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A NAVIGATIONAL SYSTEM FOR UNCHARTED WATERS: THE LONDON CONVENTION AND LONDON PROTOCOL'S ASSESSMENT FRAMEWORK ON OCEAN IRON FERTILIZATION

I. OCEAN IRON FERTILIZATION: GATEWAY TO HOPE OR DESTRUCTION . . . OR SOMEWHERE IN BETWEEN?

Climate change discourse has sparked ideas and motivated action from local grass-roots groups to international organizations.¹ Out of this mobilization, scientists and researchers have produced ideas — some easily practicable, others lofty and imaginative — to combat climate change.² Using geoengineering, the process of manipulating the Earth and its elements, to fight climate change is one such lofty idea; ocean iron fertilization is a specific example.³ Ocean iron fertilization is exactly what it sounds like: scientists select a swath of ocean, formulate a mixture comprised mainly of iron dust, and fertilize the ocean with it.⁴ The iron, in turn, mixes with other nutrients in the water to produce blooms of phytoplankton, a form of marine plant life.⁵ The phytoplankton then go to work absorbing carbon dioxide through the process of photosynthesis.⁶ Researchers hypothesize that the carbon dioxide absorbed by the phytoplankton could actually reduce greenhouse gas pollution.⁷ But, like so many ideas that, at the outset, strike hope and the promise of discovery in the hearts of optimists, ocean iron fertilization is not without powerful opponents.⁸ “[W]e’re looking at a state of the world where we rely on manipulating the ocean on a truly huge scale and that would undoubtedly have large and possibly irreversible effects on ocean ecosystems,” Greenpeace has admonished.⁹ Professor S.W.A. Navqi, co-chief scientist on the most

1. See *infra* note 17 and accompanying text.

2. See *infra* note 19 and accompanying text.

3. *Id.*

4. Hugh Powell, *Fertilizing the Ocean with Iron*, OCEANUS (Nov. 13, 2007), <http://www.whoi.edu/oceanus/printArticle.do?id=34167> [hereinafter Powell, *Fertilizing the Ocean*].

5. *Id.*

6. *Id.* See also J. Stein Carter, *Photosynthesis*, BIOLOGY AT CLERMONT COLLEGE, UNIV. OF CINCINNATI, <http://biology.clc.uc.edu/Courses/bio104/photosyn.htm> (last modified Nov. 2, 2004) (explaining the process of photosynthesis).

7. Randall S. Abate & Andrew B. Greenlee, *Sowing Seeds Uncertain: Ocean Iron Fertilization, Climate Change, and the International Environmental Law Framework*, 27 PACE ENVTL. L. REV. 555, 561 (2010).

8. Richard Black, *Setback for Climate Technical Fix*, BBC NEWS (Mar. 23, 2009, 17:18 GMT), <http://news.bbc.co.uk/2/hi/7959570.stm>.

9. *Id.*

recent ocean iron fertilization experiment, LOHAFEX, took a slightly different perspective: “This is rubbish . . . They are scaring and misleading people.”¹⁰

A primary difficulty with ocean iron fertilization lies in the puzzling question of its legality.¹¹ The 2009 LOHAFEX experiment won permission, lost permission, and ultimately re-obtained permission from the German government to proceed; this confusion stemmed from an absence of domestic or international laws regulating ocean iron fertilization.¹² International bodies within the United Nations have started a move toward regulation of ocean iron fertilization, but no single international legal instrument speaks directly to, or even analogizes very well to, ocean iron fertilization.¹³

The London Convention and London Protocol have established themselves as the competent international body for the regulation of ocean iron fertilization. The Contracting Parties to these treaties are moving forward with legally binding options to bring ocean iron fertilization regulation officially within the purview of the London Convention and London Protocol. Chief among these regulations is the new Assessment Framework, which provides tools for evaluating ocean iron fertilization proposals’ promotion of legitimate scientific research. The Contracting Parties’ use of the Assessment Framework will play a significant role in whether ocean iron fertilization will grow as a field of scientific research and, ultimately, in determining the fate of ocean iron fertilization as a possible geoengineering strategy. The Assessment Framework is in its beginning stages and is not without limitations. Nonetheless, it shows substantial potential to promote global, transparent, and effective regulation of ocean iron fertilization, and leads the way toward eventually establishing international norms and standards with regard to ocean iron fertilization.

