Public Conceptions of Justice in Climate Engineering: Evidence from secondary analysis of public deliberation

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Abstract

Secondary analysis of transcripts of public dialogues on climate engineering indicates that justice concerns are an important but as yet under-recognised dimension influencing public reactions to these emerging techniques. This paper describes and explores justice issues raised by participants in a series of deliberative public engagement meetings. Such justice issues included the distribution of costs and benefits across space and time; the relative power and influence of beneficiaries and others; and the weakness of procedural justice measures that might protect public interests in decision making about climate engineering. We argue that publics are mobilising diverse concepts of justice, echoing both philosophical and practical sources. We conclude that a better understanding of conceptions of justice in this context could assist exploration and understanding of public perceptions of and attitudes towards climate engineering and the different technologies involved. Such detailed public engagement would appear essential if sound, well-informed and morally justifiable decisions are to be made regarding research or development of climate engineering.

Keywords: climate engineering; environmental and social justice; public deliberation; moral hazard; environmental dumping

1.   Introduction

Questions of justice are central to climate change, and issues of ethics have been repeatedly raised in considerations of climate engineering as a policy response (Gardiner, 2010; Preston, 2012; Burns 2013). Yet questions of ethics and justice with respect to publics remain as yet relatively unexplored, despite increasing interest in climate engineering following the Paris climate accord in 2015 (e.g. Nicholson and Thompson, 2016; Williamson, 2016). This paper aims to establish whether justice implications are a significant factor in public reactions to climate engineering and to consider which conceptions of justice public expressions of concerns regarding climate engineering might reflect. It proceeds with a brief review of justice issues as arising in climate engineering and related literature to establish the context. After outlining the methodology applied, the paper then turns to examination of four justice issues prevalent in a series of deliberative public engagement meetings (moral hazard, environmental dumping, vested interests and fair procedures). Finally, we discuss the different ways justice is expressed and underlying conceptions are mobilized indicating important implications for policy and fertile lines of future investigation.

2.   Climate engineering and justice in the literature

Climate engineering encompasses a diverse group of emerging technologies and techniques that seek to directly intervene in the planetary climate system to counter or reduce the negative effects of climate change (Royal Society, 2009; NAS, 2015a and b). It is commonly divided into methods that reduce the warming from incoming sunlight (solar radiation management or SRM) and methods that remove carbon dioxide from the atmosphere (carbon dioxide removal or CDR). The deployment of SRM is highly controversial, but CDR, on the other hand, is assumed in some form in most decarbonisation pathways which would limit global temperature rises to below 2°C (UNEP, 2015). SRM and CDR share some ethical characteristics: for example both raise serious concerns regarding the prospect that their apparent future availability justifies continued delay to mitigation and adaptation. Although they can raise distinctive issues for policy (NAS, 2015a and b), this paper highlights public concerns that are largely common to both sets of technologies.

The unevenly distributed nature over space and time of both the impacts of climate change and the burdens of mitigation and adaptation has strongly shaped international negotiations – most recently at Paris - and domestic policies in many nations (Adger *et al,* 2006; Pickering *et al,* 2012; Schlosberg, 2012). At the same time, public responses to potential mitigation technologies such as nuclear power and carbon capture and storage have been shaped by environmental justice concerns such as the dumping of wastes on vulnerable communities (Bickerstaff *et al,* 2013; Shrader-Frechette, 2002; Walker, 2012; Taebi and Roeser, 2015). Given the prominence of justice concerns related to climate change mitigation and adaptation amongst academics and policy-makers, we believe it is important to scrutinise the justice implications of climate engineering as a response to climate change.

There are sound reasons to anticipate significant justice implications, both from the potential outcomes (intended and unintended) and from the power and scope of the technologies involved. Ethicists and philosophers (e.g. Gardiner, 2010) engaging with climate engineering have raised multiple issues including serious justice concerns as well as questions over whether the levels of interference with - or control over - nature implied by climate engineering are ethically acceptable and whether climate engineering may result in new injustices, and not simply act to mitigate the likely injustices of climate change. Gardiner (2010) suggests climate engineering would exacerbate

the 'moral corruption' problem, adding to disincentives for the wealthy current generation to take effective action. Gardiner argues that in such situations those who have gained from business as usual will be tempted to support partial or inadequate responses that justify maintaining their present advantages. He suggests this is an acute problem in climate change because of the simultaneous separation of those responsible from those most affected in both time and space. This results in a form of 'moral hazard' in which apparent insurance against damage leads to riskier behaviour, which typically imposes costs or risks on others (Krugman, 2009). Preston (2012) suggests climate engineering might further compound the injustices of climate change by adding new uncertainties over rainfall patterns, for example, to which the poorest are most vulnerable. In addition, Burns (2013) emphasizes the intergenerational risks of rapid warming should a climate engineering programme be abruptly terminated, while Smith (2012) sees climate engineering as an unacceptable domination of future generations by present generations.

However, as a whole, as Oldham *et al* (2014) show, the climate engineering literature is dominated by natural sciences with a focus on assessment of the potential and practicalities of climate engineering technologies, often using modelling techniques to explore climatic implications. Some modellers have examined the distribution of certain climate impacts likely to arise in the presence of climate engineering (Irvine *et al,* 2010; Ricke *et al,* 2010; Moreno Cruz *et al,* 2012). But these modelling approaches are in a minority, limited in their approach, and typically, and implicitly, assume liberal utilitarian and distributional concepts of justice – in the forms discussed by Lamont and Favor (2013) - with simplistic portrayals of public interests and vulnerabilities in which publics are invisible, or at best imagined (Walker *et al*, 2010).

