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## **A Review of Deliberative Public Engagements with Climate Geoengineering**

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## **Climate Geoengineering Governance (CGG)**

Climate Geoengineering Governance (<http://geoengineering-governance-research.org>) is a research project which aims to provide a timely basis for the governance of geoengineering through robust research on the ethical, legal, social and political implications of a range of geoengineering approaches. It is funded by the Economic and Social Research Council (ESRC) and the Arts and Humanities Research Council (AHRC) - grant ES/J007730/1

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The CGG Working Paper series is designed to give a first public airing to a wide range of papers broadly related to the project's themes. Papers published in this series may be, but are not necessarily, early outputs from the project team; equally they may be from other authors, and reflect different perspectives and different issues from those directly pursued by the project itself. The aim is to promote vigorous and informed debate, in a spirit of pluralism.

What the working papers have in common is that they will all be at an early stage of development, prior to full publication. Comment and response, at any level of detail, is therefore doubly welcome. Please send all responses in the first instance to the authors themselves - each paper contains a correspondence address. We will be looking for opportunities to use the website or other project activities to give a wider airing to any dialogues and debates that develop around a paper or issue.

### **About the Authors**

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# **A Review of Deliberative Public Engagements with Climate Geoengineering**

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## **Abstract**

In a short space of time, climate 'geoengineering' has been added to the list of technoscientific issues subject to deliberative public engagement. Here we analyse this rapid and intense trajectory of publicization, and explore the particular manner in which the possibility of geoengineering has been incorporated into the field of 'public engagement with science' (PES). We describe the initial framing of geoengineering as a tractable deliberative object, and subsequent attempts to 'unframe' the issue by placing it within broader discursive fields. The tension implicit in these processes of structured debate – how to turn geoengineering into a workable object of deliberation without implying a commitment to its viability as a policy option – raises significant questions about the role of PES scholars and methods in 'upstream' public engagement processes.

## 1. Introduction

In a short space of time, climate 'geoengineering' has been added to the list of technoscientific issues subject to deliberative public engagement. Since 2009, a series of stage-managed forums have elicited and explored public views on the large-scale manipulation of the Earth's climate system. A range of discussion platforms have explored the prospects of Carbon Dioxide Removal (CDR) and Solar Radiation Management (SRM) – the two main categories of technology proposal into which 'geoengineering' is commonly divided. Although most of these exercises have taken place in the United Kingdom, other forms of public engagement have been tried elsewhere in the world, and the number and range of deliberative experiments on this issue is likely to expand in the future (e.g. Bostrom *et al.*, 2011; Kahan *et al.*, 2012; Mercer *et al.*, 2011; Merk *et al.*, 2014).

This paper analyses this rapid and intense trajectory of publicization of geoengineering, and explores the particular manner in which the set of issues that have emerged around geoengineering have been incorporated into the field of 'public engagement with science' (PES). In a recent reflection on the future of PES research, Stilgoe, Lock and Wilsdon emphasize "the limits of evaluating individual exercises in their own terms" and call instead for "critical, evaluative research that looks not at particular dialogues, but at the broader project of dialogic governance" (Stilgoe *et al.*, 2014: 6). Here we heed this advice and offer a second-order examination of how the dialogic governance of geoengineering has evolved in the UK since the Royal Society called in 2009 for a broad and active programme of public deliberation – a call that was immediately taken up by the UK Research Councils and led to a string of public forums where the desirability and implications of different geoengineering proposals were tackled in formal debate.

As Stilgoe, Lock and Wilsdon argue, examining how projects of dialogic governance emerge around particular issues requires explicit attention to “the institutions that support public engagement as part of the experimental apparatus” (*ibid*: 6) as well as, we might add, a reflexive examination on the part of PES scholars of the role that their own technical and methodological innovations play in the pursuit of evermore productive deliberative processes (Braun & Schultz, 2010; Felt & Fochler, 2010; Lezaun & Soneryd, 2007). We have therefore complemented our analysis of the literature that has emerged from the deliberative public engagements of the last five years with a number of interviews with PES scholars who were directly involved in the design, facilitation and analysis of public debates on geoengineering. In these interviews, we invited them to reflect on their experiences in the conduct of public deliberation, and to compare these experiences with previous engagement activities on other controversial technoscientific issues. Finally, we have also drawn on our experience in planning and managing deliberative workshops on geoengineering and climate change.

