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Geoengineering's Thermostat Dilemma

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Geoengineering is gaining attention as a possible tool for ameliorating climate change. These largely untested techniques are sometimes analogised to a thermostat that will enable humans to fine-tune the Earth's climate. Although overly simplistic, this metaphor highlights a fundamental dilemma that the capacity to geoengineer would raise: whose hand should control the thermostat? Unpacking this question exposes multiple issues warranting careful research and debate: (1) which nations should decide; (2) what role scientists and other expert communities should have in the decision making process; (3) what role non-State actors should have in the process; (4) how to account for the interests and preferences of future generations; and (5) what mechanisms should be in place to ensure compliance with decisions agreed upon. From the standpoint of organising collective action, geoengineering is relatively unproblematic because a single nation may have the resources and technical capacity to undertake geoengineering on its own. However, as the thermostat metaphor reveals, geoengineering will present extremely difficult challenges of law, policy making, and ethics for the international community.

1. Introduction

Geoengineering refers to a variety of unconventional and often controversial proposals for responding to climate change. These methods include: spraying tiny sulphur particles into the atmosphere to block the sun's radiation, fertilising the ocean to stimulate phytoplankton growth that might store carbon in the oceans, and the like. Geoengineering technologies are far from mature, as no geoengineering techniques are ready to be deployed, and thus no full-scale geoengineering projects have been undertaken. Moreover, even if some geoengineering techniques are perfected

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one day, they are unlikely to constitute a complete and permanent solution to climate change. Nonetheless, geoengineering proposals raise the prospect of choosing a climate for the planet. Accordingly, geoengineering is sometimes likened to a thermostat for the Earth, a metaphor that highlights a critical question: who should control the thermostat?

To be sure, the thermostat metaphor is overly simplistic. Similar to the term "global warming", the metaphor focuses too narrowly on average temperature rise. Climate change poses a grave threat not only because of hotter temperatures, but also because of rising oceans, more powerful storms, more frequent droughts, and other expected climate effects. The thermostat metaphor potentially trivialises climate change in suggesting that the problem is merely a matter of comfort. Furthermore, the analogy both overstates the degree of control that humans have over the Earth's complex climate systems and understates the technical difficulties of implementation. Geoengineering proposals involve various risks and uncertainties that we are only beginning to explore. These risks and uncertainties are magnified by the incomplete climate models on which we rely. In addition, adverse effects of geoengineering are likely to vary from one region to another, suggesting that no climate setting will be without objection. Finally, the thermostat analogy gives short shrift to the effects of climate change on other living things. The comparison encourages a utilitarian, anthropocentric mindset that obscures ethical consideration of other species and the environment. Ultimately, the thermostat metaphor represents a potentially dangerous framing of climate issues that could foster complacency and undermine more realistic and important responses to climate change.

Notwithstanding its serious shortcomings, the thermostat metaphor does capture a dilemma that looms over the geoengineering debate: who should decide whether and how geoengineering is implemented? In the discussion to follow, I assume that technically feasible methods of geoengineering could eventually be developed. Even under this assumption, geoengineering will raise numerous difficult issues for the international community. This essay uses the thermostat metaphor to explore some of the more prominent policy and legal questions at stake.

2. Collective Decision-Making

To what extent would a geoengineering thermostat pose a unique challenge for international decision making? On the one hand, ordinary inter-

national law-making procedures, though imperfect, may be sufficient to address geoengineering. State representatives could consider geoengineering governance through the United Nations or other multi-State organisations and address relevant concerns through treaties and other formal mechanisms. On the other hand, if geoengineering departs from other global concerns in significant ways, we may need new or modified decision making mechanisms that take those differences into account.

At least three aspects of the thermostat problem call for broader participation and input than is typical for international decision making processes. First, geoengineering decisions will have exceptionally far-reaching and concrete impacts. Geoengineering deployment could have potentially disastrous effects for millions, such as modification of the Asian and African summer monsoons. Governance of geoengineering thus must address a truly global concern, in contrast to relatively local fishery conflicts or transboundary pollution problems. Second, geoengineering would serve as a single thermostat for the entire world; for the most part, there is little realistic prospect for multi-zone climate control. This thermostat mechanism would allow little or no room for national variations on a global norm, in contrast with many other subjects of international regulation. Legitimate concerns thus would have to be considered in international fora if they are going to be considered at all. Third, and perhaps most importantly, a decision to implement geoengineering would require the resolution of contentious disputes rooted in deeply held values. People's views on geoengineering will depend on their underlying values and beliefs concerning justice, nature and tolerance for risk, and these values and beliefs will play an especially significant role amidst the substantial uncertainty surrounding geoengineering.

