Congressional Research Service

MEMORANDUM March 11, 2010

To: House Committee on Science and Technology, Subcommittee on Energy and Environment
Attention: Anne Cooper

From: Richard Lattanzio, Analyst in Environmental Policy (7-1754)
Emily Barbour, Legislative Attorney (7-5842)

Subject: **International Governance of Geoengineering**

This memorandum responds to your request for information regarding potential international governance and regulatory mechanisms for geoengineering (or climate engineering) technologies. The memorandum includes a short introduction to geoengineering technologies, a discussion on the criteria that may be used to develop effective international governance structures and instruments, and a summary of existing international regulatory frameworks. This memorandum was requested in preparation for a subcommittee hearing on the governance of geoengineering. Please note that information contained in this memorandum was provided on deadline and may be elaborated upon for use in forthcoming CRS products.

This memorandum does not provide a detailed summary of the science of geoengineering, outline the economic needs for research and development of the technologies,[1] analyze the geoengineering option relative to current climate change policies such as mitigation and adaptation,[2] or assess the scientific, social, legal, and political acceptability of pursuing geoengineering research and deployment.[3] Additionally, because the subcommittee hearing is part of a joint investigation into geoengineering science and governance coordinated by the U.S. House of Representatives and the United Kingdom's House of Commons, this memorandum's discussion of international obligations potentially implicated by geoengineering activities is limited to those contained in customary international law and the international agreements that received close attention from the House of Commons' Science and Technology Committee[4] and the Royal Society in its report on geoengineering on governance.[5] These agreements are

[1] These first two investigations were the purview of the hearings on November 5, 2009 ("Geoengineering: Assessing the Implications of Large-Scale Climate Intervention") and February 4, 2010 ("Geoengineering II: The Scientific Basis and Engineering Challenges") by the House Committee on Science and Technology, Subcommittee on Energy and Environment. See http://science.house.gov/RelatedByTag.aspx?KeywordID=55

[2] Many commentators agree to a large extent with the United Kingdom's Royal Society emphasis that "geoengineering is not an alternative to greenhouse gas emission reductions. Geoengineering may hold longer-term potential and merits more research, but it offers no quick and easy solutions that should distract policy-makers from working toward a reduction of a least 50 percent in global carbon dioxide emissions by 2050." See "Memorandum submitted by the Royal Society" to the United Kingdom House of Commons Science and Technology Committee for a January 13, 2010 hearing on "The Regulation of Geoengineering."

[3] A great deal of literature exists on this debate. Please contact Richard Lattanzio (7-1754) for more information.

[4] *The Regulation of Geoengineering*, *Hearing before the H. of Commons' Science and Technology Comm.* (2010), *available at* http://www.publications.parliament.uk/pa/cm200910/cmselect/cmsctech/uc221-i/uc22102.htm (last visited Mar. 9, 2010).

[5] The Royal Society, *Geoengineering the Climate: Science, Governance and Uncertainty,* September 2009, at:
(continued...)

as follows: the United Nations Convention on the Law of the Sea, the London Convention and Protocol, the Convention on Biological Diversity, and the United Nations Framework Convention on Climate Change and the Kyoto Protocol. The memorandum also provides a list of some additional multilateral international agreements with global, rather than regional, application that may be implicated by some geoengineering activities. However, this memorandum is not intended as an exclusive list of international frameworks that could support or constrain geoengineering activities, and, therefore, countries considering undertaking geoengineering projects will presumably review their obligations under the full range of bilateral, regional, and multilateral agreements to which they are parties.

For further assistance, please contact Rick at 7-1754 or Emily at 7-5842.

Part I: An Overview of Geoengineering Governance[6]

Introduction to the Science of Geoengineering

Despite concerns that climate change may be more severe and more rapid than estimated by the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report in 2007,[7] progress toward a global reduction of carbon dioxide (CO_2) and other greenhouse gas (GHG) emissions remains slow. Prompted by regard over the slow progress of global GHG reductions, the uncertainties of climate sensitivity, the potential existence of climate thresholds (or "tipping points"), and the political, social, and economic impact of pursuing aggressive mitigation strategies, some in the international community have begun considering alternatives to address potentially catastrophic climate change. One such alternative is the use of geoengineering technologies.

Geoengineering technologies aim to intervene in the climate system through large-scale and deliberate modifications of the Earth's energy balance in order to reduce temperatures and counteract anthropogenic climate change.[8] The methods proposed are diverse and vary greatly in terms of their technological characteristics and possible consequences. They are classified by most commentators into two main groups:

- *Carbon Dioxide Removal (CDR) methods:* technologies or practices that reduce the levels of CO_2 and other GHG emissions in the atmosphere allowing heat radiation to escape more easily into outer space. These methods include, (1) enhancing the uptake and storage of GHG by biological systems through afforestation,[9] adapted land use, production of biomass or biofuels coupled with carbon sequestration, ocean fertilization, and enhanced ocean upwelling; and (2) using physical- or chemical-engineered systems to aid in the sequestration of GHG through enhanced weathering techniques, alkalinity enhancement, ambient air capture, and atmospheric scrubbers.

(...continued)

http://royalsociety.org/geoengineeringclimate/

[6] This section was prepared by Richard Lattanzio, Analyst in Environmental Policy (7-1754).

[7] See IPCC website at: http://www.ipcc.ch/publications_and_data/ar4/syr/en/contents.html

[8] Most commentators refer to the Royal Society report for a definition of geoengineering. This is a composite definition drawn from several passages of the report.

[9] "Afforestation" is the creation of forests on land that has not recently been, or has never been, forest land. "Reforestation" is the reestablishment of forest land after its recent removal.

- *Solar Radiation Management (SRM) methods:* technologies that reduce the net incoming solar radiation received by the planet by deflecting sunlight or by increasing the reflectivity (or "albedo") of the atmosphere. These methods include, (1) modifying land-based albedo through human settlement adjustments, desert or grassland reflectors, or reforestation; (2) modifying troposphere-based albedo through cloud brightening or whitening; (3) modifying upper atmosphere-based albedo through the injection of stratospheric aerosols; and (4) employing space-based techniques for reducing solar radiation including orbiting reflectors or refractors.

Some emerging geoengineering techniques appear technically feasible, though they run the risk of uncertainty regarding their effectiveness, cost, environmental effects, and socio-political impacts. Little research has been done on most of the geoengineering methods considered, and no major directed programs of research are in place. Peer reviewed research and publication is scant, and deployment of the technology — either through controlled field tests or commercial enterprise — has been minimal.[10] Most observers agree that more research is required to test the feasibility, effectiveness, cost, social and environmental impacts, and the possible unintended consequences of geoengineering before deployment. These uncertainties have led some in the international community to consider the need and the role for governance structures to guide research in the short term and to oversee potential deployment in the long term.

Introduction to the Governance of Geoengineering

Geoengineering is an emerging policy area. At present, no international treaties or institutions exist with sufficient mandate to regulate the full spectrum of possible geoengineering activities. While it is likely that some existing national, regional, and international mechanisms may apply to geoengineering practices and their impacts, they have yet to be analyzed or tested with this purpose in mind. Consequently, risk exists that some methods could be researched or deployed unilaterally by individual nation states, corporations, or individuals without appropriate regulation or international agreement. Given the nascent state of understanding in the science, potentially useful techniques may be mistakenly ignored and potentially dangerous proposals may be mistakenly promoted.