Justice considerations are also largely absent in the dominant climate engineering media discourses. Content analyses of climate engineering discourses (such as Nehrlich and Jaspal, 2012; Scholte *et al,* 2013; Anselm and Hansson, 2014) rarely mention justice. In her commentary on media analyses Buck (2012) reports that "*the justice issue is seldom considered; [and] even when it was present, it was rarely the dominant frame*" (p176). McLaren (2016 forthcoming) suggests that the dominant discourses around climate engineering have acted to frame justice considerations out of the debate, through a combination of 'post-political' technological optimism and catastrophic portrayals of climate change.

In contrast, justice features more strongly in the findings of public engagement studies on climate mitigation technologies such as carbon capture and storage (CCS) (McLaren, 2012). While other ethical concerns such as 'messing with nature' have been reported in some detail (Corner *et al,* 2013), questions of justice appear occasionally in brief mentions of distributional concerns and most often obliquely in discussions of governance and authority. Parkhill *et al* (2013) note that participants in their dialogues raised questions about governance, accountability and transparency, as do Bellamy et al (2014) who note participants' demands for informed consent. Macnaghten and Szerszynski (2012) suggest their deliberative groups reveal a deep scepticism about climate engineering technologies and their potentially undemocratic nature. Wibeck *et al* (2015) also note lay concerns raised in Swedish focus groups about governance, the locus of power, and the prospect of Southern nations being further disadvantaged. Such reports of public deliberation, then, only offer tantalising hints at wider justice concerns.

This paper aims to start to fill this lacuna – the lack of systematic exploration of the dimensions of justice related to climate engineering, as articulated or intimated by various publics - through a secondary analysis of a series of public deliberative events held in the UK. We seek to explore whether this gap represents a lack of concern or salience; or is a product of ways in which the topics were framed and discussed; or - as we believe - that the issues are influential, yet taken for granted and rarely directly expressed. In addition, we aim to begin to explore the nature and sources of the issues raised and the conceptions of justice mobilised in public deliberation.

Our identification and analysis of justice concerns is informed by a broad-based understanding of both scholarly and movement-based conceptions of justice (Schlosberg, 2007; Sen, 2009; Stumpf et al, 2015). The recognition of vulnerability, and resulting movement-based claims of justice rooted in lived experience are particularly significant in environmental justice approaches (Schlosberg, 2007; Walker, 2012). We consider justice concerns to extend to domains of distribution, procedure and correction, and include approaches based in human rights, capabilities, and recognition (Caney, 2010; Honneth and Fraser, 2003; Schlosberg, 2012). Justice concerns also arise in virtue ethics, where concern for others and for fairness is an indication of good character or a 'virtue of justice' (Slote, 2014). This broad understanding acknowledges the prospect of diverse motivations for justice and diverse sources of public interpretations of justice. Public interpretations might arise from abstract philosophical theories (ranging from egalitarian to libertarian in orientation), or from assessments of the characteristics of the technologies or procedures under consideration (Cotton, 2014), but in practice we might expect real world experience and analogues, and political and social movement claims to be more influential in shaping lay concepts. Different conceptions are important influences shaping the ways in which justice can be understood and promoted in practice. Cosmopolitan concepts that suggest equal treatment of all people regardless of their relatedness or proximity to us (Caney, 2010) might recommend different practical policies than communitarian approaches (Sandel, 2009), especially in international and intergenerational contexts.

The presence and salience of justice is not just an academic question, particularly given its presence in other public debates over emerging technologies, but also a substantive one given its importance in negotiations over climate policy. Variations in expressions and conceptions of justice are expected to have significance for formal and informal governance regimes for both research and possible deployment of climate engineering.

3. Public engagement and methodological issues

The research value of deliberative methods is well established particularly with respect to appraisal of novel technology (Macnaghten et al, 2005; Pidgeon and Rogers-Hayden, 2007; Delgado et al, 2010; Jasanoff, 2011), but also with respect to energy and climate issues (Capstick et al, 2015; Bellamy et al, 2014; Butler et al, 2013; Corner et al, 2013; Pidgeon et al, 2014). The ability of deliberative methods to 'open-up' assessment to a wider range of interests and considerations (Stirling, 2008; Bellamy, 2013) is critical. A deliberative approach is similarly apposite for justice considerations because they can arise in or represent a diverse range of ethical stances (from libertarian to egalitarian), which equally merit being 'opened up' for discussion. As Capstick et al (2015: 3-4) argue, deliberative "research can generate depth of explanation and insight into why people have the attitudes they do, the discourses they construct and draw upon, and the complexity of their understanding and emotional engagement" with the issue under discussion. As participants

project their lived experiences onto novel attitudinal objects such as imagined futures and technologies, they also reveal the values and principles they mobilize to consider the potential risks and consequences of those futures.

Deliberative research is therefore important in delivering the 'interpretive role' of science and technology studies (Jasanoff, 2011), and offers both substantive and instrumental benefits for the governance of science and technology (Fiorino, 1990). Our focus on justice considerations deliberately evokes the normative purposes of engagement and technology appraisal highlighted by both Jasanoff and Fiorino. The timing and nature of public engagement is critical in this respect. Climate engineering has witnessed early upstream engagement, considered to be valuable if findings are to influence the development or regulation of a technology prior to the emergence of path-dependency (Stirling 2008). However, this means that the processes of engagement themselves act to frame and define the object of deliberation, establish particular pathways for development and also tend to construct, craft or constitute the publics with which they engage (Bellamy and Lezaun, 2015). Bellamy and Lezaun (2015) suggest that early deliberation by the Royal Society (2009) and in Experiment Earth (Ipsos MORI 2010) helped to define climate engineering as a coherent object and framed expectations regarding it. They argue that to deliver both substantive and normative purposes, subsequent work (including the deliberation on which this paper is based) then had to seek to 'un-frame' and unsettle those definitions and expectations.

