Published online May 2011

Introductory Perspective

The Asilomar International Conference on Climate Intervention Technologies: Background and Overview

Margaret Leinen[I]

I. BACKGROUND OF THE PAPERS

The editors of the Stanford Journal of Law, Science and Policy invited the papers included in this special section of the journal from participants in a March 2010 international conference on climate engineering held at the Asilomar Conference Center. The conference, sponsored by the nonprofit Climate Response Fund, was a forum to consider principles for governing research into purposeful climate modification techniques that could be used to limit the impact of climate change.

II. BACKGROUND OF THE CONFERENCE

The evidence that climate is changing and that much of the change can be attributed to human activity has reached a high level of scientific consensus.[1] The most recent report of the Intergovernmental Panel and Climate Change (IPCC) also demonstrated that the impacts of climate change on water, glaciers and snowpack, agriculture, forests, and ecosystems, to name but a few systems, were strong and could clearly be related to climate.[2] Since the 2007 report, many studies have shown that the impacts appear to be accelerating. While the evidence of change and of impacts is mounting, it has remained difficult to achieve international consensus on reductions in the emission of greenhouse gases. And recent modeling studies suggest that even the proposals negotiated at Copenhagen in 2009 would have resulted in a doubling of carbon dioxide (CO_2) in the atmosphere compared to today by the end of the century.[3]

[I] Climate Response Fund.

[1] CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS, CONTRIBUTION OF WORKING GROUP I TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 10 (Susan Solomon et al. eds., 2007), *available at* http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_wg1_report_the_physical_science_basis.htm.

[2] CLIMATE CHANGE 2007: IMPACTS, ADAPTATION, AND VULNERABILITY, CONTRIBUTION OF WORKING GROUP II TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 8 (Martin Parry et al. eds., 2007), *available at* http://www.ipcc-wg2.gov/publications/AR4/index.html.

[3] Elizabeth R. Sawin et. al., *Current Emissions Reductions Proposals in the Lead-Up to COP-15 are Likely to be Insufficient to Stabilize Atmospheric CO2 Levels: Using C-ROADS—A Simple Computer Simulation of Climate Change to Support Long Term Climate Policy Development*, University of Copenhagen, Climate Change: Global

The scientific community has raised serious concerns about the pace of climate change impacts and the potential for abrupt or irreversible changes to which it would be difficult to adapt. Some have started to call for research into climate engineering, or "geoengineering," technologies to understand whether those technologies could play a role in the global response to climate change. Climate engineering technologies seek to manipulate an element of the physical, chemical, or biological aspects of Earth's climate system at regional scales or larger to counteract the potentially dangerous consequences of greenhouse gas emissions and climate change.[4] Such techniques have often been called "geoengineering," but are more accurately termed climate engineering. Many are based on natural processes that affect climate, like volcanic eruptions or ocean phytoplankton production. Others have no natural analogues.

With increasing frequency over the last five years, individual scientists have begun to call for research into these techniques.[5] The scientific community does not view climate engineering technologies as alternatives to emissions reduction. Quite the contrary, all the references mentioned make a strong plea for rapid and extensive emissions reduction.[6] Instead the scientific community has proposed research to understand the details of how the techniques work, how effective they would be, the degree to which they could be scaled to address climate impacts, and their environmental consequences.[7]

Scientific societies and academies have also joined in the call for research; the National Academies of the G8+5 nations called for such research as part of an overall climate research agenda in June 2009.[8] The American Meteorological Society adopted a policy statement calling for research in July 2009, and the American Geophysical Union endorsed the policy. The U.K. Royal Society completed a yearlong study of climate engineering that emphasized the need for additional research in September 2009.[9] In May 2010, the U.S. National Academy of Sciences study of America's Climate Choices also called for research into climate engineering.[10] The call for research has raised important questions about the legality of climate engineering research, its ethical implications, risk management, governance, environmental consequences, and public concern. At least one climate engineering technique is relatively inexpensive. This has raised concerns that a single wealthy individual or a single government could deploy the technique without adequate scientific understanding or international discussion.[11] The U.S. House of Representatives Committee has explored many of these issues in a set of hearings on Science and Technology, as has the U.K. House of Commons Select Committee on Science and Technology.