What emerges from our analysis is what we will describe as a process *unframing*. By this we mean a deliberate effort on the part of PES researchers to expand the discursive and analytic frame of reference for debate and thereby control the peculiar performative dimension of public engagement with climate geoengineering. An initial attempt to establish geoengineering as a discrete and well-characterized object of deliberation, most clearly expressed in the *Experiment Earth?* public dialogue sponsored by UK Natural Environment Research Council (NERC) in 2010, was soon followed by a second wave of dialogic experiments that actively sought to problematize geoengineering as a self-contained “engagement matter” (Irwin *et al.*, 2013). This process of *unframing* was supported by a series of methodological innovations in the conduct of public deliberation, from a redefinition of the role of (natural-scientific) experts in articulating the matters under consideration, to a conscious effort to blur the boundaries of geoengineering as a discrete object of deliberative inquiry.

While similar examples of *unframing* are noticeable in the PES treatment of other controversial domains of technoscience, particularly as public forums have moved 'upstream' of research and development trajectories (Wilsdon & Willis, 2004; Rogers–Hayden & Pidgeon, 2007), what is remarkable about the case of geoengineering is the speed and deliberateness with which the PES community has reversed some of the discursive lock–ins found in early formulations of geoengineering as a matter of public policy. Our interviews with PES researchers suggest that this effort to place the issues within a broader, looser range of matters of concern was driven by the fear that geoengineering was being stabilized too quickly as a self–evident policy option, not least by the apparent success of PES initiatives in elucidating a set of stable public concerns and imaginaries. This fear was not exclusive to social scientists and PES researchers, however. It was shared by many of the natural scientists involved in the initial scientific and technical assessments of geoengineering proposals (Stilgoe 2015). What ensued was a distinct methodological and political challenge: how to make planetary–scale geoengineering amenable for public deliberation without in the process making it “more real” as a policy option.

## 2. From *Geoengineering the Climate* to *Experiment Earth*?

The report issued by the Royal Society in September 2009, *Geoengineering the climate: Science, governance and uncertainty*, represented a landmark in the emergence of climate geoengineering as an object of science policy interest in the UK and beyond. The document, prepared by a working group that included social scientists and legal scholars, achieved several feats in structuring the incipient public debate on geoengineering.<sup>1</sup> First, it carved out geoengineering as a specific and relatively self–contained object of public debate, offering what

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<sup>1</sup> With the inclusion of social scientific expertise in its working group, as well as in its valuation of public and civil society views, *Geoengineering the climate* followed previous Royal Society initiatives on emerging or publicly controversial technologies, such as those conducted in the domains of nanotechnology (Royal Society and Royal Academy of Engineering, 2004) and personalized medicine (Royal Society, 2005).

would quickly become a canonical definition – “the deliberate and large-scale intervention in the Earth’s climatic system with the aim of reducing global warming” (Royal Society, 2009: ix). Second, it provided a taxonomy of geoengineering “methods,” organised around the distinction between carbon dioxide removal CDR techniques and SRM techniques. The Report identified the most relevant technologies in each of these two classes and provided an initial evaluation on the basis of four technical criteria: effectiveness, timeliness, safety and cost (*ibid*: 6). Third, the report placed the overall discussion of geoengineering within a set of considerations that emphasized the governance challenges posed by this response to climate change. Here, the report situated geoengineering alongside other controversial emerging technologies, drawing an explicit parallel with genetically modified crops:

“Just as field trials of genetically modified crops were disrupted by some NGO’s, it is foreseeable that similar actions might be aimed at geoengineering experiments involving the deliberate release of sulphate or iron (for example) into the air and oceans” (*ibid*: 15).

In this context, the report drove home the message that “the acceptability of geoengineering will be determined as much by social, legal and political factors, as by scientific and technical factors” (Royal Society, 2009: 50). Finally, the report called for “an active and international programme of public and civil society dialogue... to identify and address concerns about potential environmental, social and economic impacts and unintended consequences” (*ibid*: xii), making research into public attitudes and meaningful public engagement a precondition for advancing a responsible R&D agenda.

To support the deliberations of the working group, the Royal Society commissioned a preliminary investigation into these public views (Royal Society, 2009: 43). This research, conducted by the firm British Market Research Bureau, included four focus groups with participants stratified by environmental beliefs and behaviours, and a telephone survey with a nationally representative sample of 1,000 respondents. Whilst the survey method served to elicit rudimentary support or opposition for the forms of geoengineering under consideration, the focus groups method allowed for a more nuanced discussion of attitudes towards

climate change and climate politics before going on to discuss specific geoengineering ideas. Perceptions of geoengineering were shown to be generally negative, but complex and dependent upon the specific proposal under consideration. Importantly, the focus group discussions suggested that, rather than inducing the feared 'moral hazard' – whereby the prospect of geoengineering would weaken efforts to mitigate climate change through the reduction of greenhouse gas emissions – the emergence of a geoengineering option might instead galvanise such efforts (c.f. Corner & Pidgeon, 2014). On the basis of this initial research the report concluded that "further and more thorough investigations of public attitudes, concerns and uncertainties over geoengineering should be carried out in parallel with technological R&D, and accompanied by appropriate educational and knowledge exchange activities, to enable better informed debate and policy making" (Royal Society, 2009: 43).

