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A GREEN HERRING: HOW CURRENT OCEAN FERTILIZATION REGULATION DISTRACTS FROM GEOENGINEERING RESEARCH

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TABLE OF CONTENTS

INTRODUCTION

As efforts to mitigate climate change have stalled over the past several decades, domestic and international focus has begun to shift towards adapting to its effects.[1] Limiting carbon emissions to 500 parts per million, or nearly double

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1. *See, e.g.*, Richard Black, *Climate Change Advisers Urge UK to Prepare for Change*, BBC NEWS (Sept. 15, 2010, 9:18 PM), http://www.bbc.co.uk/news/science-environment-11322929.

preindustrial concentrations, requires overcoming substantial political obstacles.[2] As time runs short on any comprehensive solutions, scientists and international delegates have begun considering ocean fertilization and other geoengineering measures in conjunction with mitigation efforts as a means to solve the climate crisis.[3]

Geoengineering is a broad category of "engineered interventions" designed to combat and counteract the effects of climate change.[4] The Royal Society provides a comprehensive definition: "the deliberate large-scale manipulation of planetary environment to counteract anthropogenic climate change."[5] While geoengineering approaches are incredibly varied, they all seek to prevent temperature rise not by reducing greenhouse gas emissions from the source, but by counteracting the effects of these emissions.[6] Once left to science fiction novels[7] and Popular Mechanics magazines[8], scientists and legal scholars now seriously discuss geoengineering as part of the solution to

2. *See generally* Stephen Pacala & Robert Socolow, *Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies*, 305 SCIENCE 968 (2004).

3. *See Experts Advocate Geoengineering Research Programme*, 9 A WORLD OF SCIENCE 1, 11 (2011), *available at* http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/SC/pdf/AWOS_vol9no1_geoengineering.pdf.

4. Edward Parsons & Lia Ernst, *International Governance of Climate Engineering*, 14 THEORETICAL INQ. L. 307 (2013).

5. *See* ROYAL SOC'Y, GEOENGINEERING THE CLIMATE: SCIENCE, GOVERNANCE AND UNCERTAINTY 1 (2009), *available at* http://royalsociety.org/uploadedFiles/Royal_Society_Content/policy/publications/2009/8693.pdf.

6. *See About Geoengineering*, INTEGRATED ASSESSMENT OF GEOENGINEERING PROPOSALS (Sept. 17, 2013), http://www.iagp.ac.uk/about-geoengineering. There are two main branches of geoengineering approaches: Carbon Dioxide Removal and Solar Radiation Management. *See* ROYAL SOC'Y, *supra* note 5, at ix. While Carbon Dioxide Removal does not reduce Carbon Dioxide at its emission source, it does seek to combat climate change by reducing carbon dioxide atmospheric concentrations through the use of various removal and storage technologies. *See generally id.* at 9. Solar Radiation Management, on the other hand, seeks to offset the effects of increased greenhouse gas concentrations by altering the ratio of radiation received from the sun. *See generally id.* at 23.

7. *See, e.g.*, H.G. Wells, THE WAR OF THE WORLDS (Heinemann 1898).

8. *See, e.g.*, Joanna Borns, *Spongelike Air-Capture Gadget Scrubs Away Carbon Emissions*, POPULAR MECHANICS (Oct. 1, 2009, 12:00 AM), http://www.popularmechanics.com/science/environment/4256184; Jeremy Jacquot, *Can a Kind of Ancient Charcoal Put the Brakes on Global Warming*, POPULAR MECHANICS (Oct. 1, 2009, 12:00 AM), http://www.popularmechanics.com/science/4297513?click=main_sr.

climate change and at the very least to be used as a stopgap measure.[9]

However, policymakers and representatives at United Nations climate talks have yet to discuss geoengineering as a tool to combat climate change.[10] While delegates vigorously discuss carbon reduction year after year at the UN Climate Change Conference, policymakers have largely treated geoengineering as a separate issue.[11] Many fear that a discussion on geoengineering, let alone basic research on the subject, will undermine the current emphasis on reducing carbon emissions.[12]

Delegates have also treated the discussions about climate change and geoengineering separately because each option poses dramatically different political obstacles. Climate change mitigation remains stalled by the so-called prisoner's dilemma:[13] while states would be collectively best off avoiding increased global temperatures through global reductions in carbon emissions, each individual actor economically benefits the most by continuing with its own emissions.[14] For an effective agreement, all developed nations must agree to emission reductions.[15] But efforts perpetually stall as

9. *See, e.g.*, David G. Victor et al., *The Geoengineering Option*, FOREIGN AFFAIRS (Mar./Apr. 2009), http://agriculturedefensecoalition.org/sites/default/files/file/geo_current_116/116QC_2009_CFR_The_Geoengineering_Option_by_Victor_Council_on_Foreign_Relations_2009.pdf.

10. *See* Allister Doyle, *Geo-engineering Wins Scant Enthusiasm at UN Climate Talks*, REUTERS (Dec. 2, 2012, 4:57 PM), http://in.reuters.com/article/2012/12/02/climate-talks-geo-engineering-idINDEE8B104720121202.

11. *See id.*

12. *See* Victor et al., *supra* note 9.

13. The prisoner's dilemma is a game theory model used to illustrate the barriers to cooperation in a competitive environment. The model is typically explained through the following scenario: the police interrogate two suspects to a crime in separate rooms. Each is offered the option of confessing to the crime, or staying silent and remaining loyal to his partner. If both suspects remain silent, then the police have insufficient evidence for arrest and both suspects go free. But if one cooperates with the police and the other does not, the cooperating prisoner receives a substantial reduction on his sentence while the loyal accomplice gets the maximum sentence. Although the suspects are best off by remaining silent, the risk of one side defecting typically causes both sides to defect, thus putting both suspects in a worse off position. For more on the prisoner's dilemma and game theory generally, see Avinash Dixit and Susan Skeath, GAMES OF STRATEGY (W.W. Norton & Co., 2d Ed. 2004).

14. *See* Stephen M. Gardiner, *A Perfect Moral Storm: Climate Change, Intergenerational Ethics and the Problem of Moral Corruption*, 15 ENVIRONMENTAL VALUES 397, 400 (2006).

15. *See* Victor et al., *supra* note 9.

individual states worry that economic rivals will strategically defect, continue to emit, and reap relative economic benefits.[16]

Geoengineering, on the other hand, more closely resembles nuclear brinkmanship. While traditional climate change solutions require the participation of all parties, geoengineering empowers one player to take dramatic, irreversible action. The nations most vulnerable to rising sea levels could threaten to implement geoengineering in an attempt to force action on emissions reduction. Similar to the nuclear arms race, states with little bargaining power may see geoengineering as an opportunity to voice their opinions. If willing, one country could act unilaterally to implement several geoengineering techniques, manipulating the climate globally.[17] While a single geoengineering experiment would not cause the same level of turmoil as a nuclear test, these experiments, if implemented irresponsibly, could result in the opposite of their intended effect, causing irreversible damage to our atmosphere.[18]

Unlike nuclear proliferation, some geoengineering techniques are so inexpensive that virtually every vulnerable country could conduct experiments.[19] Expenses are so low that wealthy philanthropists and entrepreneurs can participate; some already do.[20] In no field of geoengineering is this truer than in ocean fertilization.[21] The technique increases carbon uptake in the ocean by supplying nutrient-deficient regions of the ocean with the nutrients they lack.[22] Adding these nutrients causes phytoplankton blooms where ocean life was previously nonexistent.[23] In theory, the

16. *See id.*
17. *See id.*
18. *See id.*
19. *See id.*
20. *See* Tracy D. Hester, *Remaking the World to Save It: Applying U.S. Environmental Laws to Climate Engineering Projects*, 38 ECOLOGY L.Q. 851, 864 (2011). Bill Gates has funded more than $4.5 million worth of research in climate engineering projects. *See* Eli Kintisch, *Bill Gates Funding Geoengineering Research*, SCIENCEINSIDER (Jan. 26, 2010, 2:10 PM), http://news.sciencemag.org/scienceinsider/2010/01/bill-gates-fund.html.
21. *See Q&A on Ocean Fertilization*, UNESCO IOC (October 23, 2012), http://www.unesco.org/new/en/natural-sciences/ioc-oceans/single-view-oceans/news/ocean_fertilization_we_cannot_afford_to_gamble_with_the_ocean/.
22. Hugh Powell, *Will Ocean Iron Fertilization Work?*, 46 OCEANUS MAGAZINE 10, 12 (2008), *available at* http://www.whoi.edu/oceanus/printArticle/do?id=34167.
23. Hugh Powell, *Fertilizing the Ocean with Iron*, 46 OCEANUS MAGAZINE 4,

resulting blooms will absorb carbon dioxide from the atmosphere, and when the phytoplankton die, their bodies will sink to the ocean floor, locking in the carbon dioxide for hundreds, if not thousands of years.[24]

This Comment proposes that nations tackle the dangers posed by ocean fertilization experiments together with other geoengineering activities, in the context of combatting climate change. Unilateral ocean fertilization merits concern. However, regulation of unilateral ocean fertilization should not be done at the expense of furthering scientific knowledge and rigorous debate on all geoengineering experiments.

Part I of this Comment introduces the scientific concepts behind ocean fertilization, its benefits, and its drawbacks.[25] Part II examines the current international framework that seeks to regulate and in many cases prohibit ocean fertilization.[26] Part III provides a recent case study on unilateral ocean fertilization and the failure of the international community to prevent potentially dangerous behavior.[27] Part IV identifies the enforcement problem arising from addressing ocean fertilization separately from other geoengineering and climate change concerns and analyzes the gaps in the framework that inhibit the prevention of rogue experiments.[28] Finally, Part V proposes the ratification of a geoengineering protocol to the United Nations Framework Convention on Climate Change to more effectively combat unilateral geoengineering experiments, rather than tackling each geoengineering method separately.[29]

I. OCEAN FERTILIZATION BACKGROUND

While ocean fertilization is just one of many geoengineering techniques, it deserves special attention when discussing unilateral geoengineering because of its incredibly low barriers for implementation. Ocean fertilization is a category within the Carbon Dioxide Removal (CDR) strand of

5 (2008).