The data on which this paper is based was collected as part of the Integrated Assessment of Geoengineering Proposals (IAGP) project, which was designed to address gaps in knowledge about the effectiveness and side effects of geoengineering schemes. The public dialogues were intended to enable systematic academic study of public perceptions of climate engineering and its risks. The project involved full-day facilitated deliberative workshops in four UK cities (Birmingham, Cardiff, Glasgow and Norwich), in 2012, each with eleven participants, recruited by a professional market research agency to be broadly reflective of the gender, age, ethnic, educational and socio-economic diversity of the UK and its constituent nations. Primary analysis of the dialogues has been published previously (Corner et al, 2013). This secondary analysis, applying a new set of analytical questions regarding justice issues, is a testimony to the richness of the deliberative process in eliciting expression of opinions, values and challenges, despite the relatively small number of participants. In common with all qualitative work of this kind, no claim to statistical representativeness can be made on the basis of a sample of this size. But the multi-layered data from small group deliberations such as this offers an equally important analytical lens to that provided by larger-scale (but necessarily less nuanced) quantitative studies.

Nonetheless, secondary analysis is uncommon, and not unproblematic (Capstick et al, 2015). In this case, basing the study upon secondary analysis arguably enables better exploitation of the rich existing resource of transcribed deliberative sessions generated within the IAGP project. The fact the data was not explicitly collected for the purpose of an analysis of justice considerations may even be an advantage in that the design and implementation of the engagement process cannot have been distorted to introduce deliberate framing effects. Although secondary analysis typically raises a question of 'fit' between the data and the questions asked of it (Hammersley, 2010), in this case the research question established by the IAGP is clearly broad enough to encompass issues of justice and responses from publics, and the material gathered rich enough to address them. However, in this context, the relative absence of explicit justice issues from the initial research design raises a risk that

unconscious framings might have been introduced by facilitators unprepared for these issues. To help address this, facilitators' contributions were coded (distinctly) as part of the process, and no reasons for concern were identified.

Secondary qualitative analysis can also raise concerns about interpretation (Hammersley, 2010), recognising that however well recorded or transcribed, those undertaking interviews or facilitating deliberative processes are exposed to a richer experience of communication which can supplement – or in rare cases, contradict – the words used, and can therefore, theoretically, better interpret the material. This issue is not considered significant in the present circumstances, as most of the co-authors on this paper were present in the deliberative sessions. Thus in the writing and review process, there has been adequate opportunity to identify and rectify any possible misinterpretation of participant contributions, as well as obtaining the benefits that can arise from a detailed scrutiny of the transcripts by a new, more detached, reader (such as the identification of unintended framing effects). So in this case, secondary analysis of qualitative data of this nature is considered not only appropriate but desirable.

The original deliberative sessions were designed with consideration of the need to articulate systems thinking, and to provide balanced information and policy framings in ways that open up spaces for reflection and deliberation and solicit a broad spectrum of opinion (a philosophy towards public engagement described at greater length in Pidgeon et al, 2014). The central approach taken was to encourage participants to raise concerns and questions about climate engineering, as well as reflecting on its potential benefits; and to constantly probe to unpack participants' reasoning behind their questions and concerns. Climate engineering was discussed as a potential response to climate change, following discussion of mitigation and adaptation. Although not constituting as extreme an 'unframing' exercise as that of Macnaghten and Szerszynski (2012) who did not even describe geoengineering as a response to climate change, this served to reposition climate engineering as one of a series of possible valid responses, rather than as a singular novel approach. Four specific climate engineering techniques were described in some detail to help stimulate discussion and to illustrate the diversity of techniques falling under the rubric of climate engineering. These were: stratospheric aerosol injection, marine cloud brightening, direct air capture and biochar. Although the discussions mainly addressed climate engineering in general, in the following we note when participants' comments refer to specific technologies.

In the design and facilitation of the process, care was taken to not introduce potentially misleading framings identified in previous public engagement (Corner et al, 2013). However, in the final session of each day, a number of quotes representing specific perspectives (selected from existing academic and grey literature sources) were introduced to ensure that all the groups had considered the same broad range of possible responses. The nine statements reflected common academic and media framings. These included three statements of clear relevance to justice concerns: "*Some countries will see geoengineering as an excuse to avoid reducing their own emissions and that's not fair*"; "*How do we expect everyone to agree on something like geoengineering? If some countries think one thing and other countries think something else then it will just be the rich and powerful countries that get to decide*"; and, with particular respect to moral hazard: "*If we could come up with a geoengineering answer to this problem then we could carry on flying our planes and driving our cars*". In the process of analysis, we have been careful to distinguish views raised before the introduction of this material from those that followed these prompts.

The discussion in this paper is based on qualitative thematic analysis of the transcripts assisted by using the data management software Atlas Ti; and in particular on an analysis of the co-occurrence of different themes and opinions amongst the 44 participants. The coding process was focused on those aspects of the transcripts perceived as relevant to justice, although all the material has been closely read multiple times. Any material expressed by the participants in terms of justice or fairness was included, alongside material relating to justice issues identified by philosophers and ethicists working on climate engineering, and material that reflects concerns or issues raised by activists and publics on other environmental justice topics.