In response to this call, NERC joined forces with the Sciencewise Expert Resource Centre, the Living with Environmental Change Partnership and the Royal Society to conduct the first large-scale deliberation exercise on geoengineering, the *Experiment Earth?* public dialogue (NERC, 2010). Carried out by the research firm Ipsos MORI between February and May 2010, this was a multi-pronged exercise designed to "identify and understand public views on geoengineering research and deployment, including its moral, ethical and societal implications" (NERC, 2010: 1). Its largest component consisted of three reconvened deliberative workshops, each with ~30 sociodemographically representative participants who met for two full-day discussions (in Cardiff, Birmingham and Cornwall) over the course of two weeks. A section of those who participated in these workshops met for a final meeting at the National Oceanography Centre at the University of Southampton, where they had a chance to discuss again their views with NERC staff, scientists and climate stakeholders. The dialogue also convened two 'targeted discussion groups' (in Cardiff and Birmingham), comprising young people and people at a high risk of flooding respectively. Finally, the exercise included a qualitative online survey with 65 respondents selected from stakeholders in community groups, and three open access events held in Cardiff (with school children), Birmingham (a drop-in

event at the city's science museum) and Oxford (a discussion with Professor Andy Ridgwell at Science Oxford).

The dialogue activities drew heavily on the taxonomical work produced by the Royal Society report. Facilitators divided the proposals into CDR and SRM geoengineering varieties, and presented participants with nine proposals to consider (five CDR proposals and four SRM proposals), offering for each a short list of potential risks and benefits.<sup>2</sup> The discussions that ensued showed that participants generally had a low level of awareness and knowledge of geoengineering prior to their involvement in the exercise. At the same time, they were keen to discuss the pros and cons of specific proposals. Echoing the focus groups organized by the Royal Society, the discussions did not produce evidence of the expected 'moral hazard'. The views expressed in the deliberative workshops indicated that "it was important to participants that geoengineering should not conflict with mitigation, and wherever possible should augment mitigation efforts" (*ibid*: 2). Perceptions of individual technologies showed more support for CDR proposals than for the SRM alternatives, but again proved to be complex and dependent upon the specific proposal under consideration.

Sciencewise-ERC commissioned an official evaluation of *Experiment Earth?*, which was conducted by the environmental consultancy Collingwood Environmental Planning (Orr *et al.*, 2011). Using as its benchmark Sciencewise-ERC's own principles for best practice in public dialogues on science and technology (Sciencewise-ERC, 2013), this evaluation concluded that *Experiment Earth?* had met the objectives stated by its sponsors. "In terms of scope," the official report also noted, "whilst issues of climate change mitigation were raised by participants and there was some desire to situate the discussions in a wider context of environmental change, the participants felt able to raise key issues and felt the exchanges with scientists were extremely valuable" (Orr *et al.*, 2011: 1).

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<sup>2</sup> The five CDR 'techniques' or 'technologies' were biochar, liming the ocean, iron fertilization, air capture, and afforestation. The four SRM technologies included in the discussion were stratospheric aerosol injection, mirrors in space, white roofs and cloud whitening.

### 3. Setting the stage for a second wave of public engagement

After 2010, two UK Research Council (RCUK) initiatives provided the funding and institutional stimulus for a further round of public deliberation on geoengineering. The Integrated Assessment of Geoengineering Proposals (IAGP), an initiative sponsored by the Engineering and Physical Sciences Research Council (EPSRC) and NERC “to conduct an objective, policy-relevant assessment of geoengineering proposals,” incorporated from the start a stream of workshops designed to “involve and engage with the lay publics and informed science-policy stakeholders”. This included four one-day deliberative workshops held in Birmingham, Cardiff, Glasgow and Norwich in early 2012 (Corner *et al.*, 2013). In parallel, the Stratospheric Particle Injection for Climate Engineering project (SPICE), an initiative funded by EPSRC, NERC and the Science & Technology Facilities Council to assess the feasibility of stratospheric aerosol injection, developed at the request of RCUK a programme of public dialogue and stakeholder engagement activities, including three deliberative workshops held in Cardiff, Norwich and Nottingham in February 2011 (Parkhill & Pidgeon 2011; Pidgeon *et al.*, 2013; Parkhill *et al.*, 2013; Stilgoe *et al.*, 2013; Stilgoe 2015).

Two further independently-funded public engagement exercises took place during the same period. First, a series of focus groups on SRM were carried out in Durham, Newcastle and London in December 2011 (Macnaghten & Szerszynski, 2013). Second, in the summer of 2012 a group of researchers at the University of East Anglia affiliated with the IAGP project conducted an integrative analytic-deliberative Deliberative Mapping technology assessment of geoengineering proposals, consisting of two parallel strands of engagement: one for citizens and one for specialists (Bellamy *et al.*, 2013; Bellamy *et al.*, 2014).

Each of these experiments in deliberative public engagement took place during a fairly short span of time (2011 – 2012) (see Table 1), and was designed and carried out by a tightly-knit community of PES researchers, with experts and facilitators often participating in, or advising on, more than one exercise. Significantly, this second wave was preceded by critical reviews of the

*Experiment Earth?* dialogue (Corner *et al.*, 2011) and of geoengineering engagement and appraisal more generally (Bellamy *et al.*, 2012). These reviews focused on the methodological and processual aspects of previous inquiries into public attitudes on geoengineering, and identified problematic areas in the initial operationalisation of geoengineering for deliberative dialogue.

**Table 1. Deliberative public engagements with geoengineering**

Engagement	Methodology	Reference(s)
Royal Society focus groups (< September 2009)	Four focus groups of participants stratified by environmental beliefs and behaviours <sup>†</sup>	Royal Society (2009)
Experiment Earth? public dialogue (September 2009)	Three two-day reconvened deliberative workshops (n = ~30 each) of sociodemographically representative participants (Birmingham, Cardiff, Cornwall); two 'targeted discussion groups' of young people and people at a risk of flooding (n = 10 each) (Birmingham, Cardiff); three open access events (Birmingham, Cardiff, Oxford) <sup>†</sup>	NERC (2010); see also Corner <i>et al.</i> (2011)
SPICE deliberative workshops (February 2011)	Three one-and-a-half-day reconvened deliberative workshops (n = ~10 each) of sociodemographically representative participants (Cardiff, Norwich, Nottingham)	Parkhill & Pidgeon (2011); Pidgeon <i>et al.</i> (2013) see also Parkhill <i>et al.</i> (2013); Stilgoe <i>et al.</i> (2013); Stilgoe (2015)
SRM focus groups (December 2011)	Seven three-hour focus groups (n = ~7 each) of sociodemographically representative participants (Durham, London, Newcastle) stratified by shared lifeworld experiences	Macnaghten & Szerszynski (2013)
IAGP deliberative workshops	Four one-day deliberative workshops (n = 11 each) of sociodemographically representative	Corner <i>et al.</i> (2013)

(Spring 2012)	participants (Birmingham, Cardiff, Glasgow, Norwich)	
Deliberative Mapping (Summer 2012)	Two two-day reconvened citizens' panels (n = ~7 each) of sociodemographically representative participants (Norfolk) stratified by gender as part of a larger process also involving specialists	Bellamy <i>et al.</i> (2014); see also Bellamy <i>et al.</i> (2012); Bellamy <i>et al.</i> (2013)

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<sup>†</sup> These engagements also included non-deliberative engagement elements, i.e. surveys. Acronyms: Integrated Assessment of Geoengineering Proposals (IAGP) project; Stratospheric Particle Injection for Climate Engineering (SPICE) project; Solar Radiation Management (SRM).

In Corner *et al.*'s (2011) review of *Experiment Earth?* two discursive strategies of this exercise came up for particular criticism. First, facilitators had often used the frame of a climate emergency – an imminent ‘catastrophe’ or ‘crisis’ brought about by runaway climate change or climate ‘tipping points’ – to create decision-making scenarios for workshop participants. This framing, the review noted, not only avoided the thorny question of when to declare a climate ‘emergency’, or who should be in a position to do so. It also created a context that “artificially enhanced the acceptability of conducting research” (ibid: 14), and that favoured in particular those geoengineering proposals that claimed to be fast-acting and highly impactful at reducing global temperature (see also Corner & Pidgeon, 2014; Amelung & Funke, 2015; on emergency framings in the geoengineering debate see Nerlich & Jaspal, 2012; Hulme 2014, pp. 21 – 26; Markusson *et al.*, 2014).

Second, the use of the idiom of ‘naturalness’ to characterize certain geoengineering proposals was thought to have skewed public views on their acceptability. *Experiment Earth?* had concluded that participants preferred interventions they associated with the preservation of “natural systems” or “natural processes.” Yet, the review argued, proposals were sometimes presented in a way that predetermined the public’s answer to this very question. Biochar, for instance, was repeatedly introduced as a “natural process.” Air capture and storage was likened to the use of “artificial trees.” The effect of stratospheric aerosol injections was explicitly compared to that of “volcanic

eruptions” (at a time when the Icelandic volcano Eyjafjallajökull had been a popular news item).

