Critical thinking from Stanley Foundation conferences

POLICY *dialogue* BRIEF

Assessing Global Climate Engineering Governance

In an effort to begin a global dialogue around international cooperation on climate engineering, the Stanley Foundation and Perspectives jointly organized the workshop "Assessing Global Climate Engineering Governance." The event, held April 1–3, 2015, in Zurich, Switzerland, examined various types of governance needs surrounding climate engineering, including carbon dioxide removal (CDR) and solar radiation management (SRM) approaches.

This brief reflects the workshop discussions on a variety of climate engineering technology options. By design, workshop participants brought a wide range of complementary perspectives to the discussion, including on public risk perception, stakeholder engagement in the Global South, international environmental law, ethics, national security, UN climate negotiations, earth system governance, and economics.

The meeting was structured to enable focused expert discussion on key dimensions of climate engineering governance leading to greater clarity and, ideally, a common understanding of those dimensions. Ultimately, the organizers hope this discussion will open a global inclusive and representative discourse leading to more-adequate and informed decision processes on climate engineering in the medium to long term.

Highlights of the Workshop

- Despite not having led to emissions reductions compatible with the target of limiting warming to 2° C, the United Nations Framework Convention on Climate Change (UNFCCC) process provides important lessons for the emerging governance of climate engineering.

- The Intergovernmental Panel on Climate Change (IPCC) is a highly relevant institution with regards to developing a common understanding of the state of climate change-related research and communicating it to policymakers. Climate engineering could be addressed by the IPCC in various contexts (assessment reports, special reports, scenario development).

- A special IPCC report on CDR and another one on SRM would help advance the discussion of these technology clusters in order to identify policy-relevant knowledge gaps, thus enabling research funders to support relevant research.

Co-Hosted by
The Stanley Foundation and Perspectives

April 1–3, 2015
Zurich, Switerland

The Stanley Foundation

perspectives climate change

This brief summarizes the primary findings of the conference as interpreted by the rapporteur, Inken Krause, organizer, Matthias Honegger, and chair, Axel Michaelowa. Participants neither reviewed nor approved this brief. Therefore, it should not be assumed that every participant subscribes to all of its recommendations, observations, and conclusions.

- While most action currently needed on SRM involves scientific research, it is useful to think about long-term governance objectives preceding a decision to apply an SRM technology.

- Actions needed to improve societies' capability of addressing climate engineering can be classified in five categories: enabling and regulating research, developing and assessing technology pathways, developing institutional and regulatory capacity, deciding on and regulating deployment, and financing deployment.

- In order to advance collaborative governance in all these areas, an international research and governance conference with very broad participation is a recommended next step.

The idea to host an expert meeting on climate engineering governance came against the backdrop of recent events and developments in international climate policy. The new developments lean toward a bottom-up approach for mitigation that is unlikely to follow the emission path required to limit warming to 2° C. Moreover, for almost a decade, attention on climate engineering has increased substantially, albeit from a very low base.

Workshop organizers observed that a lack of common understanding of the main dimensions of climate engineering governance has placed limits on useful discussion. At the same time, most mitigation pathways in the scientific and political discussions appear to rely heavily on some forms of CDR as well as unrealistically high annual global emissions reductions in the near future. These two developments risk creating a situation where ad hoc decisions on climate engineering are taken by policymakers under pressure.

The focus of the workshop was thus on putting the nascent climate engineering governance discourse into the greater context of international climate negotiations.

The Term *Governance*

The concept of global climate engineering governance is not well defined. Given the complexity of the challenge, a useful understanding of climate engineering governance is probably not limited to the legal meaning. Therefore, a more process-oriented view was taken in the meeting's discussions: Governance of climate engineering could take place on multiple levels and within very different time horizons. In a preworkshop memo, the term *anticipatory governance* was introduced as "the vision for dealing with emerging technologies by building the capacity to manage them."[1] The level of societal capacity is seen as the ability to make collective decisions, such as on government action (e.g., treaties or legislation), nongovernmental action (e.g., market pricing or nongovernmental organization protests), as well as mixed public-private activities (e.g., standards, financing, subsidies, and insurance). Hence, anticipatory governance recognizes that the "complicated political economy of technoscience cannot be squeezed into crude dichotomies like government versus market or promotion versus banning."[2] Thus, workshop participants generally agreed that governance should create conditions that enhance international cooperation, so they explored what those conditions might be with respect to climate engineering decisions.