In line with good practice as suggested by Friese (2014), coding categories were primarily developed empirically from the transcript material, subsequently compared to theoretical concepts, and further developed in an iterative process as recommended by Pidgeon and Henwood (2004). Co-occurrence of different themes and categories was assessed using the Atlas Ti co-occurrence utility, which highlights the physical proximities of concepts in the text, and by systematic manual checking of the identities of speakers.

The source material is still highly relevant to current climate policy, given renewed interest in climate engineering, and especially CDR, following the Paris accord (Nicholson and Thompson, 2016; Williamson, 2016) and the persistence of justice–related disagreements over climate policy in recent years. While our findings are drawn from UK-based public engagement, they are of wider relevance both to other nations involved in geoengineering research and development, and to global climate policy. Understanding perceptions of justice in nations like the UK is globally significant as the UK is amongst the nations that are understood - on philosophical grounds - to *owe* duties of mitigation and compensation.

4.   Justice issues identified in the dialogues

Various justice concerns were raised or endorsed in all groups in the IAGP dialogues, by a wide range of participants. The following sections introduce the most persistent and prevalent concerns identified, explore how they were raised, unpack the possible meanings, associations and motivations involved, and identify conceptions of justice these might reflect. By their nature, quotes are inevitably selective, but those presented here illustrate relevant aspects of the discussions. Typically, the selected quotes were either not contested within the discussions, or more often, reflect several participants speaking in similar terms. The quotes given are identified by the city and whether the speaker was male (M) or female (F) and for those directly related to issues for which prompts were given, whether the comment was made before or after the prompt (pre-prompt, post-prompt).

The following sub-sections consider in turn four different aspects of justice: the concept of 'moral hazard', the notion of 'environmental dumping', discussions around vested interests and the idea of fair governance.

4.1   Mitigation Deterrent or 'Moral Hazard'

First we examine discussion of the prospect that some countries, groups or individuals may be motivated to reduce mitigation by the actual or apparent availability of climate engineering. Such a

mitigation deterrent effect (Morrow, 2015) or 'trade-off' between climate engineering and mitigation (Baatz, 2016) could be serious for climate justice. The side-effects or uncertainties of climate engineering make it less able to reduce climate injustice than mitigation. Moreover, insofar as it might reduce the effort or expenditure on mitigation by those actors understood to have caused climate change, climate engineering reduces the extent to which mitigation delivers corrective justice. Such mitigation deterrent can be described as a form of moral hazard. There is substantial debate over the exact nature and extent of the 'moral hazard' problem with respect to climate engineering and the best terminology to describe it (Hale 2012; Lin, 2013; Reynolds 2014; Morrow, 2015; Moreno-Cruz, 2015; Baatz, 2016) but few if any scholars or commentators reject the existence of the phenomenon.

Moral hazard can be inherently an issue of justice where the outcome is a transfer of risk from those making the decision to others. In the case of climate engineering, moral hazard typically implies shifting climate risk onto those most vulnerable to climate impacts, and especially onto future generations, by reducing or delaying mitigation. In the following we use the term moral hazard as a broad category encompassing a variety of logics for mitigation deterrence, and present material that illustrates the plural and inter-related public concerns in this respect. Understood in this way, moral hazard featured in the group discussions on both CDR and SRM approaches in statements such as the following:

> "I think [geo-engineering] would act as a smoke screen…. it lulls us all into a false sense of security." M, Cardiff (pre-prompt)

> "it could be a cop-out as well. For not doing things on a day-to-day basis. Because it doesn't matter, because 'Hey, we're going to take all that from the sky and we're going to put it into the ground in 50 years' time, so where's the problem? … [But] most geo engineering technologies do not yet exist; will they exist?'" M, Cardiff (pre-prompt)

The potentially demotivating effect of climate engineering was recognized by participants, and linked to uncertainty about its practical deliverability, but not explicitly expressed as an issue of inter-generational justice. However, in other ways, participants expressed significant concerns for future generations with respect to both climate engineering and climate change more generally. These arose both in cosmopolitan forms - of concern for generic future people – and more communitarian terms - of concern for children or grandchildren.

> "I think it's our responsibility, we're only custodians, we're only here for a short period of time why should we ruin it for every generation to come." M, Cardiff

> "now I've got three kids of my own I think completely differently and it's about creating a future for them." M, Birmingham

Reflecting findings regarding energy practices (see Shirani et al, 2013), future concerns framed in communitarian terms were substantially more likely to be expressed by participants who at some time in the session had identified themselves as parents than by other participants.

The implication that moral hazard might be unfair to future generations was perhaps taken for granted. But concepts of fairness were more directly and explicitly mobilized in the second, and more commonly raised dimension of moral hazard: that of countries or groups using climate engineering as an excuse to unfairly avoid or renege on commitments or obligations to contribute to mitigation.

> *"you're kind of closing the stable door after the horse has bolted … if you had a system where you could deal with the carbon dioxide and reduce it, would that though then give some of the countries an excuse to just pour out more and more and more."* M, Glasgow (pre-prompt)

> *"But it might make things worse. There might be then be new technologies come out because people think, 'Oh well, we've got this, we've got this geo-engineering here and that's going to fix all the problems so we can have extra planes or extra you know like something new!'"* F, Glasgow (pre-prompt)

> *"if [geoengineering] was put in place then some countries would use that as an excuse. They'd say 'there you go, it's in place, it's doing the job; we don't have to worry about emissions and what have you.'"* F, Norwich (post-prompt)

Such obligations were seen by participants to arise not only on the basis of principles of 'the polluter pays' or historical responsibility, but on a broader sense of collective responsibility to mitigate, so encompassed also developing countries and emerging economies, as well as more 'usual suspects' like the United States of America and Russia. Some participants actively voiced concerns that it would be unfair to expect the UK to act if other countries did not – a view that extended even to the conduct of climate engineering where that was considered.