Challenges to Crafting Regulation

While technical unknowns exist at each stage in the science of geoengineering — from basic research through implementation and evaluation — most observers believe that the greatest challenge confronting geoengineering governance may be the social, ethical, legal, and political risks associated with it.[11] Some of the most significant policy issues that may complicate the crafting of regulation are as follows:[12]

[10] Minimal but not absent. In 2008, a German-Indian joint research venture on ocean fertilization produced significant debate among Parties to the London Convention and the Convention on Biological Diversity before being allowed to continue. Commercially, several companies, including Climos, Planktos, and Mantria, have investigated avenues through which to use geoengineering techniques in the carbon markets by selling emission offsets for ocean fertilization and biochar sequestration. These and other examples can be found in Mason Inman's article, "Planning for Plan B," *Nature Reports Climate Change,* Vol 4, January 2010.

[11] Royal Society report, op.cit.

[12] Sources: "Technology control dilemma" as outlined by the Royal Society from a definition in D. Collingridge, *The Social Control of Technology,* Francis Pinter: New York, 1980. "Reversibility" and "encapsulation" as defined by the Royal Society report, op.cit. "Commercial involvement" and "public engagement" as defined by the Royal Society report as well as broached in many of the policy articles debating the acceptability of geoengineering research and implementation.

- *Technology Control Dilemma* refers to the analytical impasse inherent in all innovative technologies wherein potential risks may be foreseen in the design phase but can only be proven and resolved through actual research, development, and demonstration. Ideally, appropriate safeguards are put in place during the early stages of the development of a new technology, but anticipating the evolution of a new technology can be difficult. By the time a technology is widely deployed, it may be impossible to build desirable regulations and risk management provisions without major disruptions.
- *Reversibility* refers to the ability to cease a technology program and have its effects terminate in a short time. In principle, all geoengineering options defined above could be abandoned in short notice, with either an instant cessation of climate effects or with a small time lag after abandonment. However, the issue of reversibility applies to more than just the cessation of the geoengineering activities themselves. Potential scenarios may include the abrupt abandonment of geoengineering management technologies in an environment that also failed to effectively mitigate GHG emissions. Such a scenario could result in a rapid and irreversible climate adjustment through an increase in temperature. Similarly, financial investment in the construction and maintenance of physical infrastructure to support geoengineering may create a strong economic resistance to reversibility.
- *Encapsulation* refers to whether a technology program is modular and contained or whether it involves the release of materials into the wider environment. Encapsulated technologies are often viewed as more "ethical" in that they are not seen as polluting. But encapsulated technologies may still have environmental impacts depending on the nature, size, and location of the application. As such, regulatory consequences may arise as much from the indirect impacts of activities on species and habitat as from the direct impacts of released materials on atmospheric and oceanic ecosystems.
- *Commercial Involvement* refers to the conditions of private sector engagement in the development and promotion of geoengineering. Involvement may be positive, in that it mobilizes innovation and capital investment, which could lead to the development of more effective and less costly technology at a faster rate than the public sector. However, commercial involvement could by-pass or neglect risk assessment related to the socio-economic environmental and regulatory dimensions of geoengineering in favor of what one commentator refers to as "irresponsible entrepreneurial behavior."[13] Private sector involvement would likely demand some form of GHG emission pricing to spur investment, as well as considerations of ownership models, intellectual property rights, and trade and transfer mechanisms for the dissemination of the technologies.
- *Public Engagement* refers to the wider dialogue between scientists, policymakers, the public, and civil society. The consequences of geoengineering — including the risks discussed above — could be felt by people and communities across the world. Public attitudes toward geoengineering, and public engagement in the formation and development of proposed governance, could have a critical bearing on the future of the enterprise. Perceptions of risks, levels of trust, transparency of actions, and economies of investment could play a significant role in the political feasibility of geoengineering.

[13] See John Virgoe's comments in the "Uncorrected Transcript of Oral Evidence" presented before the U.K. House of Commons Science and Technology Committee on January 13, 2010. Please note that the uncorrected transcript is not yet approved as a formal record of the proceedings. Transcript can be found at: http://www.parliament.uk/parliamentary_committees/science_technology/s_t_geoengineering_inquiry.cfm

Criteria for Crafting Regulation

Some technical characteristics of geoengineering have been used by most commentators as criteria to aid in determining the structure and extent of any potential international regulatory regime.[14] These criteria are as follows:

- The extent to which the impacts of geoengineering *are international or transboundary in scope*;
- The extent to which the impacts of geoengineering *dispense hazardous material into the environment*; and,
- The extent to which the impacts of geoengineering *directly intervene in the balance of the ecosystem*.

Consequently, different aspects of geoengineering technologies may require different regulations. For example:

- *Different technologies may require different regulatory regimes:* To the extent that most CDR technologies are similar to familiar and existing ones, many could be adequately controlled by existing national legislation. Air capture technologies are similar to those of carbon capture and sequestration for power generation. Biochar and biomass sequestration face similar life cycle analyses and regulatory issues as biofuels. Ecosystem impacts of enhanced terrestrial weathering would likely be contained within national boundaries. Enhanced weathering in oceans and ocean fertilization techniques are the only CDR technologies that may require new regulatory structures due to risks associated with ecosystem interventions that could cross national boundaries. For SRM technologies, however, the scope, dispersions, and interventions are more likely to cross national boundaries. While land surface albedo modification could potentially be managed under national regulatory frameworks, all other technologies may trigger transboundary issues. Some existing treaties address atmosphere and space but have rarely been tested for enforcement.
- *Different stages of the research cycle may require different regulatory regimes:* Geoengineering development involves several stages. Regulatory frameworks must be flexible enough to cover the full cycle (e.g., from assessment through research, modeling, laboratory trials, field trials, implementation, monitoring, and evaluation). Transboundary environmental impacts grow along this cycle, and negative social and economic consequences may be felt as early as small-scale field trials.
- *Different environments for potential research or deployment may require different regulatory regimes:* Legal classifications with respect to geoengineering technologies often relate to the differing environments — space, atmosphere, ocean, land — in which the techniques are deployed. This approach allows for the different jurisdictions and different resource ownership arrangements. Land-based and lower atmosphere activities are placed under sovereign rights; but for the open ocean, upper atmosphere, or space, effective legal instruments are scarcer.

[14] Royal Society memorandum to the U.K. House of Commons, op.cit.

Potential Regulatory Instruments

Guidelines for Regulation

Many observers note that certain baseline characteristics within the science of geoengineering lend themselves to certain governance or regulatory guidelines. Some of the characteristics they mention are as follows:

- Because the climate is global, a regulatory framework for geoengineering should likewise be international and transboundary.
- Because the range of stakeholders potentially affected by geoengineering is broad, a regulatory framework should be accessible, inclusive, and equitable to all nations, sub-national groups, non-governmental organizations, corporations, and civil societies.
- Because the number of actors potentially employing geoengineering techniques may be small in comparison to the number of those affected, a regulatory framework should be open and transparent with respect to the exposure to risk.
- Because the global impacts of geoengineering — both its benefits and damages — may be unevenly distributed, a regulatory framework should consider cost structures, ownership models, and compensation assessments.
- Because the technology is new and unproven, a regulatory framework should be flexible in the light of ongoing scientific and technical evidence.
- Because the impacts of geoengineering are uncertain, a regulatory framework should be able to respond rapidly to emerging situations including foreseen and unforeseen risks and to be withdrawn fully if new situations so require.