The Current Landscape of Climate Change Governance and Relevance for Climate Engineering

The workshop opened with a presentation on the state of international climate negotiations and the relevance of recent developments for climate engineering.

The presentation shed light on lessons learned from climate change mitigation efforts over 20 years of top-down climate governance. Despite mitigation policies, the emissions trend has not fundamentally changed, and annual emissions are still rising. The presentation depicted that in the past five years, an interesting development toward a more bottom-up approach could be discerned within the UNFCCC, giving countries more freedom in the definition of their contributions to prevent dangerous levels of warming and keeping options for various legal formats open in the upcoming climate negotiations, formally known as the 21st Conference of the Parties of the UNFCCC in December 2015. In the current preparation of the 2015 agreement, as well as toward the 2020 deadline for its entering into force, governments have the power to define their own contributions to address climate change before entering the international process, which is very different from the 2009 Copenhagen conference where state actors attempted a top-down method of internationally negotiated commitments. Despite heavy criticism, the UNFCCC is still viewed as the center of climate change governance activities among a number of transnational climate policy efforts. In the absence of a UN-led process, scattered initiatives would make it impossible for nongovernmental organizations with limited resources to significantly observe and influence the process.

Climate engineering options arguably fit into the bigger picture of climate negotiations as indicated by a number of lessons drawn from including new technology options in policy instruments under the UNFCCC. In particular, lessons on measuring and financing emissions reductions could prove valuable for CDR. There seems to be a growing risk that climate engineering could enter political discourse in a disruptive manner, as climate change policy stakeholders currently do not engage with the topic of climate engineering. Therefore, the presenter recommended fostering proactive engagement between climate engineering researchers, other climate policy researchers, and negotiators and

observers in the UN process in order to build a better understanding of the challenges on all sides.

The subsequent workshop discussion made the point that the UNFCCC process could be associated with some emissions reductions, as compared to business-as-usual forecasts, though the level of feasible emissions reductions was questionable. The effect of building capacity to set up emission inventories and project-based emissions reductions in a wide range of human activities, as well as the building of governmental capacities to report on these developments, is, however, a clear and noteworthy result of the UNFCCC process. Regarding a potential contribution of the process to the governance of climate engineering, two key components emerged in the discussion: (1) economic incentives could be created alongside regulation to determine under which conditions and against which monitoring of captured greenhouse gas quantities CDR projects could receive funding because the incentive structure for CDR technologies largely resembles that of classical mitigation options, and (2) regarding SRM, there is also an opportunity, requiring further exploration, to identify governance options and means for evaluating potential benefits.

Five Governance Dimensions

Five climate engineering governance dimensions were introduced via a pre-meeting memo, which was also presented at the outset of the workshop. The five dimensions, introduced in order to structure and focus discussions, were:

1. Enabling and regulating research within all relevant fields to develop a foundation of knowledge.

2. Enabling development and assessment of technology options and various hypothetical deployment pathways.

3. Developing the institutional capacity to establish modalities regulating potential technology deployment.

4. Deciding on and regulating deployment.

5. Financing technology application.

These five dimensions provided the backbone of discussions in smaller groups throughout the workshop. Participants addressed each of the five dimensions in a dedicated session, which led to discussion of crosscutting issues. A final session was dedicated to identifying and formulating the most important steps to enhance collaborative governance over the short and long terms.

Enabling and Regulating Research

Knowledge of the possibilities and limitations of climate engineering and in particular its economic, social, and political implications is viewed as insufficient, and many researchers fear that their work is hampered by a political lack of credibility associated with the subject, hesitation of funders to support dedicated research programs, and a sense among young researchers that the subject could limit their career opportunities. Most participants agreed that research efforts are somewhat constrained, though they differed as to the type of research that should be strengthened. Several participants said dedicated efforts should be made to prevent the isolation of individual disciplines in the research process.

There was some discussion as to who or what institutions could act in ways that would better enable research to take place. In particular, questions were

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raised as to how research could be enabled without creating distortions from a particular interest toward research of a certain kind. Participants agreed that dedicated IPCC special reports on CDR and SRM would likely help advance research. This could be the case given that such a synthesis of the existing academic literature would highlight the limitations in the current knowledge base and identify important knowledge gaps. Participants noted that this would in turn lend the subject more weight and credibility among parties and observers in the UNFCCC negotiations as well as research funders. Whether signals from purely political actors such as the UNFCCC should be expected, or whether such signals would help enable research, were left as open questions.

A key point of discussion was the apparent hesitation of funders to support substantial research projects on climate engineering. It was noted that in the case of many CDR technologies, much of the research effort has moved away from basic research into the development of prototypes and concrete technical solutions. Such development efforts could be undertaken by the private sector if there was a credible perspective that a substantial carbon price would later reimburse the investments made. Many workshop participants stated that the adequacy and credibility of private sector involvement in research and development hinges on the monetary interests of the respective institution. Various other approaches to deal with the situation of limited research funding were mentioned, such as exploring mixed public-private possibilities and setting up an umbrella fund that would allow reorienting of support from existing foundations to coordinated research efforts.

Participants noted that the introduction of representative deployment scenarios would be a task for which the IPCC would be suited.

Enabling Development and Assessment

Development of a detailed deployment pathway is needed in order to be in a position to fully judge the benefits and risks of a particular technology to an advanced level, especially for SRM. To advance research on the possible consequences of particular types of SRM deployment, standardized scenarios are needed because otherwise only a narrow group of experts would be able to judge research results. Participants noted that the introduction of representative deployment scenarios would be a task for which the IPCC would be suited. Later, common assessment metrics would be required in order to establish clear guidelines for the desirability of particular approaches and their implications on countries. These metrics would need to encompass more than technical parameters and span the spectrum of ecological, social, and political effects.

Given the far-reaching consequences of the selection of such assessment metrics, they would need to be guided by internationally recognized principles. Because of their relevance for climate change, the UNFCCC would be a natural starting point to apply metrics within an international framework.

Developing Institutional Capacity

Here again, as in the previous discussions, there was a strong sense that the requirements for CDR are different compared to SRM. The discussion of CDR centered on existing mechanisms and tools that allow for regulation and deployment of mitigation technologies, including, for example, carbon markets. A benefit of including CDR in carbon market schemes is that they also provide for regulation such as measuring, reporting, and verification (MRV) of emissions reductions and incremental project financing. Since not every technology is covered under current carbon market mechanisms, properly formulated new regulations can enable countries to identify the CDR applications that fit their sustainable development needs. Of course, creating such regulations requires an institutional capacity to define and evaluate such impacts as well as the capability to develop and apply appropriate MRV methodologies to new types of mitigation approaches. While some deficits

in current carbon markets were noted, participants seemed to agree that these capacities could eventually be strengthened in order to address new and emerging CDR technologies.

In particular for SRM, participants agreed there is a need to develop institutional capacities in order to regulate research and development, prevent inappropriate use of climate engineering options, and allow for potentially beneficial applications thereof. Any type of decision of this sort would need to be based on recognized principles in order to gain a common vision of the goals of any climate engineering activity, including a notion as to which agency or body would legitimately make any such decisions. Several aspects of principles were discussed, such as the integrity of measuring, reporting, and verifying results; a capacity for mutual restraint or some balance of powers; transparency; and trust.

Deciding on and Regulating Deployment

Because CDR approaches are already partially applied or close to application—in particular those based on biological processes—the governance challenge of CDR is largely limited to:

- Ensuring the environmental integrity of emissions reductions claims and long-term stability of sequestered carbon.
- Limiting the adverse effects from large land-use changes or changes to ecological systems such as ocean food chains.
- Ensuring there is competition between technology options.
- Mobilizing the vast resources needed for large-scale application.
- Regulating deployment in a manner that ensures sustainable development in line with local conditions and needs.

The discussion of challenges of deciding on and regulating deployment of SRM at some point in the future revealed a number of key aspects that characterize governance of SRM deployment as a very particular governance problem:

- The need for long-term stability or resilience of a potential deployment regime.
- Potential trade-offs between inclusiveness and effectiveness.
- The need for a liability mechanism against damages from deployment.
- The difficulty of differentiating damages caused by:
    - Normal weather events.
    - Climate-change-induced weather events.
    - Climate-engineering-induced weather events.
- The need to ensure that certain principles are met by the decision process as well as the decision outcomes.
- The need for a mechanism to assure SRM does not crowd out mitigation efforts.
- The potential need to put in place emergency decision pathways for:
    - Starting SRM deployment.
    - Stopping SRM deployment.
- Ensuring that monitoring, adaptation, and compensation measures are adequately taken.

On the issue of eventual decisions on allowing and regulating deployment of SRM, key governance trade-offs, such as inclusiveness versus feasibility, or legitimacy versus effectiveness, were discussed as inevitable elements of the political process. In particular, two extreme scenarios dominated the discussion: (1) a small club of great geopolitical powers makes the essential decisions in the absence of participation by smaller states and nonstate actors, and (2) all UN members and other observers are included in a universal broad, inclusive, and transparent process. In this context, the further differentiation between procedural and substantive legitimacy is highly relevant and probably merits greater attention in further academic work.

Several mechanisms for enhancing the reliability of a future regime were discussed, including those designed to automatically enforce greater accountability of any party that decides to deploy SRM and to enhance the chances of reaching mutually beneficial outcomes. One such idea was to set up a multilateral insurance fund and seek an agreement under a UN convention to hold parties liable for damages from SRM deployment if damages exceed the volume of the insurance fund. As a consequence, each party willing to deploy SRM would be incentivized to get other parties to agree with its approach and thus to contribute to the insurance fund. Such a mechanism could compel the initiators to find a generally agreeable deployment approach and to reach a critical mass of consenting countries before deployment.

While exploring some early ideas for improving cooperation on decisions of SRM deployment can be highly beneficial to clarify the various assumptions that often underlie SRM governance debates, there was a sense among the

participants that deployment of SRM would probably not happen in less than three decades. Therefore, no specific recommendations on the decision format could be made, as the level of knowledge and the general geopolitical situation would likely change significantly over that period.

Financing Technology Application

The challenge of financing CDR at scale is at least equal to the challenges encountered in scaling up renewable energy or putting other sectors on a low-carbon path. Therefore—and even more so than in the cases of renewables or energy efficiency, which have a large potential for cutting costs or generating revenue—large-scale CDR deployment requires instruments that incentivize private sector participation in the rapid implementation of large-scale CDR efforts. Such mechanisms should be tied to regulation that ensures efforts lead to measurable, reportable, and verifiable carbon sequestration in a cost-effective manner while meeting the requirements of sustainable development according to the local conditions and needs. Participants largely agreed that functioning carbon markets could at the same time provide the needed regulation and financing in a manner that would trigger competition and allow gradually decreasing technology costs through further research and development.

While in the past many researchers have focused on the technical cost of SRM technologies, participants discussed a broader range of financing issues around SRM deployment. The financing challenge for SRM was differentiated into six components: costs of research and development of viable SRM options, capital costs of putting the required infrastructure in place, operating costs, costs associated with liability payments and compensation measures, costs associated with ensuring sufficient security and redundancy of the system, and costs associated with continuous measuring, reporting, and verifying of effects from deployment.

Substantial discussion centered on which sources of financing could adequately prevent CDR or SRM application from being captured and distorted in a socially adverse manner. Initially, most participants felt private sector funding should be excluded in any SRM activities because of the risk of creating interest structures resembling those of the military-industrial complex. However, given the scale of SRM funding, which is subject to vast uncertainties primarily regarding potential liabilities and costs associated with continuous monitoring, some form of private sector participation might be required for specific tasks associated with SRM deployment. Such private sector participation is exemplified by space flights, which were once considered a purely public matter but have become attractive to private investments.

For CDR on the other hand, most agreed that the scale of funding required would make it mandatory to tap into the private sector's capabilities of developing economic business models by creating additional incentives through a carbon market.

Recommendations

The second day of the workshop resulted in the formulation of recommendations to various stakeholders, including decision makers involved in climate change policy negotiations, research funders, researchers, and nongovernmental organizations. While the following recommendations do not necessarily reflect the views of every participant, there was a high level of agreement on a large majority of the points:

Research

- Separate CDR and SRM discourse to reduce misconceptions and foster constructive engagement.
- Implement a staged-gate process to guide SRM research and development in order to foster transparency and allow for sequential control of activities. This is particularly relevant as there is no agreed distinction between field tests with physical effects that can be neglected and small-scale deployment.
- Clearly define and enhance the role of research and development at multicountry research institutions to improve international cooperation.
- Create a (voluntary) registry of research activities to improve transparency in research, to advance common scenario development and assessment approaches, and to foster better collaboration between researchers.
- Identify and highlight new research funding options, including mixed public-private funding or an umbrella fund to coordinate existing funds for further climate engineering research.

Institutional Capacity

- Request new and separate IPCC special reports on CDR and SRM to increase transparency and garner political attention. The IPCC would then serve as an impartial convener and identify research gaps in the current academic literature and thus motivate further research.
- Allocate CDR and SRM research and related activities to a climate change office within an environment ministry to help ensure sufficient attention is brought to the subject. For example, the United Kingdom has a task force in charge of following climate engineering developments.
- Govern SRM independently of CDR, especially in terms of timetables to pursue or ban deployment.
- Broaden, deepen, and diversify the political and scientific debate on climate engineering to improve the quality of knowledge on its implications.

- Design practices and processes for research institutions to communicate with decision makers on the particulars of climate engineering.

Assessment of Options

- Each particular SRM and CDR option should be assessed individually.
- Common assessment metrics are a must for comparable assessment of various application approaches; such metrics could be proposed by the IPCC based on propositions from current academic literature.
- Assessment of any SRM technology requires a broad set of criteria, possibly including elements that have yet to surface.
- Assessment of CDR technologies could apply criteria utilized in other mitigation options.
- Assessment of technologies that are based on biological processes requires a holistic approach covering the entire life cycle of the intervention.
- Carbon sequestration technologies should be assessed with regard to the general maximum carbon storage capacity, including geological, economic, and political factors shaping the feasibility of sequestration sites. This knowledge could be key, as the storage capacity for carbon sequestration might be a limiting factor in the future.

Deployment

Characteristics of the SRM governance challenge require vast research efforts and exploration of various governance formats, and it is too early to propose one particular format.

- Two decades of international climate policy under the UNFCCC merit exploring the lessons that can be applied to CDR and SRM governance.
- International cooperation on climate engineering should be fostered by collaboration on all levels, including research, assessments, institutions, and financing of activities in order to allow deployment negotiations to take place on the basis of robust understanding between parties.

Financing

- Large-scale CDR deployment requires financial incentive mechanisms such as broadened carbon market mechanisms.
- The elements included in SRM deployment cost assessments should be broadened to include more than just capital and operating costs of the technology itself.
- SRM financing mechanisms could be designed to foster the reliability of deployment regimes.

In order to identify the most immediate climate engineering governance needs, participants agreed that an international research project involving all relevant research disciplines as well as nonacademic stakeholders would be an ambitious but highly beneficial undertaking. As a first step, participants recommend a conference with broad participation, including developing countries, to launch an increasingly representative discourse on climate engineering governance.

In order to identify the most immediate climate engineering governance needs, participants agreed that an international research project involving all relevant research disciplines as well as nonacademic stakeholders would be an ambitious but highly beneficial undertaking.

Endnotes

[1] Foley, Rider et al, "Toward the Anticipatory Governance of Geoengineering," Working Paper, *www.geoengineeringourclimate.com*, February 2015.

[2] Ibid

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Affiliations are listed for identification purposes only. Participants attended as individuals rather than as representatives of their governments or organizations.

The Stanley Foundation

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Perspectives

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