24. Powell, *supra* note 22, at 10.
25. *See infra* Part I.
26. *See infra* Part II.
27. *See infra* Part III.
28. *See infra* Part IV.
29. *See infra* Part V.

geoengineering targeted at stimulating primary productivity—the production of organic compounds from carbon dioxide—in oceans.[30] Unlike Solar Radiation Management (SRM) geoengineering techniques,[31] CDR seeks to directly address the source of climate change by reducing the amount of carbon dioxide in the atmosphere.[32] But rather than doing so by reducing carbon emissions at their source, CDR attempts to remove carbon dioxide that has already entered the atmosphere.[33] Thus, while CDR does attempt to combat the source of climate change directly, it does not reduce the anthropogenic source.[34] As carbon emissions place immense strain on our planet, CDR hopes to pull equally hard in the opposite direction to counter the problem.

A. Ocean Fertilization Techniques

All ocean fertilization techniques start with the concept of stimulating primary productivity in oceans by increasing phytoplankton populations.[35] Phytoplankton are autotrophic ocean organisms, which absorb carbon dioxide like plants through photosynthesis.[36] When they die, their carbon-filled bodies fall to the depths of the ocean, locking in the carbon, potentially for hundreds of years.[37] But phytoplankton are

30. *See* Int'l Maritime Org. [IMO], *Report of the Thirtieth Consultative Meeting and the Third Meeting of Contracting Parties*, LC 30/16, annex 6, res. LC-LP.1 (Dec. 9, 2008) [hereinafter IMO Report res. LC-LP.1] ("[O]cean fertilization is any activity undertaken by humans with the principal intention of stimulating primary productivity in the oceans.") The Intergovernmental Oceanographic Commission (IOC) similarly defined ocean fertilization as a type of geoengineering based on the purposeful introduction of nutrients to the upper ocean to increase marine food production and to remove carbon dioxide from the atmosphere. Statement, Intergovernmental Oceanographic Commission of UNESCO, Ocean Fertilization (Oct. 19, 2012), *available at* http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/SC/pdf/IOC_statement_Ocean_fertilization.pdf [hereinafter UNESCO Statement].

31. Proposed SRM techniques include Stratospheric Sulfur Dioxide Injection, Cloud Albedo Enhancement, and Space-based filters and mirrors. *See generally* William C.G. Burns, *Geoengineering the Climate: An Overview of Solar Radiation Management Options*, 46 TULSA L. REV. 283, 289–96 (2010).

32. *See* ROYAL SOC'Y, *supra* note 5, at 9.

33. *Id.*

34. *Id.*

35. *Id.* at 16.

36. *Id.*

37. *Id.* at 9; *see* Doug Wallace et al. *United Nations Educational, Scientific, and Cultural Organization*, Ocean Fertilization: A Scientific Summary for Policy Makers 3 (2011). Some phytoplankton are eaten by other organisms,

not distributed evenly across the ocean.[38] Certain ocean regions lack significant phytoplankton populations despite having many nutrients required for their existence.[39] Ocean fertilization attempts to turn these "ocean deserts" into grounds for rapid increases in phytoplankton populations, known as phytoplankton blooms, in order to increase natural carbon uptake.[40] The most common ocean fertilization technique, ocean iron fertilization, offers a fairly simple solution to do just that.[41] Scientists have discovered that adding iron sulfate to so-called "high-nutrient low-chlorophyll" ocean regions can cause massive phytoplankton blooms where ocean life was previously nonexistent.[42]

While ocean iron fertilization is the dominant field of ocean fertilization, there are several other creative techniques, many of which target low-nutrient, low-chlorophyll waters instead.[43] These regions require nitrogen to stimulate phytoplankton growth.[44] A technique proposed by the Ocean Nourishment Corporation, an Australian ocean fertilization venture, would add nitrogen directly, without any iron, by pumping urea from factories through pipelines to the edge of continental shelves in tropical and subtropical ocean regions.[45] Other scientists propose adding phosphorus to the released iron mixture.[46] The phosphorus could stimulate the bacteria *trichodesmium*, which converts dissolved nitrogen into a usable form, setting off equally large

thus the CO_2 would also be stored in marine animal waste. *See* Powell, *supra* note 23, at 2.

38. *See* Hester, *supra* note 20, at 868.

39. *Id.*

40. *See* ROYAL SOC'Y, *supra* note 5, at 16.

41. *Q&A on Ocean Fertilization*, UNESCO IOC (October 23, 2012), http://www.unesco.org/new/en/natural-sciences/ioc-oceans/single-view-oceans/news/ocean_fertilization_we_cannot_afford_to_gamble_with_the_ocean/.

42. *See* Melissa Eick, *A Navigational System for Uncharted Waters: The London Convention and London Protocol's Assessment Framework on Ocean Iron Fertilization*, 46 TULSA L. REV. 351, 351 (2010).

43. *See generally* Amy Nevala & Kate Madin, *Proposals Emerge to Transfer Excess Carbon into the Ocean*, 46 OCEANUS MAGAZINE 26, 26–27 (2008).

44. *See* Randall S. Abate & Andrew B. Greenlee, *Sowing Seeds Uncertain: Ocean Iron Fertilization, Climate Change, and the International Law Framework*, 27 PACE ENVTL. L. REV. 555, 564–65 (2010).

45. Nevala & Madin, *supra* note 43, at 26; *see also Our Ocean Solutions*, OCEAN NOURISHMENT CORP. (2014), http://www.oceannourishment.com/ouroceansolutions/.

46. Powell, *supra* note 22, at 12.

blooms.[47] Experiments in low-nutrient, low-chlorophyll regions open new areas for ocean fertilization and prevent the stripping of nutrients from surface waters often caused by traditional ocean iron fertilization experiments.[48]

Finally, some ocean fertilization experiments propose phytoplankton stimulation without adding any nutrients at all.[49] Ocean upwelling can deliver underutilized nutrients from the deep ocean to the surface, where it can be absorbed by phytoplankton in surface water.[50] Atmocean, another geoengineering corporation, proposes placing long, open ended tubes—some as long as 1,000 meters—into the ocean.[51] One-way valves and surface wave action would help drive nutrient-rich waters from the deep up to the surface.[52] As an added benefit, upwelling would also bring cooler waters up to the warmer surface waters and potentially reduce hurricane intensity.[53] Atmocean also plans to generate cheap energy from the wave action for island nations eager to sponsor the projects.[54]

B. Appeals of and Concerns About Ocean Fertilization

Ocean fertilization has gained interest because of its relative simplicity and low cost, but several risks and uncertainties leave scientists cautious. Compared to loftier geoengineering experiments requiring new infrastructure or undeveloped technology, ocean fertilization often can be implemented with existing resources. The chemical used in ocean iron fertilization experiments, iron sulfate, is readily available for purchase in bulk at nurseries or online.[55] A ship then drizzles the iron sulfate in a slurry form from behind an

47. *Id.*

48. *See* Abate & Greenlee, *supra* note 44, at 564–65. For more on the method proposed by the Ocean Nourishment Corporation, see generally OCEAN NOURISHMENT CORP., *supra* note 45.

49. *See* Nevela & Madin, *supra* note 43, at 27.

50. *Id.*

51. *Id. See* ATMOCEAN, INC., http://www.atmocean.com/1.html (last visited Feb. 9, 2014) (providing information about Atmocean's Wave Energy/Sequestration Technology).

52. *See* Nevela & Madin, *supra* note 43, at 27

53. *See* Kevin E. Trenberth, *Warmer Oceans, Stronger Hurricanes*, SCI. AM., Jun. 14, 2007, at 44.

54. *See* ATMOCEAN, INC., *supra* note 51.

55. *See, e.g.*, *Iron Sulfate Granular*, GROW ORGANIC, http://www.groworganic.com/iron-sulfate-granular-50-lb.html.

equipped vessel in a slow zigzagging pattern to increase dispersion and prevent iron from being wasted by sinking before uptake.[56] The most significant obstacle to implementation is acquiring the proper vessel to conduct the experiment. Most ocean fertilization projects, and certainly ocean iron fertilization, occur far beyond coastal waters.[57] Thus, a vessel capable of high-seas voyages is required to carry out the project. Finally, even those with a commercial purpose in mind will likely need recording equipment to measure the efficacy of the experiment.[58]

Because most resources are readily available, ocean fertilization is substantially cheaper than other geoengineering methods. Even with full implementation, geoengineering techniques generally are a fraction of what the cost would be to prevent climate change through reduced emissions.[59] While ocean fertilization may be relatively inexpensive and simple to implement, scientists have raised serious concerns about its effectiveness. Substantial scientific uncertainty exists as to whether carbon sequestration will actually occur. Early models showed that ocean iron fertilization in the Southern Ocean alone could erase one-to-two billion tons of carbon emissions per year, or about ten-to-twenty-five percent of the world's total emissions.[60] However, small-scale scientific experiments have cast doubt on these figures.[61] Experiments show that only a small percentage of absorbed carbon will likely fall to the seafloor where it has the potential to remain for millennia.[62] Up to fifty percent may reach middle-depth waters, where it could remain for several decades, but the remainder would return to the atmosphere.[63]

Additionally, many scientists are concerned about ocean fertilization's secondary effects. Nearly every CDR method is likely to significantly affect delicate ecosystems where the technology is deployed.[64] Often, a risk analysis is necessary

56. Powell, *supra* note 22, at 12.
57. Eick, *supra* note 42, at 362.
58. *See* Powell, *supra* note 23, at 9.
59. *See* Parsons & Ernst, *supra* note 4.
60. *See* Powell, *supra* note 23, at 4.
61. *Id.* at 6–7.
62. *Id.*
63. *Id.* at 4.
64. *See* Hester, *supra* note 20, at 866.

to determine whether the consequences are acceptable given the larger crisis at hand.[65] A 2009 International Oceanographic Commission (IOC) publication concluded that large-scale fertilization projects could have unintended, unpredictable impacts over an extensive area and for an extensive period of time.[66] One concern is that the decomposition resulting from phytoplankton could cause large die-offs across a marine ecosystem by consuming oxygen at lower depths.[67] Further, when decomposed nutrients swell back from the deep ocean to the surface, thousands of kilometers away and years after the original fertilization, their introduction could start a reaction resulting in the releases of nitrous oxide and methane.[68] These potent greenhouse gasses could substantially exceed the amount of carbon dioxide equivalents the phytoplankton originally sequestered.[69]

Proponents argue that ocean fertilization comes with benefits beyond carbon uptake. Phytoplankton blooms could restore phytoplankton levels previously damaged by ocean acidification and replenish fish stocks decimated by overfishing.[70] But many scientists argue that experiments could have the opposite effect.[71] The unique balance between phytoplankton, bacteria, and other nutrients present in the water where nutrients are deposited can create different ecological winners and losers.[72] Some combinations of variables may lead to an increase in fish populations, but others may cause spikes in jellyfish or toxic algal blooms, which could have irreversible negative impacts on fish stocks.[73]

65. *See* Gareth Davies, *Framing the Social, Political, and Environmental Risks and Benefits of Geoengineering: Balancing the Hard-To-Imagine Against the Hard-To-Measure*, 46 TULSA L. REV. 261, 266–68 (2010).