More generally, the review identified a tendency to structure the discussion around discrete and well-characterized technical options. *Experiment Earth?* had adopted the taxonomy of geoengineering proposals presented in the Royal Society report, and much of the discussion in the public workshops was in fact organized around the risk-benefit parameters of individual technologies as defined in that report. Participants were shown the Royal Society’s “map of technologies,” which ranked the nine specific proposals on the basis of their affordability and effectiveness.<sup>3</sup> According to the review, this had limited the ability of participants to explore geoengineering more broadly: whether in relation to alternative ways of tackling climate change, or in terms of its broader political import. Before individual proposals were examined, the review argued, it was necessary to offer the public an opportunity to explore these larger issues at length.

“Future public engagement exercises should take care to ensure that a discussion of technical pros and cons is preceded by an opportunity for social and ethical concerns to be deliberated. This will ensure that geoengineering is framed as more than simply a set of technologies” (Corner *et al.*, 2011: 25)

Bellamy *et al.*'s (2012) review identified a narrowing of framings in geoengineering engagement and appraisal activities more broadly. First, geoengineering proposals had been considered in ‘contextual isolation’ of other options for tackling climate change. Frames highlighting ‘insufficient mitigation’ efforts and ‘climate emergency’ risks served to rationalise the relegation of mitigation and adaptation alternatives. Second, methods of engagement had

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<sup>3</sup> Jason Chilvers and Phil Macnaghten note that *Experiment Earth?* combined features from two of the ideal types of public engagement they identify: it was ‘upstream,’ to the extent that participants were able to explore their initial understanding of the technologies and develop new identities in the process, but it also expressed traits of the ‘honest broker’ model of engagement, a type of dialogue “where the articulation of different policy options associated with a particular branch of science was already mature and social/ethical dilemmas already apparent” (Macnaghten and Chilvers, 2014: 4).

inadequately responded to geoengineering's 'post-normal' scientific context (Funtowicz & Ravetz, 1993). Public participation in high-stakes issues characterized by structural uncertainty demanded a mode of engagement more expansively framed than those of the prevailing surveys, interviews and experiments. Third, the deliberate, tacit or inadvertent exertion of power via framings had led to a premature 'closing down' of policy options, favouring those proposals that were presented as the most 'technically effective' – in particular stratospheric aerosol injection.

Geoengineering engagement and appraisal activities, this review argued, should instead seek to broaden out framings and ultimately 'open up' to diversity and reflexivity, so as to avoid premature sociotechnical lock-in and intractable conflict between divergent values and interests. This was one of the lessons PES researchers should draw from previous programmes of public engagement with controversial technologies, in particular from the experience with genetically modified organisms. As a member of the Deliberative Mapping project team articulated in our of our interviews:

One of the big things for me coming into the geoengineering space is around the framing of these kinds of processes and how at the time all public engagements on geoengineering were focussed around particular geoengineering technologies or comparing particular geoengineering technologies within themselves. So the big thing probably that was brought into this space was to take this kind of opening up approach, to open up the framing and say "Well, actually what is geoengineering trying to attend to? What kind of problems is it trying to address?" I think the whole kind of idea would have been taken from especially experiences around GM I would say (Interview 4)

#### 4. Deepening public engagement, *unframing* geoengineering

The second wave of public engagement exercises would heed the warnings and criticisms in these reviews, which in effect amounted to a call to reverse some of

the key assumptions and understandings built into the project of dialogic governance set in motion by the Royal Society report. The basic format of these new dialogues was very similar to those conducted under *Experiment Earth?* – these were all invited ‘mini-publics’ carefully staged by expert facilitators – but the inputs provided to participants and the framings offered to position geoengineering as an object of discussion were very different from those of the inquiry run by Ipsos MORI. These modifications in the conditions of public deliberation amount to an effort to *unframe* geoengineering as a self-evident “engagement matter.”

A first element in this evolution towards a more open-ended constitution of the issue is the diminished role that scientific experts played in the second wave of deliberative workshops. *Experiment Earth?* had involved scientists and “STEM ambassadors” in all of its events. These experts played a leading role in facilitating the discussion, and in providing technical answers to the queries of lay participants. In contrast, the public engagement events held in 2011 and 2012 sought to create spaces of deliberation that were largely free of expert involvement altogether (other than social-scientific and facilitation expertise, that is) or, in the case of the Deliberative Mapping project, to invert traditional power relations between experts and lay publics by challenging expert views (Bellamy *et al.*, 2014).