Part II of this paper presents the process of ocean iron fertilization and its use as a geoengineering strategy. Part III discusses various treaties whose provisions speak indirectly to ocean iron fertilization, but fail to regulate it in any practicable manner. Part III additionally examines the London Convention and London Protocol’s measures to bring ocean iron fertilization within their regulatory scope. Part IV explains the basic structure of the new Assessment Framework, raises potential concerns, and asks whether it succeeds in meeting the London Convention and London Protocol’s objectives in regulating ocean iron fertilization. Part IV additionally considers the Assessment Framework’s potential effect on ocean iron fertilization as a geoengineering strategy. Part V concludes the paper with confidence in the overall utility of the London Convention and London Protocol’s steps in ocean iron fertilization regulation.

II. CLIMATE CHANGE, GEOENGINEERING, AND OCEAN IRON FERTILIZATION

A. *Geoengineering as a Climate Change Mitigation Strategy*

The Earth is getting warmer at a rate “unparalleled in the last ten thousand

10. Amit Bhattacharya, *Antarctic Mission Runs into Protest*, TIMES OF INDIA (Jan. 14, 2009, 01:23 IST), <http://timesofindia.indiatimes.com/articleshow/3974980.cms?prtpage=1>.

11. See Abate & Greenlee, *supra* note 7.

12. *Id.* See also Bhattacharya, *supra* note 10; Black, *supra* note 8.

13. See Abate & Greenlee, *supra* note 7.

years.”¹⁴ An authoritative 2007 report by the Intergovernmental Panel on Climate Change linked climate change to “the observed increase in anthropogenic greenhouse gas concentrations,” or pollution caused by human activity.¹⁵ Although this premise has gained a large consensus within the scientific community, some take the opposing view.¹⁶ Recognizing this ongoing debate, this article assumes the validity of anthropogenic climate change and the necessity of developing mitigation strategies to combat it, which an array of institutions has worked to develop.¹⁷

Geoengineering is a branch of climate change mitigation strategies that, though widely unfamiliar, is gaining international importance.¹⁸ One basic definition describes geoengineering as “an intentional, large-scale manipulation of the environment,” usually with the goal of combating climate change.¹⁹ Another less technical, albeit illuminating, definition asserts that “geoengineering is the study of how to mess with the planet even more than we already have, with the hope of moving the global climate back in the other direction.”²⁰ Scientists have developed various imaginative geoengineering techniques with a view toward cooling the planet.²¹

14. William Daniel Davis, *What Does “Green” Mean?: Anthropogenic Climate Change, Geoengineering, and International Environmental Law*, 43 GA. L. REV. 902, 902 (2009).

15. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CONTRIBUTION OF WORKING GROUP II TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 9 (M.L. Perry et al. eds., Cambridge Univ. Press 2007), available at http://www.ipcc.ch/publications_and_data/ar4/wg2/en/contents.html [hereinafter IPCC Report]. The IPCC used the rating of “very likely” to make this claim, which indicates a probability of 90-99%. *Id.* at 21. See *id.* for more on predictions about the effects of climate change.

16. See John M. Broder, *Skepticism on Climate Change is Article of Faith for Tea Party*, N.Y. TIMES, Oct. 21, 2010, at A1; *Climate Change No Threat, Says Czech President*, FOX NEWS, Oct. 19, 2010, available at <http://www.foxnews.com/scitech/2010/10/19/climate-change-threat-czech-president-vaclav-klaus>; THE ROYAL SOC’Y, CLIMATE CHANGE: A SUMMARY OF THE SCIENCE (John Pethica et al. eds., 2010), available at <http://royalsociety.org/climate-change-summary-of-science>.

17. See, e.g., CAN INTERNATIONAL, <http://www.climatenetwork.org> (last visited Oct. 20, 2010); *Changement Climatique*, MINISTÈRE DE L’ÉCOLOGIE, DE L’ÉNERGIE, DU DÉVELOPPEMENT DURABLE ET DE LA MER, <http://www.stats.environnement.developpement-durable.gouv.fr> (last visited Oct. 20, 2010); GREENPEACE INT’L, <http://www.greenpeace.org/international> (last visited Oct. 20, 2010); UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE, <http://unfccc.int/2860.php> (last visited Oct. 20, 2010); UNITED STATES GLOBAL CHANGE RESEARCH PROGRAM, <http://www.globalchange.gov> (last visited Oct. 20, 2010).