66. *See* Wallace et al., *supra* note 37, at 9.

67. *See id.* at 16.

68. *See id.*

69. *See id.*; Eick, *supra* note 42, at 358.

70. Eick, *supra* note 42, at 357; *see* Jessica Marshall, *Rising Ocean Acidity May Deplete Vital Phytoplankton*, DISCOVERY NEWS (Jan. 14, 2010), http://news.discovery.com/earth/phytoplankton-iron-ocean-acidity.html?print=true.

71. *See* Hugh Powell, *What Are the Possible Side Effects?*, 46 OCEANUS MAGAZINE 14, 14 (2008).

72. *See id.*

73. *See id.*

A final barrier to ocean fertilization is the difficulty in measuring the resultant carbon sequestration. Any plan to sell sequestered carbon would require a reliable accounting, which becomes particularly difficult in the ocean.[74]

II. CURRENT LEGAL FRAMEWORK

Largely because of the uncertainty surrounding ocean fertilization techniques, the international community has put in place a moratorium on current experiments until the risks can be more accurately assessed.[75] However, rather than create a new geoengineering or ocean fertilization treaty that could provide legitimacy to the geoengineering movement, states have sought to create and implement a legal framework using existing treaties. The legal framework for ocean fertilization has largely grown out of two international agreements, both of which did not originally intend to target any methods of geoengineering, let alone ocean fertilization. These two treaties are the London Convention and Protocol,[76] which seeks to ban dumping of waste into the ocean, and the Convention on Biological Diversity,[77] which, as its name suggests, seeks to preserve the planet's biological resources. The United States has passed domestic laws to implement the goals of these treaties, but the goals of this domestic framework did not include geoengineering research.[78]

A. The London Convention/Protocol and The Convention on Biological Diversity

The 1975 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, known as the London Convention, was one of the first treaties to

74. *See* Powell, *supra* note 23, at 6.

75. *See, e.g.*, *UN Decision Puts Brakes on Ocean Fertilization* , NATURE NEWS (June 3, 2008), *available at* http://www.nature.com/news/2008/080603/full/453704b.html.

76. Int'l Maritime Org. [IMO], *Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter*, 26 U.S.T. 2403 (Dec. 29, 1972), *available at* http://www.imo.org/About/Conventions/ListOfConventions/Pages/Convention-on-the-Prevention-of-Marine-Pollution-by-Dumping-of-Wastes-and-Other-Matter.aspx [hereinafter London Convention].

77. Convention on Biological Diversity art. 1, Jun. 5, 1992, 1760 U.N.T.S. 79, *available at* http://treaties.un.org/doc/Treaties/1992/06/19920605%2008-44%20PM/Ch_XXVII_08p.pdf [hereinafter Convention on Biological Diversity].

78. *See* Marine Protections, Research, and Sanctuaries Act, Pub. L. No. 92-532, 86 Stat. 1052 (1972) (codified at 33 U.S.C. §§ 1401–1444 (1994)).

provide for environmental protection of the oceans.[79] Administered by the International Maritime Organization (IMO) since 1977,[80] the Convention requires contracting parties to "control" and "prevent" pollution of the sea by the dumping of waste.[81] The Convention defines dumping as the "deliberate disposal at sea of wastes or other matter from vessels . . . at sea"[82] and contains a list of forbidden materials to be dumped.[83] The Convention also contains an exception for matter placed in the ocean "for a purpose other than the mere disposal thereof, provided that such placement is not contrary to the aims of" the Convention.[84] The Convention was originally ratified to prevent countries from disposing their land waste, sewage, and hazardous materials out at sea.[85]

In 1996, forty-two States party to the Convention adopted the London Protocol to modernize and eventually replace the London Convention.[86] The Protocol, which entered into force in 2006, places more stringent requirements on contracting parties.[87] The Protocol requires contracting parties to "prevent, reduce, and wherever practicable eliminate pollution caused by dumping."[88] But rather than enumerate what it forbids, the Protocol contains a "reverse list" designating allowable materials to dump, while prohibiting the dumping of everything else.[89] While the Protocol's reverse list is much more comprehensive, the Protocol's relevance

79. London Convention, *supra* note 76; *see also* Eick, *supra* note 42, at 364; THE LONDON CONVENTION AND PROTOCOL: THEIR ROLE AND CONTRIBUTION TO PROTECTION OF THE MARINE ENVIRONMENT, INT'L MARITIME ORG., *available at* http://www.imo.org/blast/blastDataHelper.asp?data_id=21278&filename=LC-LPbrochure.pdf.

80. London Convention, *supra* note 76.

81. *Id.*

82. *Id.*

83. *Id.* at annex I.

84. *Id.* at art. III.

85. *See London Convention Background*, INTERNATIONAL MARITIME ORGANIZATION, http://www.imo.org/OurWork/Environment/SpecialProgrammesAndInitiatives/Pages/London-Convention-and-Protocol.aspx (last visited Oct. 29 2013) [hereinafter *London Convention Background*].

86. London Convention, *supra* note 76.

87. *See id.*

88. Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, Nov. 7, 1996,, 36 I.L.M. 1 [hereinafter London Protocol].

89. London Convention, *supra* note 76.

remains limited because only forty-two States are party to it, roughly half the number of States that signed the original convention.[90] The Convention and Protocol work together, and are collectively known as the LC/LP.

The second international treaty relevant to the regulation of ocean fertilization is the Convention on Biological Diversity, or CBD. Opened for signature in 1992,[91] the CBD stated three goals: (1) conservation of biological diversity; (2) sustainable use of its components; and (3) fair and equitable sharing of benefits arising from genetic resources.[92] Among other obligations, the CBD requires parties to identify, regulate, and manage "processes and categories of activities which . . . are likely to have significant adverse impacts on the conservation and sustainable use of biological diversity, and monitor their effects."[93]

Despite neither convention intending to combat ocean fertilization, parties to both instruments began to express concern about ocean fertilization shortly after an unannounced ocean iron fertilization experiment cast international attention on the viability of unilateral action.[94] In July 2007, the Scientific Groups of the LC/LP submitted a "Statement of Concern" regarding ocean iron fertilization.[95] The statement concluded that knowledge on the effectiveness and potential environmental impacts of ocean iron fertilization was currently insufficient to justify large-scale operations.[96] In November 2007, the Parties to the 29th London Convention meeting endorsed the Scientific Group's "Statement of Concern."[97] They agreed that ocean iron fertilization, and ocean fertilization more broadly, falls within the scope of the LC/LP.[98] The parties recognized that each State could consider proposals on a case-by-case basis, but

90. *See London Convention Background*, *supra* note 85.

91. *History of the Convention*, CONVENTION ON BIOLOGICAL DIVERSITY http://www.cbd.int/history/ (last visited Feb. 9, 2014).

92. Convention on Biological Diversity, *supra* note 77.

93. *Id.* at art. 7(c), art. 14.

94. *See* Int'l Maritime Org. [IMO], *Report of the Twenty-Ninth Consultative Meeting and the Second Meeting of Contracting Parties*, at 4, LC 29/17 (Dec. 14, 2007); Int'l Maritime Org. [IMO], *Adoption of the Agenda*, annex I, para. 2.2, LC/SG 31/1/1 (Jan. 18, 2008).

95. *See* G.A. Res. 62/215, ¶ 97, U.N. Doc. A/RES/62/215 (Mar. 14, 2008).

96. *See id.*

97. *See* London Convention, *supra* note 76, at 4.

98. *Id.* at 5.

urged States to "use the utmost caution" when considering proposals for large-scale ocean fertilization operations.[99]

In May 2008, parties to the CBD voiced even stronger caution against ocean fertilization activities.[100] The ninth meeting of the Conference of the Parties agreed to decision IX/16, identifying large-scale ocean fertilization as an activity likely to have adverse effects on biological diversity.[101] The Conference of the Parties, recognizing the scientific and legal analysis of the LC/LP, urged States to ensure that ocean fertilization activities "do not take place until there is an adequate scientific basis on which to justify such activities."[102] While the statement was strongly worded, it did acknowledge the need for legitimate scientific research into actual outcomes and the effectiveness of ocean fertilization.[103] To promote this goal, the decision provided an exception to its recommended moratorium for scientific research.[104] However, the exception was only extended to "small-scale scientific research studies within coastal waters."[105] The inclusion of the "coastal waters" language effectively rendered the exception nonexistent because nearly every effective ocean iron fertilization experiment takes place outside of coastal regions.[106] Further, even if a scientific experiment could be classified as small-scale and within coastal waters, the CBD concluded that such experiments should be authorized only under four other conditions: (1) the experiment must be specific as to what type of data would be gathered and the acquisition of this data would be justified given any perceived risks, (2) the experiment should be "subject to a thorough prior assessment of the potential impacts of the research studies on the marine environment," (3) the experiment should be "strictly controlled," and (4) the experiment should not be used in carbon markets or for any other commercial

99. *Id.*

100. *See* U.N. E.P. Conference of the Parties to the Convention on Biological Diversity, Rep. on its 9th Meeting, May 19–30, 2008, UNEP/CBD/COP/9/29, annex I (Oct. 9, 2008).

101. *Id.*

102. *See id.*; Convention on Biological Diversity, *supra* note 77.

103. Convention on Biological Diversity, *supra* note 77.

104. *Id.*

105. *Id.*

106. *See* Eick, *supra* note 42, at 362.

purpose.[107]

In October 2008, at the thirtieth Consultative Meeting of the Contracting Parties to the London Convention, the Parties agreed to resolution LC-LP.1 seeking to regulate and limit ocean fertilization experiments.[108] The Contracting Parties reaffirmed that the scope of the London Convention and Protocol includes ocean fertilization activities,[109] defined as "any activity undertaken by humans with the principal intention of stimulating primary productivity in the oceans."[110] Given the then-present state of knowledge, the Contracting Parties concluded that ocean fertilization other than for legitimate scientific research should not be allowed.[111] Any large-scale ocean fertilization activities would be considered contrary to the aims of the LC/LP[112] and would not fall within the Convention's exception for placement of matter into the ocean for a purpose other than mere disposal thereof.[113] Finally, Contracting Members agreed to develop an assessment framework to assess on a case-by-case basis whether to approve scientific research proposals.[114]

The first test of this international framework came in 2009, when the Alfred Wegener Institute in Germany coordinated with Indian researchers to conduct an iron seeding experiment, known as LOHAFEX (Loha translates to iron in Hindi, FEX stands for Fertilization Experiment), in the Southern Ocean.[115] Unlike in previous ocean fertilization research experiments, the LOHAFEX scientists submitted their proposal for approval to the German government.[116] Emphasizing the LC/LP and CBD's recognition of the need for

107. Convention on Biological Diversity, *supra* note 77.

108. *See* IMO Report res. LC-LP.1, *supra* note 30, at annex 6.

109. *See* G.A. Res. 63/111, U.N. Doc. A/RES/63/111 (Feb. 12, 2009).

110. IMO Report res. LC-LP.1, *supra* note 30, annex 6. This definition is broad enough to cover all types of fertilization and possibly upwelling.

111. *Id.*

112. Eick, *supra* note 42, at 366; Int'l Maritime Org. [IMO], *Report of the Thirty-First Meeting of the Scientific Group of the London Convention and the Second Meeting of the Scientific Group of the London Protocol*, LC 31/16, § 2 (Jul. 7, 2008) [hereinafter IMO Report of the Thirty-First Meeting].

113. IMO Report res. LC-LP.1, *supra* note 30, at annex 6.

114. *Id.*

115. *See* Quirin Schiermeier, *Ocean Fertilization Experiment Suspended*, NATURE NEWS (Jan. 14, 2009), http://www.nature.com/news/2009/090114/full/news.2009.26.html; *see generally* Press Release, Alfred-Wegener Inst., LOHAFEX: An Indo-German Iron Fertilization Experiment (Jan. 13, 2009).

116. *See* Abate & Greenlee, *supra* note 44, at 585–86.

further scientific research, the LOHAFEX team claimed its proposal complied with international guidelines.[117] Despite the claim, it was uncertain whether the plan to deposit six tons of dissolved iron sulfate fell within the term "small-scale," which was not defined by the CBD decision.[118] It was nearly unquestionable that the experiment was not in "coastal waters," though the team argued that it fulfilled the requirement because the location was "downstream from an extensive land mass" and the waters contained "coastal plankton species."[119]

Basing its decision on these requirements, the German Environmental Ministry concluded the experiment would not comply with the CBD decision.[120] The Bureau of the Conference of the Parties to the CBD noted that the responsibility to implement COP decisions was left entirely to the parties at the national level.[121] Recognizing the confusion between the standards of the CBD and LC/LP decisions, the German Ministry of Research reversed the German Environmental Ministry's decision and allowed the experiment to proceed.[122]

Since the confusion surrounding the LOHAFEX experiment, the CBD has moderated its position to align more closely with the requirements of the LC/LP resolution. In the 2009 Scientific Synthesis on Ocean Fertilization, the Secretariat acknowledged the need for "legitimate scientific research," but insisted that any research comply with an international assessment framework.[123] In 2010, Parties to the LC/LP finalized this assessment. During their October

117. *See id.*; ALFRED WEGENER INST., RISK ASSESSMENT OF THE LOHAFEX EXPEDITION 2 (2009), *available at* http://www.awi.de/fileadmin/user_upload/News/Selected_News/2009/LOHAFEX/0%20AWI_NIO_LOHAFEX_Risk_Assessment.pdf.

118. Abate & Greenlee, *supra* note 44, at 586.

119. *Id.* at 556–57.

120. *Id.*

121. BUREAU OF THE CONFERENCE OF THE PARTIES TO THE CONVENTION ON BIOLOGICAL DIVERSITY, Minutes of the Meeting of the Bureau of the Conference of the Parties to the Convention on Biological Diversity Held in Nairobi, on 13 February 2009, at 7–8, UNEP/CBD/COP/Bur/2009/1/3 (Feb. 13, 2009), *available at* http://www.cbd.int/doc/meetings/cop-bureau/cop-bur-2009/cop-bur-2009-02-13-minutes-en-pdf.

122. Abate & Greenlee, *supra* note 44, at 588.

123. SECRETARIAT OF THE CONVENTION ON BIOLOGICAL DIVERSITY, NO. 45, SCIENTIFIC SYNTHESIS OF THE IMPACTS OF OCEAN FERTILIZATION ON MARINE BIODIVERSITY 9 (2009).

11–15, 2010 consultative meeting, the London Convention issued resolution LC-LP.2 along with the Assessment Framework.[124] The document describes the four steps of the framework: (1) the initial assessment, (2) environmental assessment, (3) decision making, and (4) results of monitoring.[125] In 2010, the CBD again expressed strong caution against all geoengineering projects, but acquiesced to the LC/LP assessment framework for ocean fertilization projects.[126]

B. Domestic Implementation of the International Legal Framework

The London Convention additionally requires States party to the Convention to implement domestic law to fulfill the goals of the convention.[127] In the United States, that domestic law is the Marine Protection, Research, and Sanctuaries Act (MPRSA, or the "Ocean Dumping Act").[128] Congress passed the MPRSA in 1972, prior to the London Convention, and provided amendments two years later to make it consistent with the treaty obligations under the London Convention.[129]

The MPRSA seeks to "prevent or strictly limit the dumping into ocean waters of any material which would adversely affect human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities."[130] The Act specifically forbids: (1) any person who departs from the United States from transporting material for the purpose of dumping, (2) a United States

124. Int'l Maritime Org. [IMO], *On the Assessment Framework for Scientific Research Involving Ocean Fertilization*, annex 6, res. LC-LP.2 (Oct. 14, 2010).

125. *Id.*

126. Convention on Biological Diversity Draft Decision, 10.L36, § 8(w), Sess. 10, Oct. 18–29, 2010, U.N. Doc. UNEP/CBD/COP/10/L.36 (Oct. 29, 2010); Convention on Biological Diversity Draft Decision 10.L42, §§ 59, 60, Sess. 10, Oct. 18–29, 2010, U.N. Doc. UNEP/CBD/COP/10/L.42 (Oct. 29, 2010).

127. London Convention, *supra* note 76.

128. Marine Protections, Research, and Sanctuaries Act, Pub. L. No. 92-532, 86 Stat. 1052 (1972) (codified at 33 U.S.C. §§ 1401–1444 (1994)).

129. *Id.* (as originally enacted); Act to Amend the Marine Protection, Research, and Sanctuaries Act of 1972, Pub. L. No. 93–254, 88 Stat. 50 (1974); *see also* Charles B. Anderson, *Ocean Dumping and the Marine Protection, Research, and Sanctuaries Act*, 1 LOY. MAR. L.J. 79, 84 (2002). Additional amendments were made in 1977 and 1988. *Id.* at 85, 87.

130. 33 U.S.C. § 1401(b) (1994).

vessel (or aircraft) from transporting material for the purpose of dumping, regardless of the point of departure, and (3) any person from dumping material within the territorial sea or the contiguous zone of the United States.[131] Any person violating the Act is liable for a civil penalty of up to $50,000 for each violation.[132] Additionally, any person who knowingly violates the Act is subject to a criminal fine, imprisonment for up to five years, or both.[133] The Act also contains a citizen's suit provision.[134]

While the Ocean Dumping Act is fairly expansive, it does include a permit exception. The EPA may issue permits for the transportation of material for the purpose of being dumped into the ocean where the agency determines that the dumping "will not unreasonably degrade or endanger human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities."[135] Criteria for permit requests are outlined, but considerable discretion is left to the agency.[136] Among the list of material absolutely banned from ocean dumping are radiological, chemical, and biological warfare agents, and high level radioactive wastes.[137] Further, the EPA has also identified several categories and circumstances in which no permit is required, including the dumping of fish wastes, the placement of materials for the purpose of maintaining fishery resources, the discharge from vessel propulsion, and in case of emergency, dumping material to safeguard life at sea.[138]

Within the several types of permits, the EPA codified the issuance of research permits in specific circumstances.[139] The

131. *Id.* § 1411; *see also* GERARD J. MANGEONE, UNITED STATES ADMIRALTY LAW 269 (1997); Anderson, *supra* note 129, at 83.

132. 33 U.S.C. § 1415(a).

133. *Id.* § 1415(b). Any person criminally convicted must forfeit to the United States any property derived from the proceeds of any violation, and any property that was used to commit or facilitate the commission of the violation. *Id.*

134. *Id.* § 1415(g).

135. *Id.* § 1412. In the case of dredged material, the U.S. Army Corps of Engineers has jurisdiction to decide whether to issue a permit rather than the EPA. *See Administering the Ocean Dumping Act*, EPA JOURNAL, Jul./Aug. 1975, *available at* http://www2.epa.gov/aboutepa/administering-ocean-dumping-act (last updated Feb. 26, 2013).

136. *See id.*; 40 C.F.R. § 227 (2012).

137. *See* Administering the Ocean Dumping Act, *supra* note 135.

138. *See* 40 C.F.R. § 220.1(c).

139. *Id.* § 220.3(e).

EPA can issue a research permit for dumping materials as part of a research project if "the scientific merit of the proposed project outweighs the potential environmental or other damage that may result from the dumping."[140]

When the MPRSA was first passed, Congress was mostly concerned with two forms of ocean waste. The first was the dumping of sewage waste into the ocean.[141] Around the time of its passage, some coastal communities were struggling to find capacity in land-based waste disposal sites, and were turning toward the oceans to dispose of the waste.[142] The second concern was the dumping of highly toxic materials resulting from the Cold War Era: radioactive waste and chemical and biological warfare agents.[143] In fact, the 1972 pre-amendment version of the MPRSA centrally focused on banning the dumping of these types of waste.[144] Today, the MPRSA is largely used to prevent the dumping of dredged material removed from navigation channels.[145] Other materials commonly dumped include fish wastes, human remains, and abandoned vessels.[146] This type of dumping is typically allowed once the EPA or the Army Corps of Engineers issues an appropriate permit.[147]

III. A PARADIGM: RUSS GEORGE AND THE NATION OF THE HAIDA PEOPLE

Concern over unilateral geoengineering is likely to increase over the years due to the convergence of several factors. First, as the international discussion about climate change continues to stall, the countries most greatly affected by rising tides may turn to unilateral experiments to stall climatic disaster, or at least to keep climate change in the

140. *Id.*

141. S. Rep. No. 92-451, at 11 (1971).

142. *Id.*

143. *Id.* at 12, 18.

144. *See* Marine Protections, Research, and Sanctuaries Act, Pub. L. No. 92-532, § 101, 86 Stat. 1052 (1972) (codified at 33 U.S.C. §§ 1401–1444 (1994)).

145. *Marine Protection, Research and Sanctuaries Act Compliance Monitoring*, U.S. ENVTL. PROT. AGENCY, http://www.epa.gov/oecaerth/monitoring/programs/mprsa/ (last updated July 13, 2013).

146. *Id.*

147. *Ocean Dumping*, US. ENVTL. PROT. AGENCY, http://water.epa.gov/type/oceb/oceandumping/ (last visited Sept. 24, 2013); *see also* 40 C.F.R. §§ 229.1 (burial at sea), 229.2 (target vessels), 229.3 (transportation and disposal of vessels).

headlines.[148] The likelihood of action is exacerbated when actors are convinced that not taking action on climate change would be worse than implementing scientifically uncertain geoengineering techniques, even if such action comes with the reprimand of the international community.[149] Second, while scientific understanding of geoengineering's risk has been slow to develop, further understanding of its implementation allows actors to feel more comfortable implementing experiments even while scientific uncertainty exists.[150] And third, private corporations that have found limited success in using carbon markets to profit from geoengineering activities may begin turning to nations with less political power as a source of funding.[151]

As discussed above, international legal regimes—specifically, the London Convention and the Convention on Biological Diversity—have begun to take action on geoengineering activities, but these decisions have come through legal instruments not initially designed to tackle issues related to climate change.[152] The current legal framework is likely to cause a halt on scientific research, as demonstrated by the caution taken by the LOHAFEX experiment.[153] But the regime is unlikely to have any impact on unilateral ocean fertilization taken for non-scientific purposes.

Unilateral ocean fertilization sponsored by government actors is not a conceptual problem. In July 2012, Californian entrepreneur Russ George and his crew dumped over one hundred tons of iron sulfate into the Pacific Ocean, two hundred nautical miles out from the Canadian archipelago of Haida Gwaii.[154] The unprecedented experiment produced a

148. *See* Victor et al., *supra* note 9.

149. *Id*.

150. *Id.*

151. *See supra* Part I.

152. *See, e.g.*, Montreal Protocol on Substances that Deplete the Ozone Layer, Sept. 16, 1987, 1522 U.N.T.S. 3 (being used to prevent stratospheric sulfur injection experiments).

153. *See supra* Part I.A.

154. UNESCO Statement, *supra* note 30; *see also* Martin Lukacs, *World's Biggest Geoengineering Experiment 'Violates' UN Rules*, THE GUARDIAN (Oct. 15, 2012), http://www.guardian.co.uk/environment/2012/oct/15/pacific-iron-fertilisation-geoengineering; *see generally* HAIDA SALMON RESTORATION COMPANY, http://www.hsrc1.com/.

phytoplankton bloom over 10,000 square kilometers in size.[155] In comparison, scientists have previously conducted thirteen ocean fertilization experiments involving the deposition of iron,[156] but the largest of those released only six tons.[157] George's endeavor completely nullified these previous experiment's efforts of moderation. Further, the scientific community and the EPA were completely unaware of the project; news of the experiment did not break until several months later, in October.[158] George completed the Haida Gwaii dump with a budget of merely 2.5 million dollars.[159]

The project implicated several different states. Mr. George secured funding for his project by petitioning the local village counsel of the Haida, an indigenous nation in British Columbia.[160] Under George's persuasion, the town of Old Massett established the Haida Salmon Restoration Corporation (HSRC).[161] The First Nations town council agreed to the project after being told it would restore local salmon populations.[162] HSRC hoped to recoup their 2.5 million dollar investment by generating and selling carbon offsets from the dump.[163] According to the HSRC CEO, the Canadian government had been repeatedly notified of the experiment.[164] The Canadian government is currently investigating the project.[165] Finally, HSRC also borrowed research equipment from the U.S. National Ocean and Atmospheric Administration (NOAA), though those

155. *See id.*

156. *See* Eick, *supra* note 42, at 356.

157. Press Release, Alfred-Wegener Inst., *supra* note 115.

158. *See* Lukacs, *supra*, note 154.

159. Peter O'Neil & Dene Moore, *Ottowa Attacks Haida's 'Rogue Science' Experiment*, VANCOUVER SUN (Oct. 30, 2012), http://www.canada.com/vancouversun/news/westcoastnews/story.html?id=ae0e928a-fe46-43a1-bc61-5dbfaa554bf8.

160. *See* Lukacs, *supra* note 154.

161. *See Our Story = Ancient Wisdom + New Science*, HAIDA SALMON RESTORATION CORPORATION, http://www.hsrc1.com/history/our-story/.

162. *Q&A on Ocean Fertilization*, UNESCO IOC (October 23 2012), http://www.unesco.org/new/en/natural-sciences/ioc-oceans/single-view-oceans/news/ocean_fertilization_we_cannot_afford_to_gamble_with_the_ocean/; UNESCO Statement, *supra* note 30; *see also* Lukacs, *supra* note 154.

163. O'Neil & Moore, *supra* note 159.

164. *See* Martin Lukacs, *Canadian Government 'Knew of Plans to Dump Iron into Pacific*, THE GUARDIAN (Oct. 17, 2012), http://www.guardian.co.uk/environment/2012/oct/17/canada-geoengineering-pacific?intcmp=122.

165. *Id.*

responsible may have misled the NOAA about the experiment.[166]

This was not Russ George's first attempt at such an experiment; his ocean fertilization engineering efforts began over a decade ago with "Planktos."[167] George's first experiment had limited resources: in 2002, he conducted an experiment by purchasing bags of red ochre pigment from the Hoover Paint Company and dragging them from behind a borrowed schooner.[168] His team of researchers recorded the results, but it is unclear and unlikely they had the scientific tools to measure the experiment properly.[169] After working to create a strong public image, donating carbon offsets to the Vatican[170] and being recognized by Nature Magazine,[171] Planktos acquired resources to engage in a larger experiment.[172] In August 2007, Planktos planned to release one hundred tons of iron ore dust near the Galapagos Islands.[173] In response, Greenpeace established a permanent patrol vessel in the area to intercept and halt any iron release by Planktos.[174]

The current legal framework on ocean fertilization, rooted in solving the previous century's environmental problems, will likely be unable to keep up with the creativity of men similar to Russ George.[175] During the Planktos Galapagos incident, environmental groups filed a petition with the EPA asking the agency to intervene and halt the

166. Keven Drews, *Haida Gwaii Village, Company, Legal Counsel to Defend Controversial Iron-Dumping Ocean Project*, THE VANCOUVER SUN (Oct. 19, 2012), http://news.newenergytimes.net/2013/04/08/u-s-businessman-takes-first-nation-people-for-2-5-million/.

167. *Living on Earth: Iron Fertilization*, PUBLIC RADIO INTERNATIONAL (2003), *available at* http://www.loe.org/series/series.html?seriesID=27.

168. *Id.*

169. *Id.*

170. Doug Struck, *Carbon Offsets: How a Vatican Forest Failed to Reduce Global Warming*, THE CHRISTIAN SCIENCE MONITOR (Apr. 20, 2010), http://www.csmonitor.com/Environment/2010/0420/Carbon-offsets-How-a-Vatican-forest-failed-to-reduce-global-warming; *see also*, New Energy Times, *2007 – Russ George Publicity Stunt – Giving the Vatican Non-Existent Carbon Credits*, YOUTUBE (Apr. 24, 2011), http://www.youtube.com/watch?v=cET-u899iJc&feature=gv&hl=en.

171. *Living on Earth: Iron Fertilization*, *supra* note 167.

172. *See* Hester, *supra* note 20, at 861.

173. *See id.*

174. *Id.*, at 862.

175. *See* Eick, *supra* note 42, at 360–61.

experiment under authority granted by the MPRSA.[176] But Planktos carefully planned the event to evade the scope of the MPRSA.[177] Because of jurisdictional limits, the Act forbids dumping only by a person departing from the United States, sailing under a United States flag, or by dumping within the territorial sea or contiguous zone of the United States.[178] By using a vessel sailing under a foreign flag and not having a record of the place of departure, Planktos ensured that the EPA could do little to prevent the experiment.[179]

George has thus far avoided any legal challenges to the Haida Gwaii experiment. Prior to the project becoming public, Canadian enforcement officials commenced an investigation into the experiment, but they have not commenced an action against George.[180] The Intergovernmental Oceanographic Commission of UNESCO (IOC) released a statement condemning the project as a violation of multiple international conventions.[181] But George called the moratoria on ocean fertilization projects a "mythology" and claimed that they do not apply to his project.[182]

IV. THE EFFICACY OF THE LEGAL FRAMEWORK

International action has been particularly vigilant in the field of ocean fertilization.[183] Bans have been placed on nearly all experiments, but these barriers may have little impact on those trying to "prove a point," or, possibly in the future, nations that feel they have nowhere else to turn. Further, the ban has done little to help scientific progress that could illuminate the benefits and dangers of ocean fertilization. The discussion on what research should be allowed has been wholly separate from the debate on how to

176. Hester, *supra* note 20, at 886.

177. *Id.*

178. 33 U.S.C. § 1411 (1994).

179. Hester, *supra* note 20, at 886.

180. Martin Lukacs, *US Businessman Defends Controversial Geoengineering Experiment*, THE GUARDIAN (Oct. 19, 2012), http://www.guardian.co.uk/environment/2012/oct/19/geoengineering-canada?INTCMP=SRCH.