In the workshops conducted in the context of the SPICE project, for instance, whilst one scientist from IAGP was available throughout, another from SPICE itself was excluded from a session in which questions for the project were formulated. More acutely, the facilitation of the SRM focus groups conducted in Durham, Newcastle and London did not include any natural scientists, a decision made “to ensure the discussion was not framed by experts” (Macnaghten and Szerszynski, 2013). Even when experts were on hand to provide technical answers, their participation was carefully choreographed to elicit further public (lay) views, rather than to define the parameters of the technologies under discussion or to close particular lines of inquiry. A member of the team that conducted the deliberative workshops for the SPICE project describes the role of the expert in those exercises as follows:

We quite carefully managed her, so before she was allowed to answer anything and the natural thing happened that an expert steps in and everybody starts deferring to her, so we used to just stop her dead ((laughs)) before she could answer any questions. The facilitators would prompt and probe with the publics as to why they were asking what they were asking, what they really wanted to know, really thoroughly exploring with them what was the basis of their questions and once we'd done that then we'd "Right Julia [pseudonym], now please go ahead and answer." So that was quite carefully managed and in the end I got her so well trained that I wouldn't have to say stop; she would just stop herself and go: "So tell me why you're interested?" ((laughs)) It was quite good." (Interview 2)

The scientist in question describes this particular definition of the role of technical expertise in the deliberation process as her personal 'learning curve':

For me, personally, the only technical difficulty for me, the only learning curve, was how to communicate with people. At the end of the day I am still a physical scientist. I do like it to be right, what I'm saying, ((laughs)) kind of thing, so learning to let go of that. I had to also learn how to facilitate, learn how to sit on your hands when someone's saying carbon monoxide when they mean carbon dioxide because what's not important is not that they said the wrong thing, it's the point that they're making and if you do correct them then you shut down their engagement. (Interview 3)

While the scientists involved in *Experiment Earth?* had (in the words of the official report) "revealed (consciously or unconsciously) their own opinions about the technologies under discussion" (NERC, 2010: 78), the careful (self-)restraining of expert input in second-wave deliberations sought to shift the balance away from the clarification of technical questions and towards a deeper articulation of the concerns of lay participants. As the scientist who provided technical expertise in the SPICE workshops puts it:

We tried to not answer technical stuff, not play 'poke the monkey in the cage' kind of thing with the expert. Which is you're trapped in a room with someone who's apparently an expert on climate change so I'm going to ask them all those questions I wanted to ask, like how efficient is a wind farm and is there any point in me unplugging my mobile phone from the charger at night? We tried to avoid that as much as possible and they would often be interrupted with, once they'd posed their question, "Can I just ask you why you're interested in that?" because that's what the facilitators were interested in: "Why's it important to you?" (Interview 3)

In parallel to this repositioning of scientific expertise in the deliberation process, there was a conscious effort to downgrade the status of different geoengineering options. What in *Experiment Earth?* had been presented as geoengineering "techniques" or "technologies" became "proposals" in the Deliberative Mapping project, or "ideas" in the SPICE workshops. A striking example of this attempt to make geoengineering seem less real, while holding it sufficiently in place to eliciting a clear set of public reactions to it, is the use of visual materials in the discussions. *Experiment Earth?* had made an extensive use of images to depict what different geoengineering technologies might look like. The facilitators in second-wave public engagement exercises were careful to identify them as 'artist's impressions' of what are essentially sociotechnical imaginaries (Jasanoff & Kim, 2009). This is how one of the facilitators of the SPICE workshop described the use of visual imagery in those discussions:

We used the ones that were already available, but what we did take great pains to do is to make sure that we labelled everything as such, and said that these are not actual photographs, because some of them do look kind of like photographs, and there were certain ones that we wouldn't use... I mean, for example, I guess, there are some CDR [Carbon Dioxide Removal] sort of artist impressions that do make them look like trees, so we didn't use those sorts of things. We used the sort of ones that look like giant fans really. Well, certainly

that is the way that a lot of people do envision they will look like, rather than more like the things next to the motorways where they look kind of like graters and look quite in keeping with the landscape. And we said: "These are a variety of ways that these things are envisioned, so by no means is this the way" but we labelled everything saying "These are artist impressions" and we would emphasise that as we're going through, so when Julia [pseudonym] did a presentation, if there was photos there, she'd say "This is an artist's impression", if it was. I mean, sometimes with the Biochar stuff it was actually a photo and we said that: "This is a photo of a Biochar"... So it was just reinforcing that, because we were aware that the moment you start giving things pictures and diagrams and stuff – again, it sort of makes it feel like you're a lot further on in the process than perhaps you are but people were quite wise to that. (Interview 2)

Finally, and perhaps most importantly, the exercises in this second wave of public engagement made a clear effort to situate 'geoengineering' within broader discursive fields. This broadening took different forms in each of the deliberative exercises, but the goal was always to break out of the set of assumptions and presuppositions so forcefully inscribed in the format of public dialogue that had emerged out of the Royal Society report.

The workshops conducted by IAGP, for instance, introduced geoengineering proposals as part of a 'societal responses to climate change' frame, rather than treating it as a singular object of debate (Corner *et al.*, 2013). The Deliberative Mapping project forced participants to consider geoengineering proposals symmetrically alongside mitigation options and adaptation (Bellamy *et al.*, 2013; Bellamy *et al.*, 2014). The SRM focus groups went even further, tentatively de-coupling geoengineering from climate change altogether, by addressing the compatibility of geoengineering interventions with different social worlds and political systems, or pursuing the topic within a broader consideration of 'climate technics' (Macnaghten & Szerszynski, 2013).

Several facilitation techniques were used to expand the frame of reference of these discussions. Geoengineering was never introduced at the start of the discussion, with participants having undergone topic-blind recruitment in each case. In the IAGP workshops, geoengineering was introduced alongside mitigation and adaptation after a presentation on climate change (Corner *et al.*, 2013). In the SRM focus groups geoengineering was first introduced seventy minutes into the process, after a long discussion on participants' experiences with weather and climate (Macnaghten & Szerszynski, 2013). The Deliberative Mapping project went further still, allowing the citizens themselves to frame initial deliberations on global environmental challenges, until climate change and the range of responses to it, including some ideas that could plausibly be construed as geoengineering, emerged 'naturally' during the course of the discussions (Bellamy *et al.*, 2014). In the words of one of our interviewees, these facilitation tactics "resituated geoengineering in the context of other climate policy options":

"The Royal Society report had snatched [geoengineering] away from the climate debate, and the Royal Society has particular issues with talking about climate, and talked about [geoengineering] as its own technology to be assessed." (Interview 1).

In contrast, the engagement activities that followed *Experiment Earth?* used new deliberative designs and facilitation tactics to constrain the discursive availability of 'geoengineering' as a self-contained, clearly bounded object of discussion, thus limiting the extent to which geoengineering could be addressed as a technology, or set of technologies, to be assessed on their own merits. As we will see below, this process of *unframing* was a deliberate response to the perceived role that public engagement was beginning to play in reifying geoengineering as policy option.

## 5. Public engagement and the reality of geoengineering

PES researchers have long recognized (and criticized) the perception among policy-makers that officially-sponsored public dialogue offers a shortcut to the acceptance of new or controversial technologies (Wynne, 2006). In the case of geoengineering, a round of deliberative exercises could be seen by scientific and policy actors as a pro forma step before launching a full-blown programme of R&D activities. In the words of one of our interviewees:

This wasn't just an academic problem; it was a practical problem because the way that the social sciences get used within that space could have implications for how people think of questions around public acceptability and the concern that I had then was that I felt there was a danger that the kind of public engagement element could be seen purely in process terms: So, okay, we need to do some public engagement. We've done the public engagement, so now we can get on and do the experiment without really seriously thinking about well, what's the substantive nature of the concerns associated with that technology and what might that mean in terms of whether this test should go ahead or not?" (Interview 6)

The domain of geoengineering brought particular challenges to this question. The UK Research Councils were at the time still uncommitted about whether geoengineering should be a recipient of public research funding, and had commissioned social-scientific research into public attitudes and regulatory implications to help them chart a possible way forward. In this context, public deliberation could play an outsize role in shaping the future of this field, most precisely by "normalizing" geoengineering as both a matter of public debate and a suitable beneficiary of state support. This gave social scientists in general, and PES researchers in particular, an unusual amount of influence, but that influence created its own set of concerns. In the words of a researcher who was closely involved in several of these initiatives:

The speed with which geoengineering has gone from being entirely speculative through the Royal Society report and the various research projects subsequently into something that is seen as very real – even though there is actually no additional knowledge on which to base that reification – is terrifying. (Interview 1)

As this statement suggests, public dialogue could play not merely a legitimizing role, but a performative one as well. That is, it could make geoengineering appear real, and a viable course of action, even in the absence of a proper system of scientific and regulatory scrutiny. This gave public engagement an additional political dimension. In the words of the same interviewee:

The thing I think we all need to be acutely aware of is that in thinking about and doing public engagement, even if we are conscious of the risk of manipulating a particular consensual public, we are also making the technology seem more likely. (Interview 1)

To those committed to public dialogue on geoengineering this posed a pressing challenge: how to create a space for discursive engagement with the issue – how to make the subject tractable to discussion – without in the process enhancing its consistency as a policy object. This conundrum is true of any public dialogue that aims to move ‘upstream’ in the R&D process (cf. Rogers-Hayden & Pidgeon, 2007), but it operated with a vengeance in the case of geoengineering. Not only is there the prospect of ‘moral hazard’, it introduces a new level of complexity to the determination of what counts as a ‘successful’ public engagement process.