> *"I think what both of you two are exactly saying is that what's the point in us doing it [mitigation] if the whole rest of the world isn't going to do it."* M, Cardiff (pre-prompt)

> *"it's good that everyone benefits, but why should the UK just do all, all this hard work [to develop geo-engineering], and no one else bothers."* F, Glasgow (pre-prompt)

Amongst these publics, 'I won't if you don't' appears to be a widely applied rule of thumb for fairness, with an implicit common understanding that free-riding, or benefiting from something to which one has not contributed, is unfair. Concerns identified under this heading were often linked to support for a normative view that climate engineering – even where it was considered attractive - should not be permitted to reduce or replace mitigation activity:

> *"I think mitigation is the key to it, you know, you've got to start somewhere and you start with mitigation and keep it going … mitigation is definitely on the cards for keeps".* F, Glasgow (post-prompt)

> *"Some research on this is sensible but [I] wouldn't want this to take money away from mitigation".* F, Norwich (post-prompt)

More recent research has distinguished a political moral hazard from a personal form: in the former politicians, governments and other organisations are seen as vulnerable to the temptation to backslide on mitigation if climate engineering appears plausible, while in the latter it is individuals who are affected. Corner and Pidgeon (2014) suggest the former is both more likely and more serious. Wibeck *et al* (2015) suggest that concerns about political moral hazard predominated in their focus groups. Our data supports a similar interpretation. Participants raised concerns about moral hazard in all groups, and with some exceptions most participants saw it as a serious risk. Moreover, while they appeared to distance themselves from the possibility that they personally might reduce mitigation because of climate engineering, they often expressed concerns that others, especially politicians, might be tempted, echoing the public scepticism Capstick and Pidgeon (2013) found regarding the political system's capacity to deliver effective climate policy.

> *"What I don't like the idea of is that if measures come out to help us in the medium and long term that people then make the decision that sod it we won't bother doing preventative measures … we'll just produce as much carbon as we like …"* M, Birmingham (pre-prompt, following discussion of aerosol injection)

> *"I could see [politicians] kind of rushing in, 'This is the saviour of the planet and we're going to put it into place.' I mean I'm not just talking about our government …"* F, Norwich (pre-prompt)

In one group, this fear of political moral hazard was illustrated by an analogy with tobacco tax:

> *"…they want people to quit smoking and the only way they'll stop it is to stop selling fags, simple as…then people can't smoke, you know what I mean? So it's the only way they'll do it but they won't stop because they sell so much and they sell so well."* F Cardiff

On the other hand, a few comments seemed to imply something of a 'negative' moral hazard effect in which the risks and shortcomings of climate engineering stimulate a greater commitment to mitigation.

> *"[Actual geoengineering] would frighten people to death wouldn't it and it might get an internal reaction into talking about it and actually getting politicians to make decisions and get things done."* M Birmingham (pre-prompt, following discussion of aerosol injection)

However on close reading of the transcripts most of the comments implying an incentive to mitigate appear to refer more generally to learning about the seriousness of climate change at the event, and not explicitly to climate engineering.

> *"I mean it's opened my eyes to how serious…I knew it was serious but the fact that we've gone into this where we're looking at reflecting sunlight and you're thinking, 'Well it's a bit closer than I thought really.'"* F, Birmingham (pre-prompt)

We might also sound a note of caution regarding the personal commitments expressed in such groups. Past experience with deliberation suggests that participants may express ideas that are thought to be socially deviant by attributing them to unspecified others. In this case we must recognise the possibility that participants who in reality might be tempted to avoid more inconvenient forms of mitigation (especially if others were not doing them) – the social form of moral hazard identified by Corner and Pidgeon (2014) - could be loathe to admit that in a group setting discussing responses to serious climate change, but might well rather express it as something 'others' might do.

Nonetheless, like many climate engineering scholars, these publics clearly identify and fear the prospect of moral hazard. However, they interpret it as an issue of justice more in terms of free-riding than as an unjust transfer of risk. This perhaps strengthens concerns that free-riding might justify a fear of moral hazard (Hale 2012); or contribute as a strategic deterrent to mitigation from an economic theory perspective (Moreno-Cruz, 2015). Avoiding moral hazard raises serious governance challenges (as previously highlighted by Parkhill *et al*, 2013), for instance: how to ensure that resources allocated to mitigation (including such diverse things as research budgets and

parliamentary time) are not diverted, or that arguments for lowered effort on mitigation as economically rational risk adjustment do not obtain political traction.

4.2   Distributed impacts: Environmental Dumping

In modern Western society, questions of justice often focus upon the distribution of harms and benefits. Participants raised distributive concerns but in unexpected ways. Although the uneven or unfair distribution of climatic effects, such as changes in rainfall patterns arising from climate engineering, is the main way in which climate scientists have engaged with justice concerns, it did not feature strongly in the discussions. This is perhaps more because the distributed nature of such implications is not immediately obvious when climate engineering is presented as a response to climate change designed to ameliorate the rise in global temperatures, rather than a lack of concern for groups or nations vulnerable to such effects. However, and somewhat unexpectedly, participants typically swiftly identified the possibility of unfairly distributed impacts from CDR techniques, drawing analogies with the dumping of undesirable wastes (or polluting processes) on poorer populations, particularly in developing nations. Such concerns arose with respect to both biochar and direct air capture.

> "But I can just imagine that's what they'll do. So they get all the CO_2 and then, what, give it to a poorer country? So dig a hole, we'll give you a couple of million ..." F, Glasgow

> "if it's lucrative for companies to be involved in it, they'll always do what they can for the countries that have got money … and you'll end up with the less developed countries being used as the dumping grounds … because that's how they'll make the money." M, Glasgow

> Participant 1: "we haven't got the land to place them on but we could produce [geoengineering technologies]. …
> Participant 2: "Yeah but then we'd send it to some poor country like we send all our rubbish … you know all the stuff that we can't recycle it all goes off to India or China or somewhere and it's dumped there." Discussion, Birmingham

The phenomenon of environmental dumping is widely discussed in the environmental justice literature especially in the USA where research suggests that communities of colour are disproportionately exposed to environmental hazards, and institutionalized racism is seen as a contributing factor (Bullard, 1990; Schrader-Frechette, 2002; Walker, 2012). However, it has not previously featured strongly in policy and public discourse in the UK, despite efforts by some UK NGOs such as Friends of the Earth and the Environmental Justice Foundation to highlight such problems, so the prevalence of this frame was unexpected.

The focus on CDR perhaps reflects a greater *tangibility* of concerns over the risks of carbon storage, which were raised as a particular future uncertainty (a risk distributed over time as well as space), and primarily, though not exclusively with reference to direct air capture approaches.

> "I don't like the idea of like carbon dioxide could be stored underground or in the ocean, so you're just creating problems for the future for that." F, Birmingham

> "what's the effect of storing it underground and what are the effects of storing it in the ocean (murmurs of agreement) because I'd really like to know what impact it actually has … Is it a ticking time bomb?" M, Birmingham

> *"Well, what damage are the chemicals going to do if it's going to remove the carbon? And when would they find that out? And then just like we were all saying earlier, if it could be in another 150 years people are like 'Why did they do that?' because this has now caused another problem." F, Glasgow*

Although concerns about storage also appear in deliberation about carbon capture and storage (CCS) related to energy technology (Butler *et al*, 2013), it does not appear that greater familiarity with carbon storage (in comparison with unfamiliarity with SRM) was the cause of concern here, as only one or two participants expressed any awareness of carbon capture and storage proposals associated with power plants in the UK. It was however noticeable that terms such as 'chemical' or 'gas' raised concerns more generally (not only because particular groups or communities might be exposed to them), perhaps reflecting their status as everyday risks in domestic and wider settings.

> *"You see that's what I was thinking I'm thinking like gas because gas like gas in the cooker that can then explode, that's why I'm not sure what could that then explode and you'd think, 'Oh my God, there'd be gas everywhere and…' do you see what I mean?" F, Norwich*

> *"Especially when we came up with the thing about geo-engineering, using chemicals, you know, as a solution. Chemicals … don't sound very good, you know". F, Glasgow*

This area offers a good illustration of the complex processes by which publics mobilize existing analogues and concepts to 'make sense' of a new and unfamiliar topic (Marcu *et al,* 2015; Wibeck *et al,* 2015), and in turn expose underlying values and principles. Such concerns also indicate that with more comprehensive initial information about the mechanisms and distributed implications of solar radiation management, the prospect of its negative localized side-effects being 'dumped' on the poor and powerless might equally be expected to raise public concerns, albeit involving different analogues.

Worries about the threat of environmental dumping did not however rely on an explicit link to concerns about the unfair distribution of power. In these engagement events, only a minority of those concerned about the excess influence of the rich and powerful made such a connection. Yet suspicion of vested interests was widespread (as we outline in the next section), and we suggest that this is another example where the underlying connection was effectively 'taken for granted'.

4.3   Suspicion of vested interests

The transcripts largely reveal conceptions of justice that are rooted in real-world context and experience, rather than in abstract justice theories (or in perceived characteristics of the climate engineering techniques considered). For instance, participants in all the groups expressed concerns about the influence of the rich and powerful on decision-making, and about the implications of corporate involvement and the profit-motive for climate engineering, often citing past experience and what we might describe as 'commonplace knowledge' about how society works. In other words, echoing Parkhill *et al*'s findings (2013) of public support for innovation coupled with fears that commercial interests might override the good intentions of scientists, our participants were concerned that climate engineering, like other responses to climate change, might be driven by vested interests rather than by scientific assessment of the climate problem.

> *"you get to know that whatever you say, whatever you think, isn't going to make the slightest bit of difference because you're in the hands of politicians and big business and if people are making a lot of money they don't care if they're polluting the planet."* M, Norwich

> *Participant 1: "so your Gates and Branson couldn't do it without permission; they can't just decide to start doing it…*
> *Participant 2: "Well, I dispute that. I think they can decide what they want, because at the end of the day they've got access to people in power".* Discussion, Cardiff

The prospect that companies perceived to have profited from climate change might subsequently profit from climate engineering appeared to be felt as especially unfair. This perhaps indicates underlying corrective or even retributive conceptions of justice, which would call for those benefiting from past harms to pay compensation or even be punished rather than further rewarded (Farber, 2008; Walen, 2014):