Granted, many problems addressed by international environmental law, such as climate change or ozone depletion, have involved disagreement over whether a problem exists and how to address it. However, once a problem is acknowledged, there is usually relatively little disagreement regarding the appropriate goal. With respect to climate change, for example, the international community agreed on a goal of stabilising greenhouse gas concentrations so as to avoid "dangerous anthropogenic interference" with the climate system. Similarly, recognition of the problem of ozone depletion led swiftly to a consensus to protect and restore the ozone layer. Geoengineering, however, presents a particularly thorny political problem because no obvious point of equilibrium is likely to command

consensus support. Simply put, reasonable persons are likely to disagree on where the thermostat should be set. These circumstances suggest an especially strong need for open and deliberative decision making processes.

3. Issues to Resolve

The question of whose hand should control the thermostat actually involves multiple inquiries regarding: (1) which nations should decide; (2) what role scientists and other expert communities should have in the decision making process; (3) what role non-State actors should have in the process; (4) how to account for the interests and preferences of future generations; and (5) what mechanisms should be in place to ensure compliance with decisions agreed upon. This section considers each of these inquiries.

3.1. Which Nations Should Decide?

At first glance, it may appear self-evident that all nations desiring to be involved in setting the thermostat should have the opportunity to participate. Virtually every nation is a party to the U.N. Framework Convention on Climate Change (FCCC), which treats climate change as a matter of concern for the entire international community. A process inclusive of all interested nation-States is consistent with basic notions of fairness, and with the traditional international law narrative of equality and consent among sovereign States. Decisions resulting from such a process are therefore more likely to be viewed as legitimate than decisions made by a select few.

Processes that require formal international consensus as a prerequisite to action, however, can be slow and ineffective. Indeed, the complexity of negotiating comprehensive greenhouse gas emission reductions among the nearly 200 parties to the FCCC has led many to advocate that climate change negotiation processes be limited instead to a smaller subset of countries. Negotiations among the several nations responsible for the vast majority of carbon emissions, it is argued, can substantially reduce overall emissions without requiring commitments from non-parties to the negotiations. Geoengineering negotiations limited to a few States would offer similar advantages of relative simplicity and reduced vulnerability to obstruction by holdouts. Excluded parties would surely object,

however, that it is presumptuous for a handful of countries to commit the entire world to a particular thermostat setting.

A bargaining structure akin to the World Trade Organisation's "green room" offers a hybrid approach that might facilitate consensus formation without excluding interested States. Under such an approach, a small group of countries participates in initial bargaining on a tentative agreement. Such agreement would still be subject to consensus approval by a larger membership. Undoubtedly, participants in the small-group negotiations could wield substantial influence on ultimate outcomes, and there would often be pressures in the large-group approval process to go along with tentative agreements. Careful attention to the selection of small-group participants is critical to reduce the danger of inadequate representation. Representation in geoengineering negotiations, for example, might include guaranteed seats for different geographic regions, on the assumption that geoengineering impacts will likely vary by region. Representatives of regions most vulnerable to the adverse impacts of geoengineering might even be given veto authority over decisions to implement certain types of geoengineering projects.

The fact that some geoengineering schemes could be carried out unilaterally complicates the question of which nations should decide. Unilateral geoengineering, even if undertaken with good intentions, surely would be denounced if it occurred without the sanction of the international community. Nonetheless, the possibility that a single nation could attempt to seize control of the thermostat or that several countries could engage in counterproductive geoengineering efforts is sufficiently serious to warrant concern about international conflicts that could result. A few countries, including the United Kingdom and Russia, have already expressed an inclination to move forward with geoengineering field tests in the absence of international approval. While such field tests are not equivalent to full-scale deployment, they still underscore the need for formal international attention to geoengineering. More generally, the possibility of unilateral action, collateral damage, and subsequent hostilities suggests that institutions relevant to international armed conflict, such as the United Nations Security Council, may ultimately have an important role to play in geoengineering policy making.

3.2. The Role of Scientists

A second issue raised by the thermostat metaphor focuses on the thermostat makers: what role should scientists play? Under a conventional understanding of scientists' role in policy making processes, while scientists are the ones generating data and recommendations, it is the democratically accountable officials who ultimately make policy choices. With respect to research activities themselves, the scientific community typically exercises broad freedom of inquiry and enjoys minimal external oversight. Knowledge is intrinsically valuable, so the argument goes, and external influences that might circumscribe or corrupt its pursuit should be avoided. Following the distinct roles of scientists and policy makers, few would advocate that scientists direct science-based policy decisions. In particular, determining where a geoengineering thermostat should be set is a value-based choice that lies beyond scientists' expertise and demands broader societal deliberation.

A strict dichotomy between research and policy, however, represents a gross oversimplification of reality. Research activities are not purely objective, as assumptions and models that underlie scientific research necessarily incorporate researchers' value judgments. Conversely, policy decisions often reflect significant influence by experts, whether resulting from their recommendations or their direct participation in decision making processes.

Science and policy issues are especially intertwined with respect to geoengineering. Firstly, as with other emerging technologies, early choices regarding research and development are likely to have outsized effects on subsequent technology adoption and use. Substantial investment in research can create and empower interests having a professional, financial, and psychological stake in promoting applications of that research. Secondly, the goal-oriented nature of geoengineering research means that efforts in the field will inevitably reflect policy preferences. Geoengineering does not involve a neutral inquiry into scientific "truth". Rather, geoengineering is more applied science than pure science in that it encompasses efforts to discover particular means of achieving a selected end. As such, research into geoengineering presumes at least some willingness to go forward with implementation in the future so long as certain conditions (of safety, risk-benefit analysis, or otherwise) are met. Yet geoengineering raises serious ethical questions of moral responsibility that demand careful reflection by society before committing to action. For example, is it

morally permissible to cause further harm for the sake of ameliorating threats generated by our own past, present, and future conduct?

Ultimately, governance of geoengineering research cannot be divorced from governance of geoengineering deployment. Because geoengineering research may close off debate on the socially contested question of whether a geoengineering thermostat should be created in the first instance, the scientific community should not exercise free rein over the pursuit of geoengineering research. The need to involve non-scientists – political actors, nongovernmental organisations, and the general public – in the oversight of geoengineering research is critical and is gaining growing recognition. However, the form of that oversight and the nature of non-scientist involvement are yet to be determined.

Under one proposed option, scientists would take the lead in developing codes of conduct or other informal mechanisms of research governance. Bottom-up, non-governmental processes can be more immediate and flexible than those requiring State action. In theory, such processes can involve non-scientists, and they can lay the groundwork for more formal regulation. One danger in a bottom-up approach, however, is that the scientists whose research would be subject to any resulting norms may dominate the process. As a result, the option of not moving forward with research – an option that warrants examination because of the dangers of moral hazard and technological lock-in – is unlikely to receive serious consideration. Moreover, without the sanction of the international community, a bottom-up process and any norms generated by it will be lacking in political legitimacy.

3.3. The Role of Non-State Actors

The Westphalian conception of international law envisions little or no role for non-State actors in the creation of international law. That conception does not accurately describe international law today, however, nor does it set out an ideal for geoengineering governance. A system operating solely through the consent of sovereigns is unlikely to be fully representative. Sovereigns imperfectly reflect the interests of the people they rule, sometimes overlooking indigenous or minority concerns, and the political processes that lead to the formation of State positions may be exclusionary and opaque. Broader participation can increase the legitimacy of international governance and foster more informed deliberation.

In the abstract, the goal of creating more inclusive processes for global decision making commands widespread support. How to achieve this goal in practice, however, poses difficult questions. Sovereign States are reluctant to yield power, reasonable persons disagree as to who should be involved and in what capacity, and options for resolving fundamental conflicts in values are limited. Universal direct participation in setting any geoengineering thermostat, for instance, is hardly sensible or realistic. Even decision making along the lines of a representative democracy may be impossible, given the lack of political structures for democratically controlling international institutions. Indeed, the very concept of democratic representation on a global scale is problematic in the absence of a global public that shares a collective identity.

Notwithstanding the barriers to more inclusive governance, non-governmental organisations, community organisations, labour unions, and other civil society organisations have come to play an increasingly important role in international law. Such organisations are not democratically chosen and have no formal law-making authority. Yet they participate by framing issues, setting agendas, developing policy options, shaping State positions, and monitoring State commitments. Civil society organisations also function as pluralistic intermediaries between international legal regimes and the publics the regimes ultimately govern. These organisations can articulate citizens' concerns and channel them into international deliberative processes, while communicating to citizens the issues and decisions that are subject to those processes.

Civil society organisations could play an important role in raising public awareness of geoengineering and of the risks and uncertainties at issue. Their most critical task, however, may be to amplify the voices of those whom geoengineering would adversely affect. Whether working through formal law-making forums, less formal norm-setting arenas, or various media of general opinion formation, these organisations can remind the world that setting the thermostat should not involve the exercise of power by the few to advance narrow or purely domestic interests. Nor should setting the thermostat consist merely of a calculation that maximises benefits and minimises costs. Geoengineering – like climate change – will have victims, human and nonhuman. By giving these victims a name, face, and voice, civil society organisations can push the world toward making responsible decisions regarding any development or use of a geoengineering thermostat.