Risks, Challenges, and Decisions 8 (2009), *available at* http://climateinteractive.org/scoreboard/scoreboard-science-and-data/C-ROADS%20Analysis%20of%20Current%20Proposals090311.pdf.

[4] *AGU Position Statement: Geoengineering the Climate System*, AM. GEOPHYSICAL UNION, http://www.agu.org/sci_pol/positions/geoengineering.shtml (last visited Jan. 29, 2011).

[5] *E.g.*, Paul J. Crutzen, *Albedo Enhancement by Stratospheric Sulfur Injections: A Contribution to Resolve a Policy Dilemma?*, 77 CLIMATIC CHANGE 211 *passim* (2006); Michael C. MacCracken, *On the Possible Use of Geoengineering to Moderate Specific Climate Change Impacts*, ENVTL. RES. LETTERS (2009).

[6] *E.g.*, Crutzen, *supra* note 5; MacCracken, *supra* note 5.

[7] *E.g.*, Crutzen, *supra* note 5; MacCracken, *supra* note 5.

[8] Joint Statement on Climate Change from G8+5 National Science Academies, THE NAT'L ACAD., http://www.nationalacademies.org/includes/G8+5energy-climate09.pdf (last visited Jan. 30,2011).

[9] THE ROYAL SOC'Y, GEOENGINEERING THE CLIMATE ix (2009).

[10] *See* BD. ON ATMOSPHERIC SCI. & CLIMATE, NAT'L RES. COUNCIL OF THE NAT'L ACAD., ADAPTING TO THE IMPACTS OF CLIMATE CHANGE 231 (2010).

[11] David G. Victor et al., *The Geoengineering Option: A Last Resort Against Global Warming?*, FOREIGN AFF. 64 (2009).

The House of Commons released a report on its hearings and on governance issues.[12] The House of Representatives has commissioned two Government Accountability Office studies, one on the state of science and one that will be published in the fall on the social and policy concerns. In all of these discussions, the need for thoughtful consideration of social and policy concerns has held equal weight with the need for scientific research.

III. THE ASILOMAR CONFERENCE

The Asilomar International Conference on Climate Intervention Technologies was designed to bring the scientific community interested in climate engineering research together with academic, governmental, nonprofit, and for-profit communities interested in the social and policy issues of such research. Our goal as the sponsor of the conference was to provide the opportunity for a structured discussion of principles that should be considered in a framework or governance for climate engineering. The conference consciously drew on the example of the Asilomar Conference on Recombinant DNA Technologies,[13] which was sponsored by the National Science Foundation and National Institutes of Health in 1975. Its purpose was to identify principles and techniques to reduce risk associated with research. It was led by Dr. Paul Berg, who later went on to win the Nobel Prize for his research on the topic, and a group of four other distinguished scientists. Dr. Berg was the Honorary Chair of the conference on climate engineering, as well.

Dr. Michael MacCracken of the Climate Institute chaired an international Scientific Organizing Committee for the Asilomar conference on climate engineering that included both physical and social scientists. They structured the agenda and invited a broad array of individuals, including those who had expressed negative opinions about climate engineering. Over 175 individuals attended the conference, including scientists, engineers, historians, philosophers, representatives of environmental nonprofits, economists, specialists in international law and treaties, academics specializing in risk management and governance, representatives from the business community, and a wide variety of media (science press, newspapers, periodicals, book authors, documentarians).[14] Fifteen countries on six continents were represented.

The conference attendees drew a distinction between climate engineering techniques that seek to sequester carbon on land or in the ocean, and those techniques that address the symptoms of climate change (e.g., warming). The participants called the former "climate remediation" because they attempt to remove CO_2 from the atmosphere. The latter were called "climate intervention" because they have the objective of intervening to prevent impacts. The Scientific Organizing Committee developed a consensus statement on behalf of the participants.[15] The statement recognizes the risks associated with climate change and expresses deep concern about the inability of humanity to reduce global greenhouse gas emissions, and concludes:

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[12] SCI. & TECHNOLOGY COMM., U.K. HOUSE OF COMMONS, PUB. 221, THE REGULATION OF GEOENGINEERING (2010).