18. See DAVID W. KEITH, *Engineering the Planet*, in CLIMATE CHANGE SCIENCE AND POLICY 494 (Stephen H. Schneider et al. eds., 2010); Scott Barrett, *The Incredible Economics of Geoengineering*, ENVTL. & RESOURCE ECON., Dec. 6, 2007, available at <http://www.springerlink.com/content/a91294x25w065vk3/>; Ipsos Mori, *Experiment Earth? Public Dialogue on Geoengineering*, NAT’L ENVTL RESEARCH COUNCIL (Aug. 2010), available at <http://www.nerc.ac.uk/about/consult/geoengineering-dialogue-final-report>; David G. Victor et al., *The Geoengineering Option*, FOREIGN AFF., Mar./Apr. 2009, at 2, 4, available at http://chemtrailsnz.co.cc/wp-content/uploads/2010/10/The_Geoengineering_Option.pdf.

19. KEITH, *supra* note 18, at 494; Davis, *supra* note 14, at 919-20.

20. Chris Mooney, *Quick Study: Given Our Worsening Climate Situation, Geoengineering Research Makes Sense, Unfortunately*, SCI. PROGRESS (Dec. 3, 2007, 11:07 AM), <http://www.scienceprogress.org/2007/11/quick-study>.

21. Eric Biber, *Climate Change and Backlash*, 17 N.Y.U. ENVTL. L.J. 1295, 1357 (2009). Another type of geoengineering involves “albedo modification,” or increasing Earth’s reflectivity. See Paul Crutzen, *Albedo Enhancement by Stratospheric Sulfur Injections: A Contribution to Resolve a Policy Dilemma?*, CLIMATIC CHANGE, August 2006, available at http://climateresponsefund.org/index.php?option=com_content&view=article&id=107:crutzen-2006-albedo-enhancement-by-stratospheric-sulfur-injections-a-contribution-to-resolve-a-policy-dilemma&catid=39:reference&Itemid=64; John Latham, *Global Temperature Stabilization via Cloud Seeding*, PLANET NETWORK (April 2008), <http://www.planetwork.net/climate/cooling/Global%20Cooling%2004-08.pdf>; Andrew Moseman, *How Geoengineering Works: 5 Big Plans to Stop Global Warming*, POPULAR MECHANICS (Oct. 1, 2009), <http://www.popularmechanics.com/science/environment/4290084>; Andy Ridgwell et al., *Tackling Regional Climate Change by Leaf Albedo Bio-geoengineering*, CURRENT BIOLOGY,

One type of geoengineering cools the Earth by drawing down CO₂ from the atmosphere, thus allowing more heat to escape the planet.²² The United Nations Framework Convention on Climate Change aptly refers to this as a carbon “sink.”²³ These techniques aim to store the sunken CO₂ in a solid form that, theoretically, would keep it from escaping back into the atmosphere forever, or at least for a few centuries.²⁴ This process, which scientists call carbon sequestration, “remov[es] carbon from the atmosphere and deposit[s] it in a reservoir.”²⁵ Natural reservoirs have existed since the dawn of time and include trees, oceans, and soil, all of which naturally absorb CO₂.²⁶ Artificial reservoirs, on the other hand, have been around since the dawn of the 1990s, when engineers began developing the means to store CO₂ in new spaces deep underground, particularly in the seabed.²⁷ Ocean iron fertilization produces a carbon sink and is a form of carbon sequestration.²⁸

Despite its purported potential to contribute to the fight against climate change, geoengineering remains embroiled in controversy. Proponents favor continuing research as it may reveal geoengineering as a potential “insurance policy” that buys the planet time, cooling it off a bit while the atmosphere waits for the other mitigation strategies to catch up.²⁹ Opponents deride it as too speculative and a distraction from CO₂ emissions reduction and express concerns that it causes too high a risk for adverse environmental side effects and unpredictable, unintended consequences.³⁰ The language of this debate

Jan. 27, 2009, at 146, available at [http://www.cell.com/current-biology/abstract/S0960-9822\(08\)01680-1](http://www.cell.com/current-biology/abstract/S0960-9822(08)01680-1).

22. United Nations Framework Convention on Climate Change, art. 1(8), May 9, 1982, 1771 U.N.T.S. 107, 165 [hereinafter UNFCCC].

23. *Id.*

24. Biber, *supra* note 21, at 1357; Davis, *supra* note 14, at 920.

25. *Glossary of Climate Change Acronyms*, UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE, http://unfccc.int/essential_background/glossary/items/3666.php#C (last visited Oct. 10, 2010).

26. *Id.*; *Glossