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### Policy and governance issues related to geoengineering research

C2G2 Webinar on Geoengineering and Biological Diversity, November 2, 2017

I will very briefly lay out the rationale for thinking carefully about the governance of research in particular; then I will raise a non-exhaustive list of some of the questions and issues relevant to any consideration of the governance of research; and finally, I will walk through a few concrete frameworks and proposals that have been put forward for research governance in this space.

First of all, when we think about rationales for why we might think carefully about the governance of research in particular, there are a few reasons.

- First of all, there have been persistent controversies over emerging scientific and technological issues in other domains and a growing awareness, I think, that technologies with the potential to fundamentally transform society have led commentators, social scientists, and policymakers to recognize that many of these technologies should not proceed in isolation of a wider public debate.

You can see that the Royal Society in 2009 acknowledged the importance of social, legal, and political factors in determining the acceptability of geoengineering in the future.

In addition, studies of existing laws have indicated that some of the mechanisms that currently exist may govern aspects of geoengineering and research but that there are gaps and overlaps in existing frameworks. In particular, as Frank just alluded to, traditional environmental impact assessments will often fail to capture very-low-risk small experiments because of their small scale, and even ethical frameworks for overseeing research will often fail to capture some of the concerns that some wider publics would want to raise around even very-small-scale research into these technologies.

Additionally, another reason for thinking about near-term governance of research is to start the progressive development of governance now in order to enable decision-making at later stages as science and governance coevolve.

In light of all of this, any discussions of early or anticipatory governance of research in these domains are confronted with what is known as the Collingridge dilemma, which is that when technologies are at very early stages of research and development, and therefore easier to steer — if we think of governance as steering — they are often too undeveloped to know with certainty what the effects or risks are likely to be; but at later stages, when we know more about these techniques, they are often too interwoven with economic and social interests to be effectively steered. So many of the frameworks that I will put forward today that have been reported in the literature and some practical experience try to get at this dilemma in particular.

[Slide] In 2010 the Stratospheric Particle Injection for Climate Engineering (SPICE) was a proposal to do a very-small-scale outdoor experiment to learn more about solar geoengineering. It was funded in the United Kingdom.

The vast majority of actors agreed that the physical risks of this project were quite negligible. I think it was intending to spray essentially a bathtub full of water into the air. But nevertheless, concerns were raised by NGOs, scientists, and broader publics about both the merit of this experiment and its wider social and political implications because it was considered to be one of the first outdoor geoengineering experiments.

I will return to SPICE later in more detail, but I wanted to flag it here as a case where the governance issues associated with research were really brought to the fore.

[Slide] There are many issues related to any discussion of the governance of research, including in SPICE: for example, what kinds of geoengineering research should governments fund, if any; who should oversee such research; what criteria should they apply; and how can we encourage international cooperation and understanding.

Many of these issues have actually been raised in earlier presentations, so this first category of questions around what is the object of governance has to do with definitional politics about what one considers to be geoengineering in the first place, and then this lumping and splitting: do we talk about the governance of geoengineering as a broad category that encompasses a wide range of techniques, or do we focus more narrowly on specific technologies or techniques; and scalar questions about where and how such governance might be triggered.

I will not walk through all of these, but you will see that there are questions about the scales and the pacing of governance, how we might do public engagement in effective ways that is actually linked meaningfully to the oversight of experiments, etc.

[Slide] These are a number of proposals for the governance of research that have been put forward and some of which have actually been applied. I will focus on a few of these, beginning with the earliest high-level set of principles that have been put forward.

[Slide] These two sets of principles, and more actually which are embedded in other fora on geoengineering, have been put forward, beginning with the Oxford Principles in 2009, which were then echoed in the Asilomar Principles that were released in 2010. Both of these were sets of principles developed by scientists and experts, including social scientists.

Interestingly, many of the principles — the Oxford Principles in any case — were derived not from any examination of geoengineering as an exceptional set of techniques, but rather drawing on the experience that experts had in other domains of emerging technology and the kinds of issues that were relevant there.

One of the things that is interesting here is that you will see that there is quite a bit of overlap actually across these two sets of principles, including that research should be regulated as a public good, public participation is important, transparency, independent assessment, and concerns about governance.

[Slide] Since the elaboration of these higher-level principles, one way to elaborate on the Oxford Principles in particular and provide practical guidance to researchers and research funders came in the form of the Code of Conduct. The Code of Conduct was put together by Anna-Maria Hubert at the University of Calgary. The instrument itself is voluntary, although it is based on existing legal sources. It is directed at a wide range of actors. It establishes an assessment framework for outdoor experiments that makes a couple of requirements for pre, during, and post research itself.

[Slide] Another approach for thinking about the governance of research has to do with the setting of substantive standards around allowed and disallowed zones for outdoor research. Most of the frameworks that have been put forward in this way are focused on solar geoengineering research and rest largely on an assumption that the matter of concern from a regulatory or governance perspective has to do with the risk of physical harm.

[Slide] The idea here would be to develop physical thresholds below which research can move forward without additional international, or perhaps even national, oversight beyond what already exists.

This figure comes from a paper published by Granger Morgan and Kate Ricke in 2010. You can see that the three axes are physical dimensions that might be used to think about defining an allowed zone. In the paper that they put forward, they suggested that the global scientific community should be responsible for defining an allowed zone on research. But I think questions remain about procedurally how that allowed zone would be defined and by whom.

[Slide] In part, recognizing that the development of substantive standards may only address part of the problem, because it does not attend to the procedural questions around how such standards are developed, several groups, including most recently the group at SCoPEX that Frank just alluded to, have thought about putting forward the notion of advisory commissions to govern research. These advisory commissions, obviously, exist in other domains. People have put forward a number of design features, including independence, transparency, broadly framed and publicly engaged.

Generally, these commissions are recommended by these groups to be interdisciplinary in nature, and perhaps also to include a wide range of stakeholders, including perhaps representatives from NGOs and indigenous groups. The advisory commissions could be tasked with a range of activities, including recommending guidelines for oversight of research, including addressing that kind of thorny question I alluded to earlier about the object of governance and what does or does not merit additional oversight.

I think there still remain some questions about the scale at which these commissions might operate: so should they offer aid and advice to some experiments, or should they apply at the project level; sub-state, national, or international level? I am not sure there is a straightforward answer here, but it certainly is an interesting idea.

[Slide] Lastly, I will loop back and return to the SPICE experiment. In the SPICE experiment in the United Kingdom, the approach to governance was broadly under the umbrella of what has come to be known as Responsible Research and Innovation (RRI), which is a framework for thinking about the steering of innovation that has been taken up at various places, including most recently by the European Union.

The approach, in particular, that was institutionalized in the case of SPICE, was a stage-gate approach, which generally uses criteria for the progression of research through discrete stages of the R&D process. In this case, the stage-gates themselves were constructed to include responsible innovation criteria, so not just technical and market criteria. For example, the stage-gates included understanding public and stakeholder views, clear communication of the purposes of the project, etc.

The way that this was institutionalized was that an independent panel that reviewed the research team's responses to the stage-gate questions then made recommendations to the UK research councils that had funded the experiment to begin with.

Eventually, the SPICE experiment was canceled, in part at least, because of the concern about patent application in May of 2012.

But I think several lessons have been derived from this experience, many of which were published in Jack Stilgoe's book, but also in a paper in 2013 that went through this process, including that many of these institutional frameworks, including a stage-gate approach and responsible innovation more broadly, should have probably been in place earlier in the research process, but that in general, arguably, it opened up broader reflection and deliberation by the research team itself, evidenced, for example, by the fact that one of the lead PIs started a blog post where he was reflecting more seriously about his role in geoengineering research and the broader political and social implications.

[Slide] Quickly, to wrap up, I think there are several things that I would like to emphasize.

First of all, I would argue that, at least among the experts who have been thinking about the governance of research, there is some general agreement regarding high-level principles around governance, which is not to say that there are not still some very fundamental disagreements about the value of research in this space at all, even within scientific circles.

What I think we do see is more disagreement around specific proposals for research governance, including around this question of the object of governance. So, is it appropriate to have governance frameworks for geoengineering in general, or should we be focused much more on specific techniques, and at what stage should that happen, and are new institutions necessary?

I think that all of these frameworks may have some role to play, but a question would then become how do these frameworks align, or not, in practice?

Lastly, just the need to attend seriously to how we might think about governing privately funded research.

I will stop there..