> *"You just mentioned [commercial oil company] there, first they're going to make mega millions producing oil and stripping the world resources and now they're going to make mega millions, protecting it, you know, it's going to be the same companies that are doing it."* M, Glasgow
> *(with reference to direct air capture)*

> *"So my biggest fear around all of this is if a private corporation was to develop … it only looking at the financial gains and all the trappings that come with that? Or is this about, 'well you know what, we've made tons of money out of what we've done in the past; we've dug for oil, we've found whatever, whatever and we've made absolutely shed loads of money. Now we're in a position where we're having a huge impact on our overall environment here's what we're going to put back in terms of our profits from previous years into developing ideas and what we're going to do with those ideas is share them.' If those companies or those entities were to be saying that I'd be saying … yeah power to them let them go ahead and develop. But we all know sitting here if a private corporation goes ahead and develops it's about monetary return."* M, Birmingham

Significantly, some participants endorsed a view that climate engineering should not be 'for-profit' at all. Even amongst those who apparently accepted for-profit climate engineering in line with a standard, understood model of progress in which commercial interests advance and develop applications of science, such acceptance was typically grudging.

> *"I have to say, anyone who's going to be doing it for money, and if a profit can be done on to it, they should not be involved in it whatsoever."* M, Glasgow

> *"Trust more in organisations who don't have a hidden agenda, for example, Greenpeace, rather than profit-driven companies … So anyone making money on it, you know, or we don't know but we'd assume that, you know, that's what their target's going to be, making money, and they can cover facts, hide certain things, whereas … a non-profit organisation [would] be in it for the better interest and it's not just to make money and, you know, cover corners or cut costs or whatever, it's, they've got good intentions, basically."* M, Glasgow

However, in some cases commercial involvement was described as the 'lesser of two evils' compared with taxpayer funding, which was seen as unlikely under current economic conditions.

> *"in the economic climate we're in, it's kind of the lesser of the two evils .. that it's funded by people like that [companies], which may mean that the decisions are in privileged hands, but what's the other alternative? To take more public money that we don't have."* F, Norwich

Strong conceptions of procedural justice may underlie the deep suspicions of vested interests expressed here. If widely replicated, such views could have serious implications for the design of appropriate governance and incentives should climate engineering be pursued (and we turn to these issues next).

4.4   Fair and responsible governance

Participants also engaged with other procedural aspects of justice, suggesting forms of governance that were seen to be fair and responsible, to be applied to any climate engineering technique. Much of this discussion was seemingly motivated by the perception of excessive influence by vested interests (in both research and potential deployment), and by concerns about the dominant role of certain countries in international climate governance.

> "Which is always the same story, it's always the rich countries that decide in the long run. So ones that have got money and they can put it in, it's…their say, it really is." F, Glasgow (post-prompt)

Some participants feared such narrow decision making, although many felt it to be inevitable. Nonetheless a prevalent suggestion was that some form of multilateral, democratic and consensual decision making process for climate engineering would be needed – both at research and deployment stages.

> "I mean you vote for governments why couldn't you ask everybody to, okay right well we'll tell you about this or what we're intending, have a universal vote?" F, Birmingham (pre-prompt)

> "I mean if our country say, for example, our country came up with an idea then surely they just wouldn't do that without consulting other countries as well?" F, Birmingham (post-prompt)

> "the United Nations has 193 members, you know, and it's your whole…it covers the whole globe so why can't it be managed by somebody like the United Nations? Not necessarily for profit." M, Cardiff (pre-prompt)

These findings echo and help elaborate those of Wibeck et al (2015), Bellamy et al (2014), Pidgeon et al (2013) and Macnaghten and Szerszynski (2012), where participants called for effective governance and oversight. Here we also find support for particular tools of procedural justice, notably participation and transparency. In addition education was generally advocated, both as a foundation for better decision-making and for justice, in any response to climate change.

> Participant 1: "If there's no money to be made it's about full disclosure isn't it? Because it doesn't benefit them to hold back on anything. …
> Participant 2: "Would you want them to know about that they're even working on the idea?
> Participant 1: "Yeah of course why not? The UN should be involved in it anyway because it's the whole earth isn't it and it's global." Discussion, Birmingham (post-prompt)

> "I think yeah we all should really … Not just the rich and … I think everyone should have a say." F, Cardiff (post-prompt)

> "I think it will come down to education and information, that you need to say to folk, 'Right, if you don't want to [protect the climate] for you, do it for your grandchildren and their children.'" F, Glasgow (post-prompt)

Such discussions of governance suggest that publics share concerns raised by scholars and ethicists that climate engineering governance would be extremely challenging if at all practical (e.g. Hulme, 2014; Hamilton, 2013; Rayner *et al*, 2013); that fair and responsible decision making in respect of climate engineering would require multi-scalar governance, and that without transparency and ongoing assessment, neither companies, nor politicians nor even scientists could be expected to act consistently in line with public interests.

5.   Discussion: Extent and conceptions of justice

This section first summarizes the extent to which justice issues were expressed in the dialogues, and the forms this took. It then discusses the significance of the publics' expressions of justice issues, and the possible conceptions that underlie them.