Public engagement exercises were proliferating at a time when geoengineering seemed to be quickly becoming part of mainstream scientific and policy discussions – the joint inquiry on geoengineering launched in 2009 by the Science and Technology committees of the US House of Representatives and the UK House of Commons, the 2010 Asilomar International Conference on Climate Intervention Technologies, and the inclusion of geoengineering in the ‘Summary for Policymakers’ issued by the Intergovernmental Panel on Climate Change in

2013 are key markers in the progressive “normalization” of geoengineering as a policy option. In this context, PES activities took a distinctive turn, away from the elucidation of public views on individual geoengineering proposals (or on geoengineering as a whole), and towards deliberative processes that consciously challenged the boundaries of geoengineering as a distinct object of inquiry.

## 6. Discussion and conclusions

Geoengineering represents a very particular object in the historical trajectory of the field of ‘public engagement with science.’ In some respects it represents a high water mark in terms of the influence of structured mini-publics on policy-making, particularly in relation to the formulation of a governmental research funding agenda in the UK. The 2009 Royal Society report, and the subsequent forums sponsored by Research Councils, were attempts to map societal concerns and expectations in anticipation of any substantial public (or private) investment in the development of purposefully designed geoengineering technologies. For instance, SPICE, the first field trial of a stratospheric aerosol injection technology, was accompanied by a substantial effort to engage relevant stakeholder and elicit public views on the merits and risks of this particular experiment and of geoengineering as a whole. Geoengineering could thus plausibly be seen an area where the demand for ‘upstream’ public engagement has been met; if we understand by this the articulation of a space of participation and appraisal that precedes the development of the science and technology in question (Wilsdon and Willis 2004; Wilsdon *et al* 2005; for critical elaborations of the ‘upstream’ concept see Rogers-Hayden & Pidgeon 2007; Stirling 2008).

At the same time, and as we have argued, the case of geoengineering has also made visible some of the challenges and paradoxes implicit in this vision of “early stage” public engagement. Because the project of dialogic governance inaugurated by the Royal Society report unfolded in the absence of a previous spirited public debate on these issues, designers and facilitators of public engagement events had to construct the topic of geoengineering from scratch,

for participants who were largely ignorant of the matter at hand and had to be equipped to discuss the subject in the course of the deliberation (Corner *et al.*, 2012).

Furthermore, the familiar challenge of how to frame a controversial technology for public dialogue was here exacerbated by the particular connotations of 'geoengineering' as a mode of intervention. If, as Stilgoe (2015) encourages us to do, we refrain from reading 'geoengineering' as a noun – an eclectic inventory of technologies and techniques – and treat it rather as a verb, a term describing an ongoing, world-shaping project, we begin to appreciate the added burden on PES research and scholarship in this area. In this interpretation, Geoengineering, including talk about geoengineering, is an activity that respecifies our relationship to the Earth's climate by introducing in our calculations the possibility (and expectation) of technological control. As Szerszynski has argued, this implies an understanding of climate change as the object of application of a set of 'climate technics' – a project, in his view, with an obvious soteriological subtext (Szerszynski, 2012).

Seen in this light, geoengineering research, and research on geoengineering, including on the evolving set of "public attitudes" that might hinder or accelerate its progress, becomes expressly performative. While this performative dimension of public engagement has been noted in relation to other emerging technologies (see for instance Delgado, Kjølberg & Wickson, 2011, for nanotechnology; see also Irwin 2006; Myers 2004), the situation is compounded in the case of geoengineering by the fact that the form of intervention being discussed is always being implicitly or explicitly contrasted with an alternative, conventional mitigation via reduction of greenhouse gas emissions, that is universally understood to present enormous technical and political challenges. Against this background, geoengineering emerges *de facto* as a techno-fix; it acquires the character of an insurance (or "plan B") against uncontrolled climate change – an insurance made all the more real by virtue of being elaborated discursively within the relatively safe confines of public engagement forums (cf. Luokkanen *et al.*, 2013).

Public engagement exercises, particularly those in the second wave of participatory exercises discussed above, were thus forced to spend much time and effort questioning or problematizing this characterization. They did so not only by raising the prospect of risks or hazards associated with individual geoengineering technologies (a task already undertaken in the Royal Society report), but, more significantly, by attempting to *unframe* geoengineering altogether. *Unframing* represented here an effort to resist the stabilization of geoengineering as a self-contained “engagement matter.” The later series of engagement events sought to accomplish this by keeping geoengineering within a constellation of approaches that included climate change mitigation and adaptation, and by subordinating questions of instrumental value to larger fields of socio-political signification. In these exercises *unframing* involved also a shift in the role of (natural) scientific expertise in public dialogue and a careful effort to manage the “reality effect” of the inputs and discussion props used in dialogue. The result was always a balancing act: geoengineering was to be turned into an explicit matter of debate, without in the process giving it too much credence as a realistic (or real) policy option.

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