance to assessments that GM plants such as maize line 1507 do not contribute to sustainable development in a global context and that this plant is neither of benefit to society in Norway nor ethically justifiable*".[29]

Being of benefit to society is particularly powerful in that developed or imported novel organisms must be wanted or needed by Norwegian citizens, and not simply benign. In addition considerable weight is given to whether the deliberate release of the organism will be of benefit to society.

On this basis, by Royal Decree of 2 June 2017, the Norwegian Ministry of Climate and Environment – the government ministry that holds the power for permitting or prohibiting GMO cases – declared that maize 1507 had "*no special traits that are beneficial to Norwegian users*".

The Royal Decree went further, giving moral grounds, for the refusal to authorise the maize, which were taken as sufficient by themselves: "*…large consumer groups have clearly expressed their ethical objections regarding the GMOs at hand"* and *"factors such as solidarity with farmers in developing countries and establishment of sustainable agricultural production systems are considered important in issues relating to GMOs*".

What we can take from Norway is that narrow risk parameters are not adequate for assessing genetically engineered organisms and that this need for wider assessment should be codified into law.

29 Ref 26, Royal Decree of 2 June 2017, *op cit*

Science in service of society

The Norwegian assessment system for GMOs gives a real-world example of how we can move away from risks and safety issues to broader conversations about how science and technology can better serve society (Macnaghten and Habets, 2020).

As Jasanoff and Hurlbut (2018: 437) explain, it is "*insufficient if the conversation is too quickly boxed into judgements of the pros and cons, risks and benefits, the permissibility or impermissibility of [e.g.] germline genome editing, and so on*".

Citizen engagement clearly needs to be more than addressing risk assessments of new scientific technologies. Instead, it should work towards determining how these technologies are conducive to, or at least consistent with, our notions of human/societal flourishing (Khushf, 2006).

Learning from Norway, three things need to be in place for this to happen:

1. A legal act that specifies the requirement of cases of GMOs (and scientific technology in general) to be useful to society, ethically justified and contribute to sustainable development.

    i. An independent body needs to be put in place to honour and carry out this act, which will have direct influence over political decision-making.

    ii. These considerations have to be given such legal weight that they can veto risk assessments to health and the environment.

    iii. Incorporating sustainable development considerations broadens the discussion to transnational/global and longer-term implications.

2. The criterion of being either needed or wanted overrides cases that are benign or neutral.

3. Citizen engagement as part of bottom-up public representation needs to continuously feature in decision-making to assess people's moral view and the ethical norms.

Conclusion

The need for better governance of science comes from the idea that both policy makers and science are supposed to respond to the needs of society (Singh, 2008).

We agree with Kurian and Wright (2012: 17), that this necessitates "*opening up institutional participatory mechanisms to allow for political deliberation, bottom-up decision making, and active citizenship*".

Without this, how can authorities "*hear the voices from the ground, how can they direct their research to meet those problems?*" (Singh, 2008: 30).

It is, therefore, necessary to "*understand, develop and innovate new governance mechanisms*" (Chilvers and Macnaghten, 2011: 7).

Researchers have called for the application of "i*ntegrated systems thinking to improve our 'science of public engagement*'" which can be developed by "*sustained interdisciplinary collaborations across the social sciences and natural sciences to develop and evaluate modalities for public engagement that are responsive to stakeholder needs and designed to maximize intended outcomes*" (for example Scheufele et al. 2021: 6).

But it is important not to be blindsided by 'science-speak'. This is not an academic exercise carried out at arms-length from real power and policy.

We have touched on the differences between citizens and professionals, and the matter of NGOs as citizen proxies. The issue of hidden and real agendas is a core concern in this regard. Language can but must not be used to disguise or divert attention for these questions.

This means time and resource investment into the process along with a commitment to honesty and transparency. Yet this is needed because as Dietrich and Schibeci (2003: 381) explained, "*only such a deep consideration can avoid the polarized attitudes and deep suspicions that we have seen arise in places such as Britain*".

Certainly, the historical and widespread backlash against GMOs amongst consumers and in certain parts of the agriculture sector is a prime example of this. Indeed, this continues today:

"*Various civil society organizations and organic farmers therefore warn against a one-sided approach of productivism, which today is expected to be delivered inter alia by gene editing. They argue that such a productivist perspective frames the problem of food security as a lack of sufficient quantities of food, rather than as a lack of access and control of food systems*" (Macnaghten and Habets, 2020: 354).

Signs of change?

As has been demonstrated in some places (such as Norway and Denmark), there has been some movement away from using citizen engagement as a means of encouraging people to trust science towards it being part of the governance of science.

There has, in the literature on governance and policy, been a greater emphasis on dialogue, as opposed to one-way communication (*e.g.* the deficit model), and upstream engagement, which occurs early on in the scientific development process.

However, as the UK government consultation on gene editing and the subsequent actions by government, its agencies and the research establishment show, any movement towards meaningful citizen engagement is at best partial and halting (A Bigger Conversation, 2022).

The EU deliberations on gene editing are possibly more receptive but that may be overly optimistic (A Bigger Conversation, 2021). Especially if we consider perspectives on citizenship.