181. UNESCO Statement, *supra* note 30. The IOC has worked closely with Parties to several international instruments currently discussing ocean fertilization, including the Convention on Biological Diversity and the London Convention and Protocol. *Id.*

182. Lukacs, *supra* note 154.

183. *See* Eick, *supra* note 42, at 361–76.

confront the issues of climate change.[184] As a result, negotiations largely continue to ignore ocean fertilization and geoengineering as a solution to climate change, despite changes in scientific knowledge.

The stated goal of the CBD and LC/LP resolutions and the LC/LP Assessment Framework was to allow monitored small-scale research while preventing experiments without a legitimate scientific purpose.[185] But, in reality, the results of the international framework seem to have accomplished the opposite. Since the Assessment Framework, there have been no additional peer-reviewed scientific experiments. Yet, Russ George ignored the moratorium and carried out a scientifically ill-equipped experiment twenty times larger than any previous scientific experiment.

The Assessment Framework attempted to legitimize small-scale ocean fertilization as a worthwhile scientific endeavor.[186] Nevertheless, the end result of the Assessment Framework specifically, and recent international action generally, raised bureaucratic barriers to research experiments while failing to provide any incentives for an increase to the research desperately needed for accurate risk analysis. The CBD and LC/LP ban on all larger experiments fails to allow any type of risk assessment that could more accurately weigh the benefits of scientific knowledge against potential environmental impacts. As a result, the current legal framework could deter legitimate scientific groups from conducting responsible experiments that could provide vital information.[187]

At the same time, the Assessment Framework has changed little to nothing for private actors. The problem with the strict standards created by the CBD and the LC/LP is that unilateral actors can unilaterally ignore them. While the language of the CBD strongly admonishes commercial ocean

184. *See* Doyle, *supra* note 10.

185. *See* IMO Report res. LC-LP.1, *supra* note 30; Int'l Maritime Org. [IMO], *On the Assessment Framework for Scientific Research Involving Ocean Fertilization*, annex 6, res. LC-LP.2 (Oct. 14, 2010); U.N. E.P. Conference of the Parties to the Convention on Biological Diversity, Rep. on its 9th Meeting, May 19–30, 2008, UNEP/CBD/COP/9/29, annex I (Oct. 9, 2008); Convention on Biological Diversity, *supra* note 77.

186. *See* Eick, *supra* note 42, at 355–56.

187. *See* Eick, *supra* note 42, at 373–74.

fertilization enterprises, its language is toothless.[188] The recent decisions of the Contracting Parties to the CBD are entirely discretionary and impose no legal restrictions.[189] Similarly, the LC/LP Assessment Framework is also non-binding.[190] While the LC/LP Assessment Framework does seek a worthy goal of prohibiting experiments that lack a legitimate scientific purpose, it is highly unlikely that a group conducting such a project would even consider itself subject to the voluntary Assessment Framework. Instead, the Assessment Framework leads to undesired and unintended consequences: First, scientific groups are delayed in or prevented from conducting beneficial experiments as they work their way through the Assessment Framework process. Second, zealous actors see the lack of progress by scientific groups as evidence of political gridlock on the issue and justification for advancing irresponsible projects. In the end, the international community loses authority over the issue.

The response to the Haida Gwaii project thus far is evidence of the powerlessness of the current international framework. Ironically, news of the Haida Gwaii dump broke during the eleventh meeting of the Conference of the Parties to the CBD.[191] With all members assembled as the story unfolded, the Contracting Parties could do no more than renew its precautionary stance toward all climate-related geoengineering activities and release a statement condemning the experiment.[192] The Contracting Parties to the London Convention and Protocol held a joint meeting just a few days later.[193] The Parties agreed to a statement of concern specifically addressed to the Haida Gwaii experiment.[194] In it, the Parties reiterated their positions as

188. *See* Ralph Bodle, *Geoengineering and International Law: The Search for Common Legal Ground*, 46 TULSA L. REV. 305, 314 (2010).

189. *Id.*

190. *Id.* at 320.

191. Lukacs, *supra* note 154.

192. *See* UNESCO Statement, *supra* note 30.

193. *Haida Gwaii Iron Dumping Hot Topic as Nations Negotiate International Geoengineering Treaty*, CALGARY HERALD (Oct. 28, 2012), http://www.timescolonist.com/news/haida-gwaii-iron-dumping-hot-topic-as-nations-negotiate-international-geoengineering-treaty-1.22800.

194. *International Concern over Ocean Fertilization Receives Unanimous Backing from Key Meeting in London – 2012*, INT'L MARITIME ORG., *available at* http://www.imo.org/blast/blastData.asp?doc_id=14525&filename=J-14%20Rev.doc.

stated in LC-LP.1 and LC-LP.2, pressing for legitimate scientific proposals to comply with the Assessment Framework.[195]

Aside from the shunning of these international instruments, little action has been taken against Russ George. Because the CBD decisions and the LC/LP are unenforceable against private actors, the success of preventing unapproved unilateral ocean fertilization projects depends on the effectiveness of domestic frameworks. But enforcement of the U.S. domestic framework and the similar frameworks of other nations also provide few signs for optimism. The United States' domestic implementation of the London Convention, the MPRSA, is successful in preventing ocean fertilization projects in the territorial waters of the United States.[196] Nevertheless, the MPRSA alone cannot prevent ocean fertilization experiments around the globe.

Even in situations where the private actor is an American citizen, the MPRSA has limited jurisdiction that allows unilateral actors to strategically craft projects to fall outside its scope.[197] Where the EPA has not authorized a permit, the MPRSA forbids any person from departing the United States with material intended to be dumped, regardless of where the dumping is to occur, and forbids any United States vessel from transporting material for the purpose of dumping.[198] It also prevents any vessel from dumping within United States waters.[199] This third circumstance rarely applies to ocean dumping because most experiments take place far away from coastal waters.[200] The first two circumstances could apply where the dumping occurs in high seas.[201] But the MPRSA does not apply if a vessel not flying under the United States flag departs from outside the United States, even if the entire crew of the ship

195. *Id.*

196. *See* Marine Protections, Research, and Sanctuaries Act, Pub. L. No. 92-532, 86 Stat. 1052 (1972) (codified at 33 U.S.C. §§ 1401–1444 (1994)).

197. *See* Hester, *supra* note 20, at 886.

198. 33 U.S.C. § 1411 (1994); *see also* MANGEONE, *supra* note 131; Anderson, *supra* note 129.

199. 33 U.S.C. § 1411; *see also* MANGEONE, *supra* note 131; Anderson, *supra* note 129.

200. *See* Eick, *supra* note 42, at 362.

201. *See* 33 U.S.C. § 1411.

is American.[202]

The 2007 Planktos experiment is a perfect example: when the EPA warned that Planktos' actions could violate the MPRSA, Planktos responded to the EPA that it would not be flying under a U.S. flag, departing from a U.S. harbor, or dumping into the contiguous zone of the United States.[203] Even though Planktos and its founder Russ George are based in California, the EPA lacked jurisdiction to enforce the MPRSA.[204]

Because the MPRSA does not have jurisdiction over Russ George's experiment, Canadian law is the only option left to penalize Russ George and his team. Since Canada is a Contracting Party to the London Convention, it is also obligated to implement domestic law to prevent ocean dumping.[205] The Canadian enforcement, part 7 section 3 of the Canadian Environmental Protection Act, has provisions similar to that of the MPRSA.[206] Thus, to have jurisdiction, Canadian enforcement officials would need to prove Russ George sailed under a Canadian vessel or departed from a Canadian port.[207] It has yet to be seen whether Canada will properly enforce its obligations against those involved in the Haida Gwaii experiment. According to information on George's website, on March 27, 2013, Environment Canada issued a search warrant and seized evidence at the HSRC office,[208] but no arrests have been made. Until and unless Canadian enforcement officials take action against Russ George, George will see no consequences as a result of his experiment.

The Haida Gwaii project would be even more difficult to enforce had Canada not been a party to the London

202. 33 U.S.C. § 1411.

203. Hester, *supra* note 20, at 886.

204. *Id.*

205. Canada ratified the London Convention on November 13, 1975. Int'l Maritime Org. [IMO], *Status of the London Convention and Protocol*, LC 34/2, annex 1 (Jul. 19, 2012) [hereinafter IMO Status Report LC 34/2].

206. Canadian Environmental Protection Act, R.S.C. 1999, c. C-32, pt. 7, § 3.

207. *See id.*

208. Russ George, *EC Raid Swarms Village Science Office with Overwhelming Force*, RUSSGEORGE.NET (Mar. 30, 2013), http://russgeorge.net/2013/03/30/swat-team-swarms-village-science-office-with-overwhelming-force/; *see also Canadian Environmental Authorities Seize Evidence from Russ George*, NEW ENERGY TIMES (Apr. 10, 2013), http://news.newenergytimes.net/2013/04/10/canadian-environmental-authorities-seize-evidence-from-georges-offices/.

Convention. The LC/LP Assessment Framework remains limited to the eighty-seven States party to the Convention,[209] and to the forty-two States party to the Protocol, most of which are already members of the Convention.[210] If private actors are looking to avoid the requirements of the LC/LP, they may attempt to launch operations from a non-contracting party, or with a Contracting Party that poorly enforces the domestic laws it is obligated to create under the London Convention.[211] Further, nations that will be critically impacted by climate change, including Indonesia, Bangladesh, and India, are party to neither the London Convention nor its Protocol.[212] These nations could ignore any ocean fertilization experiments, or could become state sponsors of experiments.

V. PROPOSAL: CREATING A COMPREHENSIVE FRAMEWORK

The international framework on ocean fertilization established by parties to the CBD and LC/LP has flaws beyond the frameworks jurisdictional reach. The CBD and LC/LP fail to consider the motivation of private actors of unilateral ocean fertilization experiments, and therefore fail to address these motivating factors. By attempting to combat ocean fertilization separately under treaties designed solely to protect the environment, the CBD and LC/LP have divorced ocean fertilization and geoengineering from the larger discussion on climate change. Delegitimizing ocean fertilization's role in solving the global climate crisis leaves advocates with no avenue other than to pursue haphazard projects.

The more appropriate venue to address geoengineering experiments and ocean fertilization—a venue that could move forward on scientific consensus and more effectively deter

209. *See* London Convention and Protocol, INT'L MARITIME ORG., http://www.imo.org/OurWork/Environment/SpecialProgrammesAndInitiatives/Pages/London-Convention-and-Protocol.aspx.

