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Swimming upstream: Engaging the American public early on climate engineering

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Abstract

Calls for public participation in climate engineering research and governance have appeared in numerous scientific and policy reports on the topic, indicating a desire for transparency and public oversight. But meaningful public engagement can require more of scientists and regulatory agencies than many realize. Over the past several decades, researchers and practitioners have developed many different methodologies to enable citizens to productively engage with experts and policy makers about emerging scientific and technological issues such as climate engineering. In fact, the United Kingdom has already convened several public participation exercises on climate engineering. Now is the time for federal agencies in the United States to start similar processes. The public is ready to discuss climate engineering. Are American scientists and decision makers ready to reciprocate?

Keywords

carbon dioxide removal, CDR, climate engineering, ENMOD, geoengineering, public engagement, solar radiation management, SRM

On March 18, 1971, columnist Jack Anderson exposed the "Watergate of Weather Warfare" in the *Washington Post*. Under the headline "Air Force Turns Rainmaker in Laos," Anderson (1971) described how covert US military operations in Southeast Asia aimed to seed clouds and increase rainfall to reduce traffic along the Ho Chi Minh Trail, the major supply route of the United States' adversary in the Vietnam War. The revelation of this top secret program eventually led to the creation of the United Nations Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques, otherwise known as the ENMOD Convention, which went into effect in 1978 (Fleming, 2006, 2010).

This little-known convention recently came back into the spotlight with the advent of the idea of climate engineering—the deliberate, large-scale intervention by humanity into the Earth's climate system in order to moderate global warming. Proposals include mimicking

volcanic eruptions by increasing the concentration of sulfate particles in the upper atmosphere to reflect incoming sunlight, and fertilizing the oceans with nutrients to create algae blooms to consume large amounts of carbon. Also known as "geoengineering," this approach has garnered burgeoning attention from scientists and policy makers in recent years as a possible response to climate change.[1]

Scientists researching climate engineering do not wish to reproduce the secrecy that surrounded past attempts at weather and climate modification, like those of the Vietnam War. "Public participation and consultation in research planning and oversight" is one of five key recommendations for responsible research that was agreed upon by a group of climate engineering experts at an international conference in 2010 (Asilomar Scientific Organizing Committee, 2010).[2] Similar calls for public participation in climate engineering research and governance have appeared in numerous science and policy reports on the topic, indicating a desire for transparency and public oversight (Bipartisan Policy Center, 2011; House of Commons, 2010; Olson, 2011; Royal Society, 2009).

However, such ideas are easier in theory than in practice. Meaningful public engagement can require more of scientists and regulatory agencies than many realize. Reports advocating public participation rarely describe how it should be conducted, who should conduct it, when, and for what purpose.[3]

These questions are not easy to answer. But over the past several decades, researchers and practitioners have developed many different methodologies to enable citizens to productively engage with experts and policy makers about emerging scientific and technological issues such as climate engineering. In fact, the United Kingdom has already convened several public participation exercises on climate engineering. Now is the time for federal agencies in the United States to start similar processes.

Public participation and climate engineering

There are two types of climate engineering proposals: those that aim to reduce the amount of carbon dioxide in the atmosphere and those that aim to reflect more incoming solar radiation back into space. The former are classified as carbon dioxide removal (CDR) techniques; in addition to fertilizing oceans, they include methods such as the large-scale planting of genetically modified, fast-growing trees, and the use of artificial trees to capture and store carbon dioxide. While such techniques actually address the cause of climate change by reducing greenhouse gas concentrations, current removal proposals appear expensive and will likely take a long time to have a noticeable effect on the global climate.

The other broad category of climate engineering proposals falls under the heading of solar radiation management (SRM). In addition to mimicking volcanic eruptions, it includes methods to brighten the clouds over the ocean by injecting small saltwater droplets, or putting mirrors into space between the Earth and the sun. There are also some surface-based SRM techniques, such as painting roofs white on a large scale or putting large mirrors in deserts.

In contrast to CDR techniques, certain SRM approaches could be technologically feasible in the near term and cool the planet quickly. Solar radiation management could also be relatively

inexpensive compared with efforts to lessen the amount of carbon regularly pumped into the atmosphere by humankind—such as changing from the burning of coal for the production of electricity to generating energy from photovoltaics, and using hybrid or electric vehicles in place of gasoline-powered automobiles (Keith, 2013). Solar radiation management also has the potential to be cheaper than efforts to adapt to a permanently changed environment—such as the building of seawalls to counter the rising waters of a warmer planet. For these reasons, certain of these proposals—specifically those that mimic volcanic eruptions and brighten marine clouds—have seen an upsurge of attention from scientists and policy makers, with rising calls for increased research (Bipartisan Policy Center, 2011; Keith et al., 2010).

Agencies such as the US National Science Foundation, the Environmental Protection Agency, and the Energy Department have already funded research into various aspects of climate engineering. So far, however, research funding has been limited, and oversight of climate engineering has been addressed in what the Congressional Research Service describes as "a largely piecemeal fashion" (Bracmort and Lattanzio, 2013: 38).

In other words, important decisions about research funding and regulation have yet to be made. The nascent nature of climate engineering research means that now is the time to think critically about whether and how to proceed with public participation.

But are Americans ready to discuss climate engineering?

While media coverage and public awareness of climate engineering are on the rise, surveys show that the large majority of Americans have not heard of climate engineering; even fewer are familiar enough with the term to correctly define it (Corner et al., 2012; Mercer et al., 2011). In the past, low levels of public awareness were cause for educational campaigns, which were seen as a necessary step before meaningful public participation. The public certainly does need accurate, digestible scientific information about climate engineering; however, certain types of public participation can contribute effectively to climate engineering science and policy before everyone is fully educated and up-to-date on the topic. There are a number of public participation processes, broadly referred to as "upstream public engagement," in which participants learn about the topic of interest as part of the process itself. Social science research has demonstrated that these types of processes can be most effective when they are started in the very early stages of research and development, before the technologies and the discourses surrounding them are set in stone (Rogers-Hayden and Pidgeon, 2007; Wilsdon and Willis, 2004).

The goal of such processes is to encourage the public to play an active role in deliberations throughout the entire research and development phase of a new technology; therefore, it is important to include the people who may be most affected by that technology in the discussion (Corner and Pidgeon, 2010). If decision making is to be more inclusive and transparent, then this means creating meaningful forums for members of the public to ask questions, such as:

> Why this technology? Why not another? Who needs it? Who is controlling it? Who benefits from it? Can they be trusted? What will it mean

> for me and my family? Will it improve the environment? What will it mean for people in the developing world? (Wilsdon and Willis, 2004: 28)

Early deliberations on these sorts of questions can help ensure that experts and decision makers consider the broadest ways of thinking about a given problem, and that regulatory policies include ample reflection on risks and public needs. For instance, in 2008 a nationwide upstream engagement process revealed significant public concerns about access to, and control of, nanotechnology. These concerns were then made available to members of Congress working on legislation related to funding future nanotechnology research (Guston, 2014; Philbrick and Barandiaran, 2009).[4]

Researchers and practitioners have developed a variety of methodologies in recent years to enable members of the public to productively discuss complex scientific issues like climate engineering with experts and decision makers. Examples include citizens' juries, consensus conferences, and citizens' technology forums—such as those involving nanotechnology. While the specifics of each method vary, they do share some common characteristics, the most important being discussion and the exchange of information between all concerned parties. Rather than information being conveyed in a one-way fashion from the experts to the public as in the typical public awareness campaign, or from the public to regulators as in public comment processes, upstream engagement processes allow for a true dialogue, with mutual learning that can transform the ideas and opinions of everyone involved (Rowe and Frewer, 2005).