We need greater clarity on what we mean when we talk about the public or citizens, because we are the public – *i.e.* we are also citizens of society – and, in an important sense, that includes scientists and policy makers. We all have our own version of what we want to happen or be excluded in society.

There is no 'monolithic entity' that is the public; "there are many different 'publics' whose values, beliefs, socioeconomic circumstances, and risk perceptions are varied" (Scheufele et al., 2021: 2).

This counters the dominant policy view that there is one general public "*made up of relatively ignorant consumers*", whereas there are in actuality "*many publics, who may be wary and rightfully skeptical, but have rich contextual and specific knowledges to contribute in a genuine, interactive discussion with policy processes*".

Which leads to the thorny question of the downsides and pitfalls of public participation in the regulation of science, including GM science, in the UK and elsewhere.

Some commentators have pointed to the significant cost in time and money. As an example, Burall's (2018) consortium model for regulating gene editing was estimated at $700K-1.5M per year, although they upheld the view that the consequences of its absence would cost much more.

Others have pointed to the issue of making the science more vulnerable, e.g. to industry competition, as it becomes more transparent (Hartley and Millar, 2014).

As we have indicated, identifying the most effective place for effective citizen engagement, is probably the pivotal issue as it encompasses all of the others.

It is unrealistic to idealistically dismiss the value for money, 'most bangs for your bucks' consideration. Not least because, as jury service and attendance at parish council meetings shows, citizen engagement is also limited by the time, patience and willingness of citizens.

Nonetheless, these have to be faced up to if we are to have science and technology in the service of society.

As Khushf (2006: 258) declared, "*the more radical the technology, the more radical the ….. challenges*". He identified "ethical", we would add practical and political. To this end, we believe the Norwegian system outlined above – adapted for different political systems and societies – is a credible way forward.

Recommendations

This review has primarily looked at citizen engagement in the regulation of gene editing and other genetic engineering technologies. It is clear, however, that many of the questions considered here apply to a range of emerging and so-called "disruptive" technologies – and so, therefore, can the conclusions we have drawn above and the recommendations below.

Overarching perspective

1. The governance of science and technology should be based on a framework broader than narrowly focused risk and benefit assessments within a solely economic or short-term context. This requires consideration of why a technology or development is wanted or needed within ethical, equitable, democratic and sustainability parameters. It also requires a rebalancing of power and input relationships pivoting around an imperative of meaningful citizen engagement.

2. Considering science and technology governance as an ethical and communal task in this way requires a range of scientific disciples and not just geneticists and technologists to be actively engaged with equal standing.

3. Existing agreements, such as the Cartagena Protocol on Biosafety to the Convention on Biological Diversity, which reference and imply such moves and rebalancing, provide legitimacy and can provide the foundations for citizen-based innovation and governance of science and technology.

Key characteristics

4. It is clear that there can be no single model of citizen-based engagement and governance of science and technology. However, some characteristics seem to be especially important for consideration:

4.1 The process needs to recognize that there are "many publics" and not one monolith. It needs to capture this diversity and local contexts.

4.2 Therefore, a collaborative, multi-disciplinary and multi- stakeholder approach should be adopted with everyone's voice and values having equal status.

4.3 The role of government, government agencies and research establishments need to be transparent in terms of scope and language. For example, if government departments are leading or framing the discussions, they, nor their advisors and staff, should pretend to be impartial or hold themselves up as objective or "honest brokers". Similarly, the vested interests of research institutions and researchers should be transparent and these bodies and people should not be presented as impartial experts.

4.4 "Institutional reflexivity" needs to be fostered and become embedded in the culture of science and technology bodies. They must create space for meaningful citizen engagement beyond narrow stakeholder perspectives and be responsive to this engagement.

4.5 Citizen engagement must go beyond the "deficit model" of educating, teaching and instructing the public.

4.6 Engaging citizens early on (or "upstream") in the development of technology is important but this should not exclude engagement later in the process at the implementation and post-release stages.

4.7 Consensus conferences and citizen juries have been shown to be valuable forms of engagement, especially "upstream" but other models need to be developed for engagement at detailed, technical stages.

Learn and test

5. It is important for countries like the UK and, indeed, a number of EU countries to examine and learn from countries such as Norway and Denmark who have committed to and sought to implement more citizen-based engagement and governance of science and technology.

6. To this end, we would like to see the creation of an Observatory of Citizen Engagement established by civil society bodies and academic researchers to map, evaluate, formulate and disseminate "best practice" of citizen engagement and governance of science and technology.

7. We would like to see the UK, the EU and other parts of the world follow Norway's lead in seeking to commit and embed citizen engagement and governance in law and in the culture of relevant institutions.

In the UK

8. We would like to see the establishment of a legally based independent body tasked with overseeing and reviewing the development and implementation of genetic technologies and ensuring effective citizen engagement and governance of these technologies.

9. All regulations relating to genetic technologies encompass a requirement to justify their use in terms of social utility and equity, ethical norms and sustainability.

10. All risk/benefit assessments obliged to include dissenting perspectives

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