3.4. The Role of Future Generations

Incorporating the interests of future generations in thermostat-setting decisions presents an imposing challenge in light of political and economic pressures to respond to short-term concerns. To be sure, climate change is not unique among environmental problems in its enduring impacts. Geoengineering using solar radiation management (SRM) techniques has especially lasting implications, however, because of the so-called "termination problem" associated with these techniques. SRM techniques would ameliorate the warming effect of higher greenhouse gas (GHG) concentrations by reducing the amount of radiation striking the Earth. Because GHG concentrations are unchanged, the sudden cessation of these techniques would have catastrophic effects. Extremely rapid climate change would follow, leaving human societies and natural ecosystems little time to adapt. To avoid a catastrophe, SRM efforts, once deployed, would have to continue until GHG concentrations naturally decline. This process could take hundreds of years even if human societies drastically curb their GHG emissions. Deployment of SRM techniques, in other words, would commit future generations to continuing deployment for the foreseeable future, a politically and logistically daunting task.

Like the long-term storage of nuclear waste, the termination problem raises serious questions of intergenerational equity. Namely, what duties do we owe to future generations, and to what extent may we constrain their freedom of action? If intergenerational equity requires that each generation pass on the planet in no worse condition than received or that future generations have equivalent options for flourishing, it is not clear whether SRM would meet those requirements. Future generations would retain some ability to adjust any geoengineering thermostat, but the deployment of SRM would preclude the option of not using the thermostat at all. Obtaining the consent of future generations to such an arrangement is obviously not feasible, nor can we know in advance future attitudes that might inform our decisions.

Conversely, geoengineering might help us meet our obligations to future generations if it were to protect them from even worse climate consequences. It is critical to ensure, however, that geoengineering not become a self-serving excuse for present inaction. To ward off the temptation to shift the burdens of climate change to the future, legal mechanisms will be needed to represent future generations in deciding whether to go forward with geoengineering, and if so, with what techniques. These

mechanisms might involve appointing a guardian or trustee to represent future generations in decision making processes or imposing fiduciary duties on decision makers to consider impacts on future generations. Giving an explicit voice to future generations does not guarantee a fair weighing of their concerns, but can prevent them from being completely ignored.

3.5. Compliance

Environmental subjects of international concern often present difficult collective action problems because their solution requires the aggregation of cooperative efforts to supply a global public good. The temptation to free-ride off of others' efforts has hindered agreement on significant reductions in GHG emissions, for instance. In theory, geoengineering faces lesser barriers to implementation than emission reductions insofar as it could be undertaken by a handful of nations, a single nation, or even a private actor. Because there can be only one thermostat for the entire world, however, geoengineering raises a different issue of global cooperation: ensuring that only authorised hands are on the thermostat. As already noted, there are likely to be strong disagreements regarding where the geoengineering thermostat should be set, if at all. Thermostat-setting disputes could lead to sabotage of geoengineering projects, countervailing efforts to manipulate the climate, or even armed conflict. These considerations suggest that compliance and enforcement mechanisms more typically associated with arms treaties may be needed. Mechanisms that may prove useful in enforcing a geoengineering thermostat include: verification regimes incorporating external monitoring and inspections, well-defined dispute resolution procedures, clear responses (such as sanctions) to treaty breaches, and export controls.

Non-State actors may have a particularly important role to play in monitoring geoengineering activity and bringing instances of noncompliance to the attention of relevant authorities. Ensuring long-term execution of an agreed-upon course will be particularly critical if SRM techniques are deployed. The institutions tasked with implementing SRM geoengineering must not only have the resources and technical capacity to carry it out, but also be designed to withstand economic and political pressures to compromise for the sake of short-term gain. At the same time, external oversight of such institutions, whether by a group of nations or by non-governmental organisations, can help assure that thermostat-setting decisions agreed upon are actually carried out.

4. Conclusion

The prospect of a geoengineering thermostat raises a host of difficult policy and legal questions. These questions cannot simply be ignored, as pressures to geoengineer will only increase unless we promptly and drastically reduce carbon emissions. Spurred by eager researchers, supportive wealthy donors, and industries seeking to profit from geoengineering contracts, geoengineering efforts are likely to move forward, and in doing so, to confront us with the conflicts embodied in the thermostat metaphor. Although the questions raised by geoengineering seemingly do not demand immediate resolution, inattention to the thermostat dilemma may limit subsequent options, commit us to less-than-desirable courses of action, and preclude careful and inclusive deliberation.

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