[13] Paul Berg et al., *Summary Statement of the Asilomar Conference on Recombinant DNA Molecules*, 72 PNAS 1981 (1975).

[14] *Asilomar Conference Participant List*, CLIMATE INST., http://www.climate.org/resources/climate-archives/conferences/asilomar/participant-list.html (last visited Apr. 28, 2011).

[15] *Statement of the Scientific Organizing Committee,* CLIMATE RESPONSE FUND, http://www.climateresponsefund.org/index.php?option=com_content&view=article&id=152&Itemid=89 (last visited Apr. 28, 2011).

> It is thus important to initiate further research in all relevant disciplines to better understand and communicate whether additional strategies to moderate future climate change are, or are not, viable, appropriate and ethical. Such strategies, which could be employed in addition to the primary strategy of mitigation, include climate intervention methods (solar radiation management) and climate remediation methods (carbon dioxide removal). We do not yet have sufficient knowledge of the risks associated with using methods for climate intervention and remediation, their intended and unintended impacts, and their efficacy in reducing the rate of climatic change to assess whether they should or should not be implemented. Thus, further research is essential.[16]

Since the conference, the Scientific Organizing Committee has been reviewing the presentations of the conference,[17] as well as the reports of discussions during the conference. They have proposed five Asilomar Principles, which were developed based on further discussion, starting with principles for governance proposed at a meeting at Oxford University in 2010. The Asilomar Principles propose the need for international governance and suggest several elements important to governance:

1. *Collective benefit:* Promoting the collective benefit of humankind and the environment must be the primary purpose of research conducted to develop and evaluate the potential for climate engineering technologies to moderate or reverse human-induced climate change.
2. *Establishing responsibility and liability:* Governments must clarify responsibilities for, and, when necessary, create new mechanisms for the governance and oversight of large-scale climate engineering research activities that have the potential or intent to significantly modify the environment or affect society. These mechanisms should build upon and expand existing structures and norms for governing scientific research and, in the event of damaging outcomes, establish who would bear the cost and the degree of liability and proof that are required.
3. *Open and cooperative research:* Climate-engineering research should be conducted openly and cooperatively, preferably within a framework that has broad international support. Research activities with the potential to affect the environment in significant ways should be subject to risk assessment, taking into account the risks and their distribution associated with both the activity itself and from the reduced understanding if the experiment is not conducted. All such research should be interdisciplinary in design and planned, reviewed, and implemented in a transparent fashion. Data needed to assess the performance of technologies and approaches should be disclosed to allow for open review and evaluation.
4. *Iterative evaluation and assessment:* Iterative, independent technical assessments of research progress on climate engineering approaches will be required. Assessing potential intended and unintended consequences, impacts, and risks will be critical to providing policymakers and the public with the information needed to evaluate the

[16] *Id.*
[17] *Asilomar Conference Agenda*, CLIMATE RESPONSE FUND, http://www.climateresponsefund.org/index.php?option=com_content&view=article&id=87&Itemid=91 (last visited Apr. 28, 2011).

potential for climate engineering to be implemented as a complement to mitigation and adaptation.

5. *Public involvement and consent:* Public participation and consultation in research planning and oversight, assessments, and development of decision-making mechanisms and processes must be provided. Approaches are needed to ensure consideration of the international and intergenerational implications of climate engineering.

IV. SUMMARY

The Asilomar International Conference on Climate Intervention Technologies was conceived of as a first step toward international dialogue between scientists and non-scientists on principles for climate engineering research—not the end point. The ideas in the Conference Statement as well as the ideas in the Asilomar Principles will need broad discussion. Organizations that fund research will need to determine whether the constraints suggested by the Principles can be accommodated by their research communities. Governments will need to determine whether the Principles can be accommodated in regulatory mechanisms and whether they adequately address policy concerns about such research. And the public and environmental organizations will need to determine whether the Principles address concerns about the potential impact of research on the environment and on policy. The articles in this issue of SJLSP are an important contribution to that dialogue.