Different methods for conducting public engagement exercises share important procedural elements. Typically, participants are recruited from the broader public in order to achieve a generally representative sample of some type, whether in terms of demographics or viewpoints on relevant topic areas.[5] Experts then introduce participants to the specific issue of interest, followed by discussion and deliberation (typically guided by a moderator), which ideally includes the experts and relevant decision makers. Engagement processes over the past decade have indicated that members of the public are able to not only grasp complex scientific and technological issues quickly, but also effectively engage experts and decision makers in discussions about those issues (Corner et al., 2012; Philbrick and Barandiaran, 2009; Walmsley, 2009).

In other words, even though public awareness is currently low, members of the public can begin contributing to research and policy making on climate engineering sooner rather than later via upstream engagement processes.

Why upstream public engagement in the United States?

Upstream public engagement makes sense as a starting place for discussing the idea of climate engineering in the United States for several reasons. First and foremost, climate engineering is very much a technology in the early, upstream phases of research, development, and regulation. Big questions—about the trajectory of scientific research, the technologies that may be developed and the risks they may entail, and government regulation—are still full of uncertainty and therefore up for

discussion. Public participation at this early stage could be particularly fruitful because it could inform research and policy regarding concerns about risks and uncertainties that may not be visible from the purely scientific perspective.

Second, from a research standpoint, emerging high-risk technologies such as climate engineering often struggle to obtain private-sector financing and support during the initial phases of investigation. As the Congressional Research Service (Bracmort and Lattanzio, 2013: 24) states: "Emerging technologies (such as climate engineering) may require some measure of initial public subsidy to help spur development"—meaning that US research into climate engineering will likely be dependent upon funding from federal agencies. Many Americans are unaware that their tax dollars are funding such work. This is not unusual with emerging science and technology, but unlike other federally funded research, even field tests of certain solar radiation management technologies could have an impact upon the entire American population, although they'd have to be large-scale field tests. Any one individual or segment of the population will be limited in their ability to either consent to or opt out of such field tests. Climate engineering technologies are not like a product that one can simply choose not to buy. While no large-scale field tests have been proposed to date, upstream engagement processes would provide an opportunity for members of the public to provide input into decisions about the nature of field testing before specific proposals are on the table.

Third, climate engineering cannot be separated from other technological and policy responses to climate change. For example, the prospect of climate engineering could create something akin to a "moral hazard" that erodes commitment to reducing greenhouse gas emissions. Individual nations could adopt the attitude that they do not need to take active, costly steps to reduce their production of greenhouse gases because a future technology will handle the problem. Thus, the public interest in climate engineering is not just about how, and to what extent, these technologies might benefit or harm them. The public must wrestle with the possibility that fewer resources may be devoted to reducing greenhouse gas emissions if climate engineering looks promising. This is particularly important for solar radiation management because, once deployed, any abrupt cessation in such management would leave many people and ecosystems even more vulnerable to elevated greenhouse gas concentrations due to rapid temperature rise (McCusker et al., 2014; Robock et al., 2008).

Climate engineering policy, in other words, is tied into a wide range of other social and environmental issues in which the public has a serious stake. Upstream engagement could provide members of the public an opportunity to think about the full complexity of responses to climate change, and about the relative benefits and risks of climate engineering compared with climate mitigation or adaption.

Fourth, the partisan divide on climate change in the United States places climate engineering discussions in a unique context. Numerous studies have demonstrated that in contrast to, say, Europe, views in the United States about climate change are connected to political ideology and political party affiliation (McCright and Dunlap, 2011; Pew Research Center, 2012), and that

political differences are framed as disagreements over the science of climate change. There are some indications that climate engineering could shift the partisan discussion on climate change (Kahan et al., forthcoming; Lane, 2013). In that case, upstream public engagement might provide useful and meaningful forums for altering some of the entrenched politics of the climate change problem, and provide an opportunity to destabilize the dogmas of current climate politics in helpful ways.