While many of these guidelines appear rational, various social, economic, and political considerations may open the door for alternative regulatory interpretations. In the sections that follow, a few regulatory frameworks are outlined and alternatives are mentioned where noteworthy.

1. No Regulation

It should be noted that one possible response to the rise of interest in geoengineering technologies is for governments to fully refrain from any regulatory or governance mechanism. Advocates of an unregulated response may either see private industry and corporations as the best avenue through which to pursue geoengineering research and entrepreneurship, or, conversely, consider government involvement as an unwanted stamp of acceptability on a deleterious technology. Public opinion and civil society engagement may also sour to either the technological uncertainty of the science or the cost considerations of research and regulation. These concerns should be balanced against the many potential risks of an unregulated program (as outlined in the previous paragraph) to evaluate the extent of government support for geoengineering enterprises and determine the maximum threshold of abstention before government interventions.

2. International Treaties and Agreements

Based on experiences with other international environmental issues, many commentators propose the need for a legally binding regulatory treaty along with a careful global assessment that gives all nations the opportunity to participate formally in evaluating the risks and benefits of geoengineering science.

Treaty instruments can negotiate, codify, and enforce normative standards on an emerging science. They undergo extensive review and ratification by governments before entering into force, and they have the potential to provide a framework under which future discussions and institutions can develop. While there are no legally binding treaties currently in place with geoengineering – specific provisions, existing treaties and rules of customary international law suggest there are some principles of shared environmental and development practice that could form a basis of regulation. Accordingly, governments could choose to enhance these principles' applicability to geoengineering by expanding existing international agreements and/or forming new ones. (Please refer to Part II of this memorandum, "Customary International Law" for further discussion).

However, the strengths of international treaties may also be their weakness.[15] Treaties are based on a process that is inherently conservative. Nations often negotiate by adjusting their commitments to a level where they are sure that compliance is technically, economically, socially, and politically feasible. If commitments are too high, nations may seek favorable (i.e. vague) language, or, conversely, refuse to join.[16] When an international situation is new and evolving or if the framing creates strongly opposing interests (such is the potential of geoengineering regulation), a common outcome of treaty negotiation is stalemate. Moreover, international agreements, particularly those involving compliance mechanisms and the establishment of new international institutions, can be viewed as infringing with countries' sovereignty, and thereby interfering with states' ability to experiment with domestic measures that best address local needs and capabilities.

Some commentators suggest that a treaty negotiation on the science of geoengineering, as it currently stands, may lead to a moratorium on research and deployment activities. A proposed moratorium could arise because the majority of countries currently lack the capacity and political incentive to geoengineer and may believe there is little to gain from permitting other states to experiment. Proponents of a ban on certain forms of geoengineering currently include several environmental groups and developing country NGOs.[17] In general, advocates of this kind of moratorium argue that: (1) geoengineering research would distract from the global goal of emission reductions (the "moral hazard" argument); (2) geoengineering could be used by governments and industry as a "time buying" strategy to avoid mitigation commitments; (3) the underlying science is too risky; (4) the potential impacts are too uneven, or, disproportionately weighted toward vulnerable developing countries in the tropics; and (5) geoengineering techniques may be co-opted by commercial or unethical interests.

Other commentators suggest that a moratorium on geoengineering technologies is ill-advised. From their perspective, a moratorium would (1) inhibit research, some of which has been ongoing for decades in the context of marine ecology, oceanographic studies, and atmospheric meteorology; (2) make it difficult to accumulate the information needed to make informed judgments about the feasibility and the acceptability of the proposed technology; and (3) likely deter only those countries, corporations, and

[15] The following critique of treaty instruments is taken from several articles by authors such as David Victor, Kal Raustiala, Eugene Skolnikoff, and Lee Lane. See specifically: David Victor, "On the Regulation of Geoengineering," *Oxford Review of Economic Policy,* Vol. 24, No. 2, 2008, pp. 322-336; as well as comments made in the Royal Society report, op.cit.

[16] Such was the situation in negotiations leading to the 1992 Convention on Biological Diversity, which, as outlined by Victor, op.cit., "contained European-inspired language that was hostile to genetically engineered crops and developing country-inspired language that demanded complicated revenue-sharing for some kinds of germplasm collections. The USA, world leader in these investments, simply refused to join the treaty."

[17] The following arguments are taken from one such organization, The Action Group on Erosion, Technology, and Concentration (ETC Group) in its "Memorandum submitted by the ETC Group" to the United Kingdom House of Commons Science and Technology Committee for a January 13, 2010 hearing on "The Regulation of Geoengineering."

individuals who would most likely develop the technology in a responsible fashion, thus failing to discourage potentially dangerous experimentation by less responsible parties.

3. International Research Consortia

Some commentators have suggested that forming an international scientific consortium would reduce the potential disadvantages of working towards an international system for geoengineering governance at this stage. They posit that an international consortium could explore the safest and most effective forms of geoengineering while also building a community of responsible researchers.[18] Prior international scientific collaborations have shown that research consortia are generally well-equipped to:

- Set research priorities at the initial stages of an emerging technology;
- Coordinate existing research, identify new research agendas, and develop effective and objective assessment frameworks to inform the initial stages of regulation;
- Collaborate with representation from the scientific, policy, commercial, regulatory and non-governmental communities to provide independent oversight of evolving regulatory issues concerning an emerging technology; and,
- Formulate, develop, and socialize an international and voluntary code of practice to govern research in an emerging technology.

Building comprehensive international assessments and effective international organizations to govern transboundary geoengineering activities may be difficult because of how little is currently understood about the technical, economic, social, and political components of geoengineering. At this point, there are no international organizations with a direct or indirect mandate to regulate the full spectrum of possible geoengineering activities. However, it is theoretically possible that existing institutions could fit this purpose if their charters were modified and expanded, but it is unclear if this would be the most effective way of achieving comprehensive international regulation of geoengineering activities. Bolstering this uncertainty is debate over the ideal form of an international body charged with geoengineering governance. Whereas some believe the current issues involved in geoengineering are ill-suited for resolution by consensus-based organizations, others caution against populating an international governing body with representatives from only a few countries, regions, or fields.[19] It is unclear at this point how this kind of international body would balance the need for international research and governance with the technical, political, and ethical uncertainties posed by a controversial, emerging technology.[20]

[18] As recommended by the Royal Society, with collaborations such as the European Organization for Nuclear Research (CERN) and the Human Genome Project used as example. See Royal Society report, op.cit.

[19] Victor, op.cit. and the ETC Group, op.cit.

[20] Given the fundamental purpose of geoengineering, many commentators point to the United Nations Framework Convention on Climate Change as a potential governing organization. Some have suggested that the Intergovernmental Panel on Climate Change (IPCC) could provide a technical framework to establish whether there is sufficient scientific justification for research on different techniques and, if so, where effort should be focused. International global programs, such as the World Meteorological Organization (WMO), and those co-sponsored by International Council for Science (ICSU), International Geosphere-Biosphere Programme (IGBP); World Climate Research Programme (WCRP); International Human Dimensions Programme on Global Environmental Change (IHDP) and Diversitas; grouped under the Earth System Science Partnership, (ESSP)) could also coordinate relevant research and provide independent international assessments adapted for the purposes of geoengineering.

Part II: A Survey of Selected International Obligations and Regulatory Frameworks[21]

The following section outlines information regarding existing international obligations and treaty frameworks that might support or constrain the implementation or research of transboundary geoengineering projects. Because geoengineering is an umbrella term for a broad array of methods of global climate adjustment, some largely theoretical and others well-understood, it is very likely that particular projects may be affected by multiple international obligations and regulatory frameworks, including some that are not identified in this memorandum. This section limits its discussion of sources of relevant international obligations to those that received heightened consideration in the Royal Society's report on geoengineering and governance: customary international law, the United Nations Convention on the Law of the Sea, the London Convention and Protocol, the Convention on Biodiversity, and the United Nations Framework Convention on Climate Change and the Kyoto Protocol. It also supplements the Royal Society's report with a list of several other multilateral treaties with global, rather than regional, application that countries could use to constrain or support the research and deployment of geoengineering projects. However, this section does not provide a comprehensive list or discussion of relevant international obligations, frameworks, or institutions.

Customary International Law

Customary international law results from a general and consistent practice by nation states which are followed from a sense of legal obligation.[22] In other words, obligations under customary international law arise from the combination of: (1) "general practice" and (2) *opinio juris*, (i.e., the belief that such practice is based upon a legal obligation).[23] Duties established by customary international law are generally deemed binding on states that have not persistently objected to it.[24] For purposes of U.S. domestic law, the legal significance of customary international law is unclear, but does not take precedence over a conflicting statute.[25]

Environmental Obligations under Customary International Law

While it can be difficult to determine when a widespread state "practice" evolves into a "duty" imposed by customary international law, there are several duties that should be emphasized for the purposes of this memorandum. First, customary international law establishes a duty not to cause significant transboundary harm.[26] Customary international law also arguably obligates states, to the extent practicable, to take measures necessary to prevent, reduce, and control pollution that is causing or threatening to cause

[21] This section was prepared by Emily Barbour, Legislative Attorney (7-5842).

[22] RESTATEMENT (THIRD) OF FOREIGN RELATIONS LAW § 102 (1987).

[23] LORI F. DAMROSCH ET. AL., INTERNATIONAL LAW: CASES AND MATERIALS 59 (5th ed. 2009).

[24] RESTATEMENT (THIRD), *supra* note 22, at 102 n.2.

[25] There does not appear to be an instance in which a U.S. statute or presidential action was struck down by a reviewing U.S. court solely on the basis that it conflicted with customary international law. For further discussion, see CRS Report RL32528, *International Law and Agreements: Their Effect upon U.S. Law*, by Michael John Garcia.

[26] RESTATEMENT (THIRD), *supra* note 22, at § 601(1) (stating that a nation is generally obligated to take "such measures as may be necessary, to the extent practicable under the circumstances, to ensure that activities within its jurisdiction or control...are conducted so as not to cause significant injury to the environment of another state.")

significant injury to the marine environment.[27] This obligation, along with several other rules of customary international law, mirror provisions in the United Nations Convention on the Law of the Sea, which is discussed below.[28]

Customary International Law and the Effect of Treaties

In addition to establishing substantive obligations, customary international law also informs the legal significance given by states to international agreements. Customary international law, as reflected in the Vienna Convention on the Law of Treaties ("VCLT") recognizes that signatories of an international agreement must refrain from acts that would defeat the object and purpose of that agreement unless the state makes clear its intent not to ratify the treaty.[29] The VCLT also codifies the customary rule that a treaty may not create rights and obligations for a non-Party without its consent.[30] In other words, countries that are not parties to an international agreement may not be bound to adhere to it.

Selected International Agreements

The status of U.S. accession and/or ratification to the treaties discussed on the following pages should be viewed in light of the two principles of international law just discussed. The United States has signed most of the treaties and protocols discussed in detail below, but has only ratified or acceded to two: the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (the "London Convention") and the United Nations Framework Convention on Climate Change ("UNFCCC"). Therefore, customary international law dictates that the United States should refrain from acts that would defeat the object and purpose of each agreement it has signed, but, in the context of the agreements discussed below, it is only bound to strictly comply with the obligations set out in the London Convention and UNFCCC.

United Nations Convention on the Law of the Sea

The United Nations Convention on the Law of the Sea ("UNCLOS") establishes a legal regime governing activities on, over, and under the world's oceans. It opened for signature in December 1982 and entered into force on November 16, 1994. A large part of the UNCLOS is concerned with defining states' jurisdiction over the oceans and rights of access to the ocean. For example, the UNCLOS permits coastal states to define and exercise sovereignty over a territorial sea that does not extend beyond 12 nautical miles from the coastal state.[31] It also establishes a 200-nautical mile exclusive economic zone ("EEZ"), in which coastal states exercise jurisdiction over marine science research, environmental protection, natural

[27] *Id.* at § 603(2).

[28] *See e.g. id.* at §§ 511-517.

[29] RESTATEMENT (THIRD), *supra* note 22, at § 312(3); VCLT, Art. 18. The United States signed the Vienna Convention on the Law of Treaties (VCLT), but the VCLT has not received the Senate's advice and consent and, consequently, the United States is not a Party to the VCLT. Nevertheless, the United States considers most of the VCLT to constitute customary international law on the law of treaties. *See, e.g.*, Fujitsu Ltd. v. Federal Exp. Corp., 247 F.3d 423 (2d Cir. 2001) ("we rely upon the Vienna Convention here as an authoritative guide to the customary international law of treaties ... [b]ecause the United States recognizes the Vienna Convention as a codification of customary international law ... and [it] acknowledges the Vienna Convention as, in large part, the authoritative guide to current treaty law and practice") (internal citations omitted).

[30] VCLT, Art. 34; RESTATEMENT (THIRD), *supra* note 22, at § 324(1).

[31] UNCLOS, Art. 3.

resources, and certain economic activities.[32] The UNCLOS also guarantees that all states are entitled to lay submarine cables and pipelines on the bed of the high seas and enjoy the traditional freedoms of navigation, overflight, scientific research, and fishing on the high seas.[33] These states also bear the burden of cooperating in the repression of piracy occurring on the high seas and taking necessary measures to conserve the living resources of the high seas.[34]

Disputes under the UNCLOS can be submitted to the International Tribunal for the Law of the Sea, established by the UNCLOS, the International Court of Justice, or to arbitration.[35] Procedures may be superseded if the parties to the dispute are also members of an international agreement that contains a previously accepted procedure to reach a "binding decision."[36]

U.S. Action

The United States has neither signed nor become a party to the UNCLOS. On October 31, 2007, the Senate Foreign Relations Committee voted to recommend Senate advice and consent to U.S. adherence to the Convention. In her confirmation hearing before the Senate Committee on Foreign Affairs on January 13, 2009, Secretary of State Hillary Clinton acknowledged that U.S. accession to the UNCLOS would be a priority for the Obama Administration.

Action by Selected Other Countries and Entities

China became a party to the UNCLOS in 1996.

The European Union became a party to the UNCLOS in 1998 via an act of formal confirmation.

India became a party to the UNCLOS in 1995.

Japan became a party to the UNCLOS in 1995.

Russia became a party to the UNCLOS in 1997.

A complete list of Parties to the UNCLOS is available at http://www.un.org/Depts/los/reference_files/status2010.pdf.

Selected Provisions with Potential Relevance to Geoengineering

Article 192 of the UNCLOS imposes a general obligation on states to protect and preserve the marine environment. In addition, the UNCLOS creates specific obligations to preserve particular marine animals. A thorough review of these "living resources provisions" can be found in CRS Report RL32185, *U.N. Convention on the Law of the Sea: Living Resources Provisions*, by Eugene H. Buck. These provisions could be implicated by ocean fertilization and some other geoengineering activities if they have a

[32] *Id.* at Arts. 55-57.

[33] *Id.* at Arts. 87, 112.

[34] *Id.* at Arts. 100, 117.

[35] *Id.* at Art. 287.

[36] UNCLOS, Arts. 282.

negative effect on the marine ecosystem. In addition to the living resources provisions discussed in that report, a large-scale ocean fertilization project could also implicate the provisions identified below.

Articles 56 and 240: Marine Research

Geoengineering research conducted in or on the oceans would likely implicate several UNCLOS provisions, including Article 56 and Articles 238 through 241.

Article 56 of the UNCLOS gives the coastal member state the jurisdiction over marine scientific research within its EEZ, but also imposes a duty on the state to exercise this jurisdiction in a manner compatible with the provisions of the UNCLOS and with regard to the rights and duties of other states.

Article 238 gives all member states, regardless of their geographic location, as well as competent international organizations, the right to conduct marine scientific research subject to the rights and duties of other states. Article 240 of the UNCLOS provides a list of principles for the conduct of marine scientific research, including that marine scientific research must not unjustifiably interfere with other legitimate uses of the sea.

Articles 194 and 207-212: Duty to Prevent, Reduce, and Control the Spread of Pollution

Article 194 of the UNCLOS imposes a duty on member states to take, individually or jointly, measures that are necessary to prevent, reduce, and control pollution of the marine environment from any source. The UNCLOS defines pollution as any human-driven introduction of substances or energy into the marine environment that results *or is likely to result* in deleterious effects such as harm to living resources and marine life, hazards to human health, hindrance to marine activities, or impairment of sea water quality.[37] Article 194 requires member states to take measures to ensure that activities under their jurisdiction are conducted so as not to cause damage by pollution to other states and their environment and that pollution arising from incidents or activities within their jurisdiction does not spread beyond the areas where they exercise sovereign rights. This provision could be implicated by a geoengineering project if it entails polluting the marine environment, by land, sea, or air. In addition to, arguably, mandating that a state not engage in that activity, once a geoengineering project resulted in the pollution of the ocean environment, Article 194 would impose a duty on the member state responsible for that pollution to control and limit its spread.

In addition to Article 194, there are several other pollution-specific provisions, including Articles 207 through 212, each which deal with pollution from different sources including pollution from land-based sources, pollution by dumping, pollution from vessels, and pollution from or through the atmosphere. Consequently, while ocean fertilization might be the geoengineering project most easily associated with a potential to implicate the UNCLOS's pollution provisions, both land and air-based geoengineering projects would implicate these provisions if they introduced new substances or energy into the marine environment that caused or was likely to cause harm to marine animals, ecosystems, or water quality. In particular, ocean-based enhanced weathering techniques, ocean-based albedo enhancement techniques, and geoengineering activities that may lead to ocean acidification could implicate these provisions depending upon the nature of their intervention.

[37] UNCLOS, Art. 1.1(4).

Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter and the "London Protocol"

The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter ("London Convention") was opened for signature in December 1972 and entered into force in August 1975. Contracting Parties pledge to take all possible steps to prevent the pollution of the sea by substances that are liable to create hazards to human health, harm living resources and marine life, or interfere with other legitimate uses of the sea.[38] "Dumping" is defined for purposes of the Convention as any deliberate disposal of substances and materials into the sea by or from ships or aircraft other than what is (1) incidental to the normal operation of ships and aircraft; or (2) placed into the sea for a purpose other than disposal that is not contrary to the aim of the Convention.[39] Several amendments were added to the London Convention between 1978 and 1993 dealing with the dumping of incinerated and radioactive wastes.

The London Protocol was agreed to in 1996 as a means of modernizing and eventually replacing the London Convention. It entered force in March 2006. The Protocol reiterates and expands upon many of the obligations discussed in the London Convention. It is notable for taking a "precautionary approach" to environmental protection from marine pollution by dumping. In addition, rather than continuing the London Convention's approach to banning the dumping of a set of substances, it reverses that approach, banning the dumping of *all* substances except for a particular set of substances.[40] In 2006, an amendment to the protocol added carbon dioxide streams from carbon dioxide capture processes to the London Protocol's list of substances that may be dumped.

U.S. Action

The United States ratified the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter ("London Convention") in 1974, but it has not become a party to the *Protocol* to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter ("London Protocol"). The London Protocol was signed by the United States on March 31, 1998 and submitted to the Senate on September 4, 2007. The State Department identified the London Protocol as a treaty "on which the Administration supports Senate action at this time" in a May 11, 2009 letter to the Chairman of the Senate Committee on Foreign Relations.[41]

Action by Selected Other Countries and Entities

China became a party to the London Convention in 1985 and the London Protocol in 1996.

The European Union has not become a party to either the London Convention or the London Protocol, but many European countries have. The European states that are parties to *both* are: Belgium, Bulgaria,

[38] London Convention, Art. 1.

[39] *Id.* at Art. 19.1.

[40] These possibly accepted substances include: dredged material, sewage sludge, fish waste, man-made structures at sea, inert inorganic geological material, organic material of natural origin, and bulky items primarily comprising iron, steel, concrete and similar materials for which concern is physical impact and dumping is the most practicable means of disposal. London Protocol, Annex 1.

[41] Letter from Richard Verma, Assistant Secretary for Legislative Affairs, U.S. Department of state, to Senator John Kerry, Chairman of the Senate Committee on Foreign Relations (May 11, 2009) *available at* http://www.globalsolutions.org/files/general/White_House_Priorities_List.pdf.

Denmark, France, Germany, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Slovenia, Spain, Switzerland, and the United Kingdom.

India is not a party to either agreement.

Japan became a party to the London Convention in 1980 and to the London Protocol in 2007.

Russia has been a party to the London Convention since 1975 but has not become a party to the London Protocol.

A list of the parties of the London Convention is available at http://www.imo.org/includes/blastDataOnly.asp/data_id%3D23854/2.pdf. A list of the parties of the London Protocol is available by following the "37 Parties" hyperlink at http://www.imo.org/home.asp?topic_id=1488.

Selected Provisions with Potential Relevance to Geoengineering

Article 19 of the London Convention and Article 1 of the Protocol: Dumping Defined

Both the London Convention and London Protocol are implicated when a substance is dumped into the oceans. However, geoengineering projects that intentionally dump substances into the ocean for a purpose *other than disposal* may fall outside of the London Convention's definition of dumping if the purpose of the dumping is not contrary to the aim of the Convention.[42] For example, as discussed below, ocean fertilization research activities have been deemed not to constitute dumping under the London Convention and Protocol.[43]

Articles 5-6 of the London Convention and Article 4 of the Protocol: Bans and Permits

Article 5 of the London Convention bars particular substances from being dumped, and Article 5 places constraints on the dumping of other enumerated substances. The barred substances are listed under Annex 1[44] while those subject to special requirements are listed in Annex 2.[45] Among the constraints placed on the dumping of Annex 2 substances is the requirement that they may not be dumped in "significant" amounts absent a permit.[46] The substances that the London Convention requires be dumped only in limited circumstances include those that, while not considered inherently harmful, *may become* harmful or seriously likely to reduce amenities due to the *quantities* in which they are dumped.

[42] *See* London Convention, Art. 19.1; *see also* London Protocol, Art. 1.4 (adopting a very similar definition of dumping).

[43] *See infra* notes 55-59 and accompanying text.

[44] These substances include: organohalogen compounds, compounds which may form organohalogens in the marine environment, organosilicon compounds, compounds which may form organosilicons in the marine environment, substances that the Contracting Parties agreed are likely to be carcinogenic under the conditions of disposal, mercury, mercury compounds, cadmium, cadmium compounds, persistent plastics, persistent synthetic materials which may float or remain in suspension and seriously interfere with fishing, navigation or other legitimate uses of the sea.

[45] London Convention, at Arts. 5-6. These substances include: arsenic, lead, copper, zinc, cyanides, flourides, pesticides, containers, scrap metal, tar-like substances, other bulky wastes likely to present a serious obstacle to fishing or navigation, substances which may become harmful due to the quantities in which they are dumped or are seriously likely to reduce amenities.

[46] London Convention, Art. 6.

The London Protocol has take a more restrictive approach than the London Convention, banning all dumping *except* for that of the substances listed in Annex 1.[47] However, even dumping of the permissible substances must be done in compliance with the permit requirement and other conditions specified in Annex 2.[48]

Article 3.1 of the London Protocol: The Precautionary Approach

The precautionary approach to environmental protection from dumping is outlined in Article 3.1, which states that Contracting Parties must take "appropriate preventative measures" when there is reason to believe that wastes or other matter introduced into the marine environment are "likely to cause harm even when there is no conclusive evidence" to that effect. It further states that, in implementing this duty, Contracting Parties must not transfer the damage or likelihood of damage from one part of the environment to another or transform one type of pollution into another.[49]

Article 6 of the London Protocol: Exceptions to the General Ban

Contracting Parties considering a geoengineering project that might implicate the London Protocol should note its exceptions to the general ban on dumping.[50] In particular, Article 6.2 permits Contracting Parties to issue a permit as an exception to the general ban "in emergencies posing an unacceptable threat to human health, safety, or the marine environment and admitting of no other feasible solution." Arguably, such a permit could entitle a Contracting Party to engage in a geoengineering project that would otherwise violate the London Protocol's general ban. However, in order to make use of this exception, the Contracting Party must consult with other countries that are likely to be affected as well as certain international organizations.[51]

Article 14 of the London Protocol: Scientific Research

The London Protocol requires Contracting Parties to take appropriate measures to promote and facilitate scientific and technical research on the prevention, reduction, and elimination of sources of marine pollution.[52] Consequently, if carbon dioxide emissions or imbalances are considered a source of marine pollution, one could argue that the London Protocol *supports* research into geoengineering projects to stabilize the amount of carbon dioxide in the climate system.[53]

2006 Amendments

Finally, the 2006 amendments to the London Protocol could be particularly relevant to geoengineering projects involving the sequestration of carbon dioxide. These amendments entered into force on February 10, 2007 and provide guidance on the means by which sub-seabed geological sequestration of carbon dioxide can be conducted. The International Maritime Organization (IMO), which is the international organization charged with developing and maintaining a comprehensive transboundary maritime regulatory framework, described these amendments as creating a basis in international environmental law

[47] London Protocol, Art. 4.1.1.

[48] *Id.* at Art. 4.1.2.

[49] *Id.* at Art. 3.1.

[50] *See id.* at Art. 6.

[51] *Id.* at Art. 6.2.

[52] London Protocol, Art. 14.

[53] *Id.* at Art. 6.2.

to regulate carbon capture and storage in sub-seabed geological formations.[54] They state that carbon dioxide streams may only be considered for dumping if (1) disposal is into a sub-seabed geological formation; (2) the substances dumped consist overwhelmingly of carbon dioxide; and (3) no other wastes or matter were added to them for the purpose of disposing of them.

2008 Resolution: Ocean Fertilization

In 2008, the Contracting Parties adopted Resolution LC-LP.1[55] agreeing that the scope of *both* the London Convention and the London Protocol includes ocean fertilization activities, which has been identified as a potential geoengineering project. The resolution defines "ocean fertilization" as "any activity undertaken by humans with the principle intention of stimulating primary productivity in the oceans."[56] It specifically excludes ocean fertilization *research* from the London Convention and London Protocol's definition of dumping by stating that ocean fertilization is a placement of matter for a purpose other than mere disposal.[57] It urges Contracting Parties to use the "utmost caution and the best available guidance" to evaluate scientific research proposals for ocean fertilization and says that ocean fertilization activities *other than research* should not be allowed given the present state of knowledge.[58] The Scientific Groups under the London Convention and Protocol, which act as scientific advisers to the Parties, will, pursuant to this resolution, develop an assessment framework by which Contracting Parties can assess ocean fertilization research proposals to determine their consistency with the Convention and the Protocol.[59]

Convention on Biological Diversity

The Convention on Biological Diversity ("CBD") was opened for signature in June 1992 and entered into force in December 1993. Its key principle is that countries have both the sovereign right to exploit their own resources pursuant to their own domestic policies and the responsibility to ensure that activities within their control do not cause damage to the environment of other states or to areas beyond the limits of national jurisdiction.[60] Rather than limiting its provisions to *conservation*, the CBD seeks to balance conservation objectives with development objectives. It calls upon Parties to develop national strategies, plans, and programs for the conservation and sustainable use of biodiversity; to identify components of biodiversity important for its conservation and use; to establish a system of protected areas where special measures need to be taken to conserve biodiversity; and to regulate or manage biological resources important for biodiversity with a view to ensuring their conservation and sustainable use.[61]

[54] Press Release, International Maritime Organization, New International Rules to Allow Storage of CO_2 under the Seabed, http://www.imo.org/Newsroom/mainframe.asp?topic_id=1472&doc_id=7772 (last visited Mar. 8, 2010).

[55] *Available at* http://www.imo.org/includes/blastDataOnly.asp/data_id%3D24337/LC-LP1%2830%29.pdf.

[56] Resolution LC-LP.1, Art. 2.

[57] *Id.* at Art. 3.

[58] *Id.* at Arts. 6, 8.

[59] *Id.* at Arts. 5, 6.

[60] CBD, Art. 3.

[61] *Id.* at Arts. 6-8.

U.S. Action

The United States has signed but has not become a party to the Convention on Biological Diversity ("CBD"). In 2009, the State Department identified the Convention on Biological Diversity as a treaty on which the Obama Administration is *not* seeking Senate action.[62]

Action by Selected Other Countries and Entities

China became a party to the CBD in 2000.

The European Union became a party to the CBD in 2000.

India became a party to the CBD in 2001.

Japan has signed but not become a party to the CBD.

Russia has signed but not become a party to the CBD.

A complete list of Parties to the CBD can be found at http://www.cbd.int/convention/parties/list.

Selected Provisions with Potential Relevance to Geoengineering

Article 4: Jurisdictional Scope

Unlike some of the other treaties discussed in this memorandum, which apply largely to areas outside of national jurisdiction, in the case of "components of biological diversity," the provisions of the CBD apply to areas *within* the limits of a Party's national jurisdiction.[63] The CBD also applies to "processes and activities" carried out within the limits of a Party's national jurisdiction regardless of where the effects of those processes or activities occur.[64]

Article 8: In-situ Conservation

Under Article 8, Contracting Parties must establish a system and guidelines for the selection of protected areas where special measures need to be taken to conserve biological diversity.[65] They must also, to the extent possible and appropriate, rehabilitate and restore degraded ecosystems and promote the recovery of threatened species. [66] Perhaps most importantly for geoengineering projects, they must regulate, manage, or control the risks associated with the use and release of living modified organisms which are likely to have adverse environmental impacts and must prevent the introduction of, control, or eradicate alien

[62] *Supra* note 41, at 5.

[63] CBD, Art. 4.1(a). The components of biological diversity seem to include the categories identified in Annex I. These categories include, for example, ecosystems and habitats that contain high diversity or large numbers of threatened species, and species and communities that are threatened, wild relatives of domesticated species, or important to research into the conservation and sustainable use of biological diversity. CBD, Annex 1.1-1.2. Article 7 also asks the Contracting Parties to identify "components of biological diversity important for its conservation and sustainable use" having regard to the list of categories set down in Annex I. *Id.* at Art. 7(a).

[64] *Id.* at 4.1(b).

[65] CBD, Art. 8(a)-(b).

[66] *Id.* at Art. 8(f).

species that threaten ecosystems, habitats, or species.[67] These requirements could constrain if not prohibit certain geoengineering projects that involve releasing living organisms, such as algae, into new ecosystems to sequester carbon.

Article 12: Research and Training

Article 12 requires Contracting Parties to promote and encourage research which contributes to the conservation and sustainable use of biological diversity. In doing so, the Contracting Parties must take into account the decisions of the Conference of the Parties reached in response to recommendations of the Subsidiary Body on Scientific, Technical, and Technological Advance.[68] Accordingly, this provision has the potential to be used to support geoengineering research projects if those projects were recommended by the Subsidiary Body on Scientific, Technical, and Technological Advance.

2008 Decision of the Conference of the Parties: Climate Change and Ocean Fertilization

The Ninth Meeting of the Conference of the Parties to the CBD ("COP") decided that reviews of programs of work of the CBD should assess the impacts of climate change. In its decision on biodiversity and climate change, the Conference urged Parties to "enhance the integration of climate-change considerations related to biodiversity in their implementation of the Convention."[69]

In addition, the COP noted the work of the London Convention and the London Protocol regarding ocean fertilization and requested that its own Parties act to ensure that ocean fertilization activities do not take place until either there is adequate scientific basis on which to justify such activities or the activities are small-scale scientific research studies within coastal waters.[70] The Royal Society criticized the move by the COP on the grounds that the definition of "coastal waters" was ambiguous and that small-scale near-shore studies are meaningless for ocean fertilization field trials.[71] For its part, the Secretariat of the Convention on Biological Diversity has published two reports analyzing the possible effects of ocean fertilization on biodiversity, both of which are available on its website at http://www.cbd.int/ts.

United Nations Framework Convention on Climate Change and the Kyoto Protocol

The United Nations Framework Convention on Climate Change ("UNFCCC") opened for signature in 1992 and entered into force in 1994. In its report on geoengineering and governance, the Royal Society noted that, in combination with the Kyoto Protocol, the UNFCCC has a significant institutional structure for the international governance of climate change and its secretariat already cooperates with that of two other environmental conventions (the CBD and the UN Convention to Combat Desertification) on mutually supportive activities.[72] Under the UNFCCC, Parties are required to: (1) gather and share information on greenhouse gas ("GHG") emissions, national policies, and best practices, (2) launch national strategies for addressing GHG emissions and adapting to expected impacts, and (3) cooperate in preparing for adaptation to the impacts of climate change. The UNFCCC does not set binding targets for GHG emissions. Instead, it provides a structure for international consideration of the issue of climate

[67] *Id.* at Art. 8(g)-(h).

[68] *Id.*

[69] UNEP/CBD/COP/9/29, Decision IX/16, "Climate Change and Biodversity," *available at* http://www.cbd.int/doc/decisions/cop-09/full/cop-09-dec-en.pdf.

[70] *Id.*

[71] THE ROYAL SOCIETY, *supra* note, at 37.

[72] *Id.* at 41.

change and states that climate change is of "common concern to humankind" but that any international response should take into account, among other factors, countries' "respective capabilities."

The Kyoto Protocol was opened for signature in 1997 and entered into force in 2005. It is designed to implement the UNFCCC by committing its industrialized state Parties ("Annex 1" countries) to legally binding reductions in emissions of greenhouse gases. Specifically, the Kyoto Protocol requires Annex I countries to reduce their aggregate greenhouse gas emissions by 5% below 1990 levels by 2012. This goal is often-called the "first round" of emissions targets under the Kyoto Protocol. One of the goals the 2009 Copenhagen Conference was to develop a "second round" emissions targets for Annex 1 Parties. However, this goal was not achieved. [73]

Like the UNFCCC, the Kyoto Protocol calls on *all* Parties to take certain steps relating to national and regional programs to mitigate climate change, the promotion and transfer of environmentally sound technologies, and the identification of domestic greenhouse gas sinks. The Kyoto Protocol established a Compliance Committee responsible for, among other duties, applying consequences for Parties that do not meet their commitments. For more on the obligations contained in the Kyoto Protocol, read CRS Report RL33826, *Climate Change: The Kyoto Protocol, Bali "Action Plan," and International Actions*, by Jane A. Leggett.

While the Copenhagen Conference did not set a "second round" of emissions reduction targets for Annex 1 Parties of the Kyoto Protocol, it did produce a non-binding political outcome, the Copenhagen Accord, with which Parties may indicate their intent to associate. The Accord represents a bottom-up approach to climate change: Annex 1 Parties of the UNFCCC are asked to develop their own individual emissions targets for 2020 and to measure, report, and verify their progress towards these targets pursuant to guidelines adopted by the UNFCCC Conference of the Parties ("COP").[74] Similarly, non-Annex 1 Parties are asked to develop "mitigation actions" for the reduction of GHG emissions, though not emissions *targets*, and measure, report, and verify their implementation of these actions.[75]

U.S. Action

The United States ratified the United Nations Framework Convention on Climate Change ("UNFCCC") in 1992. It signed but has not become a party to the Kyoto Protocol. It has indicated its intent to associate with the Copenhagen Accord.

Action by Selected Other Countries and Entities

China has been bound by the UNFCCC since 1993 and the Kyoto Protocol since 2002. It has indicated its intent to associate with the Copenhagen Accord.

The European Union has been bound by the UNFCCC since 1993 and the Kyoto Protocol since 2002. It has indicated its intent to associate with the Copenhagen Accord.

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[73] Under the "Bali Road Map" developed by the 2007 UN Climate Change Conference, there were two goals of Copenhagen Conference: (1) set post-2012 emissions targets for Annex 1 Parties of the Kyoto Protocol and (2) reach a new agreed outcome among *all* UNFCCC Parties regarding greenhouse gas (GHG) mitigation targets or actions. While Copenhagen failed to achieve the first goal, some have argued it did achieve the second, even though the agreed outcome, the Copenhagen Accord, is a non-binding political agreement.

[74] Copenhagen Accord, Art. 4.

[75] *Id.* at Art. 5.

India has been bound by the UNFCCC since 1993 and the Kyoto Protocol since 2002. It has indicated its intent to associate with the Copenhagen Accord.

Japan has been bound by the UNFCCC since 1993 and the Kyoto Protocol since 2002. It has indicated its intent to associate with the Copenhagen Accord.

Russia has been bound by the UNFCCC since 1994 and the Kyoto Protocol since 2004. It has indicated its intent to associate with the Copenhagen Accord.

A list of the parties of the UNFCCC and Kyoto Protocol is available at http://unfccc.int/parties_and_observers/items/2704.php. For accession information on developed countries, follow the "Annex I" hyperlink, and for accession information on developing countries, follow the "Non-Annex I" hyperlink.

For links to the submissions of Annex I parties relating to the Copenhagen Accord, visit http://unfccc.int/home/items/5264.php, and, for links to the submissions of non-Annex I parties, visit http://unfccc.int/home/items/5265.php.

Selected Provisions with Potential Relevance to Geoengineering

Article 4 of the UNFCCC: Commitments

Under Article 4 of the UNFCCC, Parties must formulate, implement, and update national, and where appropriate, regional programs containing measures to mitigate climate change as well as measures to facilitate adequate adaptation to climate change.[76] When a Party implements this mandate, it must communicate information related to that implementation to the Conference of the Parties.[77] Consequently, if a UNFCCC Party is using geoengineering currently as a national measure to mitigate or adapt to climate change, it needs to communicate that to the Conference of the Parties.

In addition, Article 4 requires Parties to promote and cooperate on the sustainable management, conservation, and enhancement of sinks and reservoirs of greenhouse gases, which includes biomass, forests, and oceans.[78] In the context of some potential geoengineering projects, a conflict could arise between *enhancing* a greenhouse gas sink or reservoir and either conserving it or managing it sustainably since, by enhancing the capacity of a sink or reservoir to absorb carbon dioxide, one may degrade it. However, Article 4.1(f) requires Parties to employ climate change measures "with a view to minimizing adverse effects" on the environment, the economy, and public health. This provision would arguably weigh in favor of an interpretation of enhancement that would exclude geoengineering projects with potentially numerous or severe adverse effects.

Article 4 also requires Parties to cooperate in preparing for adaptation to the impacts of climate change.[79] One could, potentially, argue that geoengineering is a form of this transboundary cooperation and frame

[76] UNFCCC, Art. 4.1(b); *see also* Art. 4.2(a) (reiterating this commitment for *developed* countries).

[77] UNFCCC, Art. 4.1(j).

[78] *Id.* at Art. 4.1(d); *see also* Art. 4.2(a) (reiterating this commitment for *developed* countries).

[79] UNFCCC, Art. 4.1(e).

geoengineering projects as *adaptation* to climate change rather than measures to *mitigate* climate change. The UNFCCC does not define adaptation to definitively preclude this position.[80]

Article 4 requires Parties to cooperate in the full, open, and prompt exchange of relevant scientific, technological, and other information related to the climate system and climate change and to the consequences of various response strategies.[81] This provision would appear to mandate that any UNFCCC Party that engaged in geoengineering research exchange information resulting from that research with the other Parties.

Article 4 reiterates these commitments for developed countries, effectively asking them to take policies and measures that "will demonstrate that developed countries are taking the lead in modifying longer-term trends in anthropogenic emissions."[82] This language could be interpreted to place developed countries in a leadership position on geoengineering projects. It also leaves open the door for developed countries to implement climate change policies and measures *jointly* and assist other Parties in combating climate change.[83]

Article 5 of the UNFCCC: Research and Systematic Observation

As for research, the UNFCCC requires Parties to promote access to data and analyses obtained from areas beyond national jurisdiction.[84] This could be read to require the sharing of information from a Party's geoengineering project on the high seas or in outer space, for example, with other Parties.

Article 3.3 of the Kyoto Protocol and Provisions of the Copenhagen Accord: Carbon Sinks

One of the most contentious issues in the negotiations over Kyoto Protocol rules is how to give nations credit for carbon sinks: forest or land uses that absorb carbon from the atmosphere so as to reduce the net additions a country makes to carbon dioxide levels in the atmosphere. Article 3.3. of the Kyoto Protocol states that the net changes in greenhouse gas emissions resulting from human-induced land-use change and forestry activities may be used to meet the emission reduction targets of each Annex I country. However, Article 3.3 appears to only permit net emissions changes to be used to meet reduction targets when they result from changes in *land*-uses or *forestry* (either afforestation, reforestation, or deforestation). The opportunity presented by Article 3.3 for geoengineering projects to be used to meet Kyoto Protocol targets, therefore, does not seem to exist for *air* or *ocean* geoengineering activities.

The Copenhagen Accord provides much less explicit guidance on the role of carbon sinks, and countries' use and enhancement of those sinks, in meeting its submitted commitments on emissions targets or, for developing countries, mitigation actions. Article 6 of the Copenhagen Accord states that the Parties "recognize the crucial role of reducing emissions from deforestation and forest degradation." In Article 7 states the Parties decision "to pursue various approaches...to enhance the cost-effectiveness of, and to promote mitigation actions." Finally, Article 11 states that the Parties will "establish a Technology Mechanism to accelerate technology development and transfer in support of action on adaptation and mitigation..." Given the generality of these statements, they can be read to promote some geoengineering

[80] *See id.*, Art. 1.

[81] *Id.* at Art. 4.1(h).

[82] UNFCCC, Art. 4.2(a) (emphasis added).

[83] *Id.*

[84] *Id.* at Art. 5 (b).

projects and geoengineering-technology transfer, but, at this early stage, the extent of that promotion is far from clear.

Countries considering researching or implementing a geoengineering project under the auspices of a UNFCCC-related agreement's provisions on carbon sinks will presumably review methodology reports and guidelines issued by the Intergovernmental Panel on Climate Change ("IPCC"). These are generally considered the worldwide standard for best practice in emissions inventories and frequently used by UNFCCC Parties.

Table: Table of Selected Parties to International Agreements Discussed

	United States	China	European Union	India	Japan	Russia
UNCLOS		X	X	X	X	X
London Convention	X	X	By Country		X	X
London Protocol		X	By Country		X	
CBD		X	X	X		
UNFCCC	X	X	X	X	X	X
Kyoto Protocol		X	X	X	X	X
Copenhagen Accord	A	A	A	A	A	A

Source: Congressional Research Service

Notes: An 'X' indicates that the country is a party to the international agreement; an 'A' indicates that it has stated its intent to associate with the agreement. The European Union did not ratify the London Convention and London Protocol as a single unit, leaving the individual nations to decide whether to ratify/accede to the agreements.

Selected Other Multilateral Treaties with Possible Ramifications for Geoengineering

Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space ("Outer Space Treaty")[85]

The Agreement Governing the Activities of States on the Moon and Other Celestial Bodies ("Moon Treaty")[86]

United Nations Convention to Combat Desertification ("UNCCD")[87]

[85] More information available at http://www.oosa.unvienna.org/oosa/SpaceLaw/outerspt.html

[86] More information available at http://www.oosa.unvienna.org/oosa/SpaceLaw/moon.html

[87] More information available at http://www.unccd.int

Convention on the Prohibition of Military or Other Hostile Use of Environmental Modification Techniques ("ENMOD")[88]

Convention on Long-range Transboundary Air Pollution ("CLRTAP")[89]

Convention on the Conservation of Antarctic Marine Living Resources ("CCAMLR")[90]

Convention on Fishing and Conservation of the Living Resources of the High Seas[91]

[88] Text available at http://www.un-documents.net/enmod.htm

[89] More information available at http://www.unece.org/env/lrtap

[90] More information available: http://www.ccamlr.org

[91] Text available at http://untreaty.un.org/ilc/texts/instruments/english/conventions/8_1_1958_fishing.pdf