210. *Id.*

211. Eick, *supra* note 42, at 366.

212. *See* IMO Status Report LC 34/2, *supra* note 205, at annex 1 (listing the parties to the London Convention); OVERVIEW OF CONTRACTING STATES, 1996 PROTOCOL TO THE LONDON CONVENTION 1972, INT'L MARITIME ORG. (May 28, 2012), *available at* http://www.imo.org/OurWork/Environment/SpecialProgrammesAndInitiatives/Pages/London-Convention-and-Protocol.aspx (follow "42 Parties" hyperlink) (Parties to London Protocol).

private actors—is the United Nations Framework Convention on Climate Change (UNFCCC). Adopted in 1992, the UNFCCC was designed to act as a jumping point for future protocols.[213] Several protocols, including the Kyoto Protocol, have already been ratified through the UNFCCC.[214] Parties to the UNFCCC should take advantage of this framework to address geoengineering. Creating a protocol through the UNFCCC is more beneficial than the current system for several reasons: First, the UNFCCC can more readily make decisions that encompass the larger mission of combating climate change, rather than viewing ocean fertilization and other geoengineering methods as simply an environmental hazard. Second, more states have ratified the UNFCCC, so its protocols can be more widely discussed and adopted. Third, a proposal through the UNFCCC would take advantage of the Convention's enormous scientific capacity embodied in the Intergovernmental Panel on Climate Change (IPCC), and would be more likely to build a process that explores scientific validity and placates concerned nations and private individuals considering moving forward with ocean fertilization projects.

Additionally, a protocol under the UNFCCC could more effectively deter private actors. Private actors conceivably have three motives to pursue. First, private actors attempt to develop scientific knowledge to fill the gap created by the lack of legitimate scientific experiments in ocean fertilization.[215] Second, private actors seek profit by trading carbon credits.[216] Third, private actors strive to keep discussions on climate change in the news and in political dialogue.[217] The

213. *See* Daniel Bodansky, *The United Nations Framework Convention on Climate Change: A Commentary*, 18 YALE J. INT'L L. 451, 493–96 (1993).

214. *See* Kyoto Protocol to the United Nations Framework Convention on Climate Change, art. 3(3), Dec. 10, 1997, 37 I.L.M. 22 (1998) [hereinafter Kyoto Protocol].

215. *See Frequently Asked Questions About Ocean Fertilization: What Are Climos Near Term Plans*, CLIMOS, http://www.climos.com/faq.php#8 (last visited Feb. 11, 2014).

216. *See* Hugh Powell, *Dumping Iron and Trading Carbon*, 46 OCEANUS MAGAZINE 22, 24 (2008); *see also Frequently Asked Questions About Ocean Fertilization: What is Climos' Funding/Business Model*, CLIMOS, http://www.climos.com/faq.php#8 (discussing regulatory carbon markets as a financial incentive).

217. Arguably, this was a motivating factor in the Haida Salmon Restoration Corporation sharing the news of their experiment at the risk of prosecution.

international framework developed by Parties to the CBD and the LC/LP largely ignores all three motives in its attempt to prevent non-scientific experiments.[218] Because the CBD and LC/LP have goals unrelated to climate change, they are ill-equipped to address these motivating factors. The UNFCCC, on the other hand, could more readily address these three motives because of the significant framework that already exists to address these issues.

A. Creating a Forum for Legitimate Scientific Experiments

For geoengineering techniques to be considered as a viable option, substantially more scientific knowledge is needed to determine whether they work.[219] Based on current research, it is impossible to determine whether the implementation of geoengineering techniques outweigh their risks.[220]

Unfortunately, the tone set by Parties to the CBD and the LC/LP discourages all ocean fertilization projects, including those with scientific value.[221] While both the CBD and LC/LP recognize the need for increased scientific knowledge on geoengineering techniques, the instruments have no intention to promote the growth of this knowledge. By placing harsh requirements on those who follow the legal framework without providing any incentives, the Assessment Framework discourages scientific progress.

Private actors like Russ George seize upon this lack of scientific progress as justification for its radical action: if the international scientific community refuses to take ocean fertilization seriously, the future of the planet requires

See Martin Lukacs, *World's Biggest Geoengineering Experiment 'Violates' UN Rules*, THE GUARDIAN (October 15, 2012), http://www.theguardian.com/environment/2012/oct/15/pacific-iron-fertilisation-geoengineering; *see generally* HAIDA SALMON RESTORATION COMPANY, http://www.hsrc1.com/.

218. The CBD stated in its most recent resolution that carbon credits should not be generated by geoengineering experiments, but action was not substantively taken to close off carbon markets.

219. *See* Victor et al., *supra* note 9.

220. *See* Davies, *supra* note 65, at 262.

221. As the Latin American Director of the ETC Group stated after the CBD COP10 meeting, "[a]ny private or public experimentation or adventurism intended to manipulate the planetary thermostat will be in violation of this carefully crafted UN Consensus." Stephanie Dearing, *Convention on Biodiversity Imposes Moratorium on Geoengineering*, DIGITAL JOURNAL (Oct 30, 2012), http://digitaljournal.com/article/299588.

financially capable actors to intervene and conduct research themselves. If legitimate research teams conduct fewer legitimate scientific experiments, unilateral experiments could become the only means to collect data. Even projects which opponents claim are entirely focused on profit attempt to collect scientific data to legitimize their practice.[222] Unfortunately, for-profit experiments are likely to be ill-equipped compared to scientific experiments.

Creating an international framework that supports scientific research would help eliminate uncertainty and allow for better risk assessment. Providing a structure for increasing scientific knowledge on ocean fertilization experiments, and all geoengineering methods, would eliminate the justification for unilateral actors to push forward with their geoengineering agenda. Increased understanding of geoengineering options would further decrease the risk of countries independently implementing geoengineering projects that have been scientifically proven to be ineffective.[223]

Not only should barriers to scientific research be reduced, projects that pursue scientific understanding and weigh the environmental impacts should be rewarded under a geoengineering protocol. The protocol should not automatically ban commercial experiments if those experiments pursue these same goals in a responsible manner.[224] Including commercial experiments within the protocol will allow these experiments to contribute to the climate change community, rather than force them to fight against international currents.

Funds should be dedicated to furthering research rather than castigating experiments and then arguing not enough is known to consider geoengineering. This funding should be in addition to, rather than a reduction from, current scientific grants on climate change research.[225] Uncertainty about

222. *See* Keven Drews, *Haida Gwaii Village, Company, Legal Counsel to Defend Controversial Iron-Dumping Ocean Project*, THE VANCOUVER SUN (Oct. 19, 2012), http://www.vancouversun.com/technology/Haida+village+company+legal+counsel+defend+controversial/7415966/story.html (discussing Russ George contacting the NOAA to collect data on his experiment).

223. *See* Victor et al., *supra* note 9.

224. *See* Abate & Greenlee, *supra* note 44, at 591.

225. *See* Victor et al., *supra* note 9 (discussing scientists' concern that advocating for geoengineering research would subtract from existing climate

geoengineering and ocean fertilization remains a real concern. The best means to remove this uncertainty is to pursue scientific experiments vigorously today. Conclusive results from these experiments can take several years, so it is imperative the international community act now before the climate change reversal becomes dependent on these technologies.[226]

The UNFCCC is the proper instrument to provide funding and a forum for scientific geoengineering experiments because it already collaborates with a highly respected scientific body and because more nations are party to the convention. The UNFCCC Conferences of the Parties already works in collaboration with the Intergovernmental Panel on Climate Change (IPCC), the scientific body that seeks to better understand climate change.[227] While the IPCC does not conduct any experiments,[228] it is the best-equipped scientific body to determine the efficacy of geoengineering experiments. Working Group I of the IPCC recently released a report that included a paragraph about the lack of knowledge sufficient to make conclusions about whether geoengineering methods would be effective.[229] A geoengineering protocol under the UNFCCC could create a controlled system for necessary scientific research, and could direct the funds to the most effective experiments based on the recommendations of the IPCC.

B. Closing Carbon Markets to Ocean Fertilization

Raising revenue through the generation of carbon credits is often discussed as the main motivating factor for private actors.[230] Thus, to prevent uncontrolled experiments, it is

science research grants).

226. *See, e.g.*, Alister Doyle, *Fertilizing Oceans with Iron Dust Helps Sink Carbon: Study*, REUTERS (Jul. 18, 2012), http://www.reuters.com/article/2012/07/18/us-climate-oceans-idUSBRE86H1EE20120718.

227. *Intergovernmental Panel on Climate Change (IPCC)*, UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE, https://unfccc.int/bodies/body/6444.php (last visited Feb. 19, 2014).

228. *Organization*, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, http://www.ipcc.ch/organization/organization.shtml#.UmA7lVCsim4 (last visited Feb. 19, 2014).

229. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2013: THE PHYSICAL SCIENCE BASIS 98 (2013), *available at* http://www.climatechange2013.org/images/report/WG1AR5_ALL_FINAL.pdf.

230. Powell, *supra* note 216, at 22–23.

essential to close off the availability of carbon credits for projects that pose significant uncertainty and could cause environmental harm. The UNFCCC already addresses which types of programs do and do not qualify for carbon credits,[231] thus it is in the best position to address whether ocean iron fertilization should ever qualify, and what qualifications must be met if it were to qualify.