What upstream public engagement might look like

At this time, there is no clear regulatory body at the federal level to coordinate upstream public engagement and incorporate the results into formal decision processes. As researchers David Winickoff at the University of California, Berkeley, and Mark Brown at California State University, Sacramento (2013: 81), suggest, a logical first step could be the establishment of a government advisory committee to "recommend principles, policies, and practices that help make research more safe, ethical, and publicly legitimate." This advisory committee could then promote public engagement exercises as part of federally funded research projects on climate engineering, and help ensure that the results are relayed to the relevant government agencies early enough to inform policy.

Unfortunately, this type of advisory committee does not yet exist. But for the time being, preliminary public engagement exercises could be encouraged by federal research funding agencies. For example, the Environmental Protection Agency, the Energy Department, the Department of Agriculture, and the National Science Foundation all fund climate engineering research; these agencies could require that future research projects include public engagement exercises, which could inform both the specific research being funded and broader discussions about research and policy. Several such efforts have already taken place in the United Kingdom; for example, in 2010 the United Kingdom's Natural Environment Research Council commissioned a series of public dialogues to inform future decision making based on public views regarding the ethical and social implications of climate engineering (Ipsos MORI, 2010). Results indicated that some approaches to climate engineering garnered more support than others, while also revealing concerns about the controllability, reversibility, effectiveness, and oversight of various technologies.

Perhaps even more pertinent, a subsequent project funded by the same organization, which did not include public engagement, met with stiff opposition from concerned citizens and environmental groups. Public opposition to the SPICE (Stratospheric Particle Injection for Climate Engineering) project was part of the reason why a small outdoor experiment was canceled, even though it was the centerpiece of the original research proposal. In later public discussions, scientists learned that the experiment itself was of less concern than what it represented—a symbolic step toward the development of technologies that could someday control the climate (Stilgoe et al., 2013). These and other public engagement efforts in the United Kingdom (Corner et al., 2012; Macnaghten and Szerszynski, 2013) provide insights into how to carry out such processes, as well as indicating what can

happen when researchers fail to include the public.

Similarly, the National Citizens' Technology Forum on nanotechnology and human enhancement (defined as the use of nanotechnologies to improve human abilities, such as enhancing intelligence or restoring damaged brain cells) provides a well-documented example of federally funded research that included upstream public engagement on emerging science and technology issues in the United States (Guston, 2014; Philbrick and Barandiaran, 2009). The researchers involved stated that their exercise served as a proof-of-concept for nationwide upstream public participation in the governance of emerging technologies—even if no specific legislation came about as a result (Philbrick and Barandiaran, 2009: 335).

Professional societies or other nongovernmental organizations could also initiate efforts in public engagement. For example, the United Kingdom's Royal Society organized a small public engagement process as part of their 2009 climate engineering report (Corner et al., 2012). The society also coordinated efforts with the Academy of Sciences for the Developing World, and the Environmental Defense Fund, to start up the Solar Radiation Management Governance Initiative. This collaboration precipitated meetings with scientists, journalists, decision makers, and members of the public in the United Kingdom, Africa, and Asia, focused on SRM research and regulation (SRMGI, 2011). This partnership and the resulting meetings demonstrate the possibility for similar collaborations in the United States.

Despite numerous potential benefits, however, upstream public engagement is not a panacea. The conveners of public engagement exercises must think very carefully about who is being included in the process, and perhaps more important, who is not included (Braun and Schultz, 2010). There is the danger of defining "the public" in such a way that it excludes particular perspectives or demographics, thus legitimizing only one subset of public views on climate engineering. Similarly, engagement processes should complement but not replace other forms of public involvement in federal decision making, such as the public involvement process mandated by the National Environmental Protection Act. These typically "downstream" participation processes allow far more people to express their opinions on actions that affect the environment than upstream engagement processes, which include only a small subset of the public.