Justice issues appear consistently and repeatedly across the all of the discussions regarding the climate engineering technologies in the dialogues. Further, they appear in a rich diversity of forms and conceptions (albeit often subtle or even implicit and taken for granted, rather than explicit). However, the extent to which these public expressions directly reflect the distributional and utilitarian justice conceptions found in the scientific literature is negligible. There is more congruence with concerns for future generations and over moral corruption, raised by philosophers such as Gardiner (2010), and with concerns raised by social movements and environmental justice scholars such as Schlosberg (2007). Publics echoed both specific concerns highlighted in environmental justice, such as environmental dumping - which can be interpreted as a concern that poorer countries and groups are not afforded the same rights, protections and even recognition as rich communities - and the inherent diversity of environmental justice concepts rooted in the justice claims of social and environmental movements. Overall, issues rooted in lived experience, with concerns about power and procedure to the fore, appear more salient (if not necessarily of more concern) than more academic concerns such as the patterning of the impacts of engineered climates across space and time.

Capstick *et al* (2015) note that, with respect to climate change, "people's understanding is culturally-embedded, and situated within broader conversations concerning such things as morality, justice, responsibility and trust" (p4). In this analysis we have found views on climate engineering that follow similar patterns. Justice issues are not typically the first or most frequent concerns raised by publics regarding climate engineering, but they are clearly relevant and appear to influence opinions whether implicitly or explicitly. Each of the issues highlighted above featured in at least three of the four dialogues, in every case raised or endorsed in some way by between a third and a half of participants. This is comparable with the proportion of the participants expressing concerns (discussed by Corner *et al*, 2013) about 'messing with nature' or the likely side-effects of climate engineering.

In these dialogues, as might be expected, justice concerns were expressed in context, reflecting established understandings of economic priorities, distributional politics and vested interests. This suggests that climate engineering is probably not being seen as *inherently* unjust because of any apparent essential characteristics of any of the specific technologies, but *potentially* unjust in the common ways the technologies might be deployed and governed, and the interests they could be expected to serve. In this respect, the findings therefore broadly support a view that that climate

engineering might achieve the form of conditional acceptance that has marked mitigation technologies such as nuclear power, and carbon capture and storage, as suggested by Corner and Pidgeon (2010). Like these technologies climate engineering is likely to stimulate continued demands for strong tools of procedural justice. Yet with the contextual and technological richness and diversity of climate engineering, such potential reluctant 'conditonality' has many possible dimensions, and arguably, at least for certain SRM technologies, might even prove impossible to obtain within a democratic system (Szersyzinski *et al*, 2013). Nonetheless, the expectation that in many guises it could - and probably would – reproduce the privilege of the rich and powerful (which is in turn understood as unfair), is likely to be shared widely enough to influence its political acceptability. Again, as in the cases of nuclear power and CCS, such reactions might help sustain widespread public suspicion or even resistance in many countries, raising particular concerns about climate engineering approaches with global impacts.

In the cases of CCS and nuclear, a key factor in conditional acceptance appears to be their integration into a coherent narrative of effective climate response (Butler et al 2013). For instance when CCS is seen as somehow providing an alternative to, or slowing the progress of, decarbonization, opposition is more marked. This matches broadly with the way moral hazard concerns over climate engineering were expressed as a normative imperative in the dialogues reported here. Publics were clearly opposed to climate engineering being deployed as an alternative to decarbonization, but may be more sympathetic to its use within a coherent climate response package.

6.   Conclusion

Carbon dioxide removal forms of climate engineering are already prevalent in scientific and political scenarios for limiting climate change to below a 2°C global rise in temperature, and the aspirational goal agreed in Paris to work towards no more than 1.5°C seems likely to also trigger renewed advocacy for consideration of solar radiation management. The role of justice in the formation of attitudes to climate engineering cannot be overlooked, any more than in other areas of climate policy. The expressions and conceptions of justice found in this study are complex and manifold, including international, intergenerational, distributional and procedural concepts. More detailed understanding would require carefully designed further deliberation, and continued efforts to unframe existing assumptions about climate engineering. The complexity revealed here suggests that politicians and researchers should remain wary of making simplistic claims about justice to try to promote a particular view on climate engineering or a particular form or technology. It is reasonable to explore the possibility that SRM might offer particular benefits to those most vulnerable to the impacts of climate change, as Keith (2013) for example, argues. But the overall implications for justice will depend on many other social, political and cultural factors as well as on the interrelated technological capabilities that emerge. The justice concerns we have identified were largely expressed as of general application to all the technologies discussed, although some of the implications of environmental dumping were clearly more directly applied to CDR methods. These findings suggest that efforts to redefine CDR as distinct from other climate engineering approaches would not reduce the breadth of governance challenges arising from demands for justice.

Moreover, these findings remind us that justice concerns are not only, or even primarily, the domain of academics and philosophers. Publics are engaged with the construction and understanding of justice and this paper has illustrated some of the dimensions they will use to judge or hold

accountable those who bring climate engineering into being. Politicians and scientists will be at the sharp edge of procedures to determine the role - if any - for climate engineering within climate policy, and the design of mechanisms or institutions that might subsequently deliver it. Those procedures, mechanisms and institutions will not be developed in a vacuum: the attitudes of the relevant societies to inequality and mechanisms that produce and reproduce it over space and through time will inevitably influence the politics and practices of climate engineering research and development, just as much as the specific modalities and expressions of those politics and practices could reshape attitudes. Researchers and policy makers need to expand their climate engineering 'imaginaries' to include a better representation of publics and their justice concerns – properly embedding the 'social' into sociotechnical systems and appraisals.

The evidence presented above suggests that perceptions of implications for justice, the nature of those involved in development and deployment, the incentives and safeguards they face, and the procedural mechanisms applied with respect to transparency, participation and accountability will all influence public reactions. More detailed - and internationally replicated - public engagement on climate engineering and its justice implications would appear essential if sound, well-informed and morally justifiable decisions are to be made regarding research or development of climate engineering.

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