The main goal of the Kyoto Protocol to the UNFCCC was to create commitments by developed nations to reduce or limit their greenhouse gas emissions.[232] Countries that committed to limitations or reductions are known as Annex B parties.[233] But the Protocol also sought to lay the groundwork for market-based mechanisms that would allow parties to reach these goals with more flexibility.[234] The two major mechanisms are emissions trading and the Clean Development Mechanism.[235]

Through international emissions trading, parties to the Kyoto Protocol can sell excess carbon units to countries over their limits.[236] Each developed country party to the Kyoto Protocol agreed to "assigned amounts" of carbon in which they can emit.[237] These levels can be divided into assigned amount units (AAUs).[238] If an Annex B party uses fewer AAUs than it initially agreed to use, the excess AAUs can be sold to countries emitting more than their assigned amount.[239] Carbon can also be traded through removal units (RMU) and emission reduction units (ERU).[240] RMUs are created through land use activities such as reforestation.[241] ERUs are generated when an Annex B party conducts an emission reduction or removal project in another Annex B country, known as a joint implementation project.[242]

231. Kyoto Protocol, *supra* note 214, art. 2.
232. *Id.*
233. *Id.*, art. 3.
234. *Id.*
235. *Id.*, art. 6 (emissions trading), art. 12 (clean development mechanism).
236. *See International Emissions Trading*, UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE, https://unfccc.int/kyoto_protocol/mechanisms/emissions_trading/items/2731.php (last viewed Oct. 14, 2013).
237. *Id.*
238. *Id.*
239. *Id.*
240. *Id.*
241. *Id.*
242. *See Joint Implementation (JI)*, UNITED NATIONS FRAMEWORK

The Clean Development Mechanism is a system in which Annex B parties can undertake green projects in developing countries in exchange for certified emission reductions (CERs).[243] These projects are designed to reduce GHG emissions, and developed countries can use this reduction, in the form of CERs, to meet emission reduction goals.[244] Further, the projects help to include developing countries in the solution for climate change, providing them with technological benefits but not imposing any specific emission requirements.[245]

While the mechanisms that generate RMUs, ERUs, and CERs provide Annex B parties greater flexibility in reaching their emission reductions and limitations, the types of projects which qualify to create these "offsets" largely do not include ocean fertilization projects. In initially creating regulated carbon markets, the international community was cautious about which types of carbon reduction activities would be eligible for carbon credits.[246] For example, joint implementation projects are eligible for ERUs only if they meet the definition of "removals by sinks" described in Article 3, paragraphs 3 and 4, of the Kyoto Protocol.[247] These paragraphs limit the definition of sinks to afforestation and reforestation.[248] An executive board must approve any new types of carbon sinks, which is unlikely to happen in the near future for any geoengineering method.[249]

While the provisions of the Kyoto Protocol already substantially address the limitations of carbon credits in

CONVENTION ON CLIMATE CHANGE, https://unfccc.int/kyoto_protocol/mechanisms/joint_implementation/items/1674.php (last visited Oct. 14, 2013).

243. Jennifer Morgan, *Carbon Trading Under the Kyoto Protocol: Risks and Opportunities for Investors*, 18 FORDHAM ENVTL. L. REV. 151, 157 (2006).

244. *Id.*

245. *See id.* at 159.

246. *See* Powell, *supra* note 216, at 24.

247. United Nations Framework Convention on Climate Change, *Report of the Conference of the Parties Serving as the Meeting of the Parties to the Kyoto Protocol on its First Session*, at 2, FCCC/KP/CMP/2005/8/Add.2 (Mar. 30, 2006).

248. Kyoto Protocol, *supra* note 214, at art. 3.

249. *Id.*; *see also* Jennie Dean, *Iron Fertilization: A Scientific Review with International Policy Recommendations*, 32 SPG ENVIRONS ENVTL. L. & POL'Y J. 321. 338 (2008–2009). For any project to meet eligibility requirements as a Clean Development Mechanism, projects would need to demonstrate that the reductions are (1) permanent, (2) additional, (3) free of leakage, and (4) amenable to monitoring. These requirements alone pose substantial barriers to OIF. Powell, *supra* note 216, at 24.

international markets, the Protocol and the UNFCCC are more limited in their ability to control voluntary markets. Since the vast majority of carbon credits are traded on regulated markets, the current provisions of the Kyoto Protocol already substantially limit the profitability of ocean fertilization.[250] However, because regulated markets are unavailable to geoengineering experiments, private actors have turned to private, or voluntary, markets as a means for profit.[251] Voluntary markets have grown rapidly with the increase in public concern and awareness about carbon footprints.[252] These markets are available for individuals and companies who wish to assuage their conscience or green their image.[253] They impose fewer requirements regarding the credits that end up on them, but the credits carry a lower sale value than credits available through regulated markets.[254]

Those who wish to profit from carbon credits today may have the opportunity to bypass the limitations of the Kyoto Protocol by trading on the voluntary carbon trading market.[255] These voluntary markets have very few rules about what types of projects qualify for carbon credits. Currently, voluntary markets have hesitated in generating carbon credits through ocean fertilization experiments.[256] Because the main buyers on these markets are those looking to enhance their green image, internationally condemned projects are unlikely to become widely accepted.[257] Nonetheless, increasing prices of carbon credits and the hope that these markets will open when the theory has a larger scientific consensus continues to motivate the commercial

250. *See* Powell, *supra* note 216, at 24.

251. *Id.*

252. *Id.* For examples of voluntary carbon markets, see the Chicago Climate Exchange or Terrapass.

253. Powell, *supra* note 23, at 8.

254. *See* KATHERINE HAMILTON ET AL., ECOSYSTEM MARKETPLACE & NEW CARBON FINANCE, FORGING A FRONTIER: STATE OF THE VOLUNTARY CARBON MARKETS 2008, at 6 (2008), *available at* http://www.ecosystemmarketplace.com/documents/cms_documents/2008_StateofVoluntaryCarbonMarket2.pdf.

255. Eick, supra note 42, at 362.

256. *See* Powell, *supra* note 216, at 24 ("You don't really sell emission reductions from landfills or from oil and gas sector [on the voluntary market]. What you do sell on the voluntary market is beautiful projects, projects that people want to be involved with.").

257. *See* Powell, *supra* note 216, at 24.

ocean fertilization industry.[258]

If voluntary markets continue to grow, regulating voluntary carbon markets may be necessary to deter for profit projects.[259] To ensure that the voluntary carbon market does not provide for a means of profit, efforts could be made to prevent groups from purchasing carbon credits generated from ocean fertilization projects. A geoengineering protocol under the UNFCCC could easily include provisions that seek to limit the use of unapproved geoengineering methods for the generation of carbon credits on voluntary carbon markets. Such a provision would likely be uncontroversial and readily followed by the voluntary carbon markets seeking a positive public image.

Additionally, a geoengineering protocol under the UNFCCC could establish specific guidelines as to what projects, if any, would be eligible for carbon credits. Even if the international community reaches the likely conclusion that no ocean fertilization experiments are eligible for carbon credits, a definitive statement about why ocean fertilization and other geoengineering experiments are currently not eligible, paired with opportunities for further research, could alter the eligibility of carbon credits for ocean fertilization on private markets.

C. Including Ocean Fertilization within the Climate Change Dialogue

While the idea of geoengineering being part of the climate change strategy has increased as efforts to mitigate climate change have stalled, discussion over ocean fertilization by the CBD and the LC/LP was entirely separate from the goal to take the most effective action to combat climate change. Because the regulation of ocean fertilization has been determined by two international conventions focused on environmental hazards, ocean fertilization has only been discussed as a hazard rather than a potential solution to climate change. Further, it sets a precedent for the international community to regulate other forms of geoengineering haphazardly and without comparing or

258. *See* Powell, *supra* note 216, at 22 ("[Economic incentives] will draw the interest of entrepreneurs. So even if iron fertilization isn't profitable now, it may be in coming decades.").

259. *See* Powell, *supra* note 216, at 23.

analyzing the risk of any methods.

The role of geoengineering in a comprehensive solution to climate change has remained largely unanswered.[260] The focus of the discussion by parties to several international conventions was to strongly urge for a greater scientific foundation illuminating benefits and drawbacks before allowing for widespread implementation of climate engineering techniques.[261] The CBD and LC/LP fail to tackle the problems of geoengineering as a whole. By solely focusing on the environmental impacts of ocean fertilization projects, the CBD and LC/LP cannot facilitate a substantive discussion that identifies acceptable geoengineering projects. Further, not including this discussion as part of the comprehensive climate change solution frames ocean fertilization and geoengineering as unworthy of any discussion.

Many continue to argue geoengineering techniques detract from solving the critical problem of dramatically reducing emissions,[262] while others who previously opposed climate engineering now seek a strategy utilizing both mitigation and climate engineering.[263] These strong differences of opinion are exactly why States already committed to combating climate change should concurrently consider all methods of geoengineering. Because the CBD and the LC/LP analyze ocean fertilization as a problem separate from the larger climate change solution, focusing solely on preventing harm to the oceans, the opportunity for a broader discussion of geoengineering in the climate solution is missing.

The practicability of individual geoengineering techniques should not be decided ad hoc, separate from the larger picture of combatting climate change. Nor should a single method of geoengineering be singled out without balancing its effectiveness compared to other geoengineering approaches. Because climate change is an international problem, the solution should be discussed as much as possible by the parties to the UNFCCC, the cohesive body already

260. *See* Davies, *supra* note 65, at 261–62.

261. *See* Doyle, *supra* note 226.

262. *See* Alan Robock, *20 Reasons Why Geoengineering May Be a Bad Idea*, BULLETIN OF THE ATOMIC SCIENTISTS (May/Jun. 2008), available at http://bos.sagepub.com/content/64/2/14.full.

263. *See* Victor et al., *supra* note 9.

formed to tackle these issues, rather than allowing parties to unrelated treaties establish different standards for different geoengineering techniques.

CONCLUSION

Ocean fertilization, like any geoengineering method, poses real and unknown risks to our planet. But so does inaction on climate change. The CBD and LC/LP decisions include boiler plate language concluding that research into ocean fertilization must be pursued, but also limit channels through which to conduct beneficial research.

The goal of the CBD and the LC/LP to prevent damage caused by hazardous dumping is honorable. But, in reality, the efforts fail to comprehensively protect against fringe experiments like that of Russ George. Instead, the CBD ban on ocean fertilization and the LC/LP Assessment Framework significantly slow the pace of legitimate research and distract from a serious discussion about the risks and benefits of ocean fertilization and geoengineering methods in combatting climate change.

A geoengineering treaty or protocol offers the best route for such a discussion. The UNFCCC is particularly equipped to tackle the problem because it includes nearly every country in the world.[264] A geoengineering treaty would allow for a wide ranging discussion about whether geoengineering proposals outweigh the risk they impose. Further, such a treaty would allow for discussion about all methods of geoengineering, which would allow States to work together in determining which geoengineering techniques should be the most rigorously pursued, and which are too dangerous to pursue. Similarly, in the preliminary research stages, States could determine how to allocate resources to research most economically. Until nations sit down for real discussions to support risk assessments of ocean fertilization experiments, rogue environmentalists will likely continue to act as a distraction using the lack of international progress as a rationale for their actions.

264. *Status of Ratification of the Convention*, UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE, http://unfccc.int/essential_background/convention/status_of_ratification/items/2631.php.