Making it count

Upstream engagement does not necessarily guarantee better climate engineering science, technology, or regulation. The quality of the outcome depends on the effectiveness of the process itself. For instance, how the information about climate engineering is presented and who presents it can strongly affect how participants respond, which in turn determines what gets conveyed afterward to scientists and decision makers about public views on the issue (Corner et al., 2012; Macnaghten and Szerszynski, 2013). More important, there is no legal requirement for federal agencies to engage the public prior to developing regulations and specific project proposals.[6]

Even if upstream engagement processes are carried out, public input may not have an effect upon federal policy. Even the best public engagement

process cannot meaningfully contribute to research and governance if the results are ignored (Guston, 2014; Stilgoe et al., 2014). This can lead to frustration on the part of participants and the broader public, who may feel that their contribution was not taken seriously, and that the resulting policy is not fair or transparent. This further erodes public trust in researchers and government.

In a similar vein, upstream public engagement processes should not be expected to identify unified, consensus views or come up with specific directives for scientists and policy makers. The value of upstream engagement does not hinge on generating consensus, or quelling controversy and debate. Rather, its strength lies in highlighting public concerns—even if they are highly contested—and exploring how they can inform the scientific and policy making process.

With these challenges in mind, upstream public engagement should not be entered into lightly; meaningful public engagement is both costly and politically risky (Stilgoe et al., 2014). To be effective, such processes should be convened in partnership with organizations that have extensive experience in this area. Public engagement exercises should not be tacked on as afterthoughts to proposals for federal funding, but thoughtfully integrated as valued pieces of the interdisciplinary research that is critical to future exploration of climate engineering.

The research community has expressed a desire for greater public participation in climate engineering research and governance. However, publishing these sentiments in policy reports and academic journals is not enough to guarantee that future research and decision making is actually more transparent and responsive to public concerns. If scientists truly want to avoid the secrecy of past attempts at climate and weather modification that led to the ENMOD Convention, then now is the time to actually begin implementing participation processes. The public is ready to discuss climate engineering. Perhaps the question then is, are scientists and decision makers ready to reciprocate?

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Notes

1. It is unclear how the ENMOD Convention might affect climate engineering proposals because the treaty does not prohibit research on or use of environmental modification for peaceful purposes. In fact, it is currently far from clear how climate engineering research will be regulated, if at all, within the United States or internationally (Bracmort and Lattanzio, 2013; Hester, 2013).
2. The five principles for responsible research advanced by the experts at the Asilomar conference are based in large part on the Oxford Principles of geoengineering research, perhaps the most well-respected set of norms proposed to date for the governance of climate engineering research (Rayner et al., 2009, 2013).
3. With a few notable exceptions; see, for example, Corner and Pidgeon (2010).
4. This engagement exercise was entitled the National Citizens' Technology Forum on Nanotechnology and Human Enhancement, and consisted of a month-long deliberative process involving over 70 citizens at six different sites across the country. These deliberations resulted in a report by participants recommending that nanotechnologies for human enhancement be developed for the collective good, with strong public oversight and equitable access to the benefits regardless of socioeconomic status (Bal, 2013).

The results of this public engagement process were provided to the Congressional Nanotechnology Caucus in conjunction with discussions about the reauthorization of the National Nanotechnology Initiative.

5. Some public engagement methods strive for statistically representative samples of the larger population, while others are primarily concerned with capturing the wide range of viewpoints on an issue of interest. For example, researchers in the United Kingdom convened seven focus groups composed of participants whose backgrounds made them likely to think about climate engineering in different ways. One group was composed of outdoor enthusiasts, another of mothers of young children, and a third of professionals in the public sector (Macnaghten and Szerszynski, 2013). Accordingly, each individual pool of recruits garnered from the general public need not be what a statistician would call a statistically representative sample of the entire larger population.
6. The Administrative Procedure Act (1946) requires that the agencies seek public comment during the development of specific federal regulations. The National Environmental Policy Act (1969) requires public involvement in any federal or federally funded project that might impact the environment. However, in both cases, the public involvement requirement is "triggered" by the proposal of a specific regulation or project. Thus, because they are not legally required to do so, federal agencies do not typically engage the public on more generalized key issues of public concern prior to specific policy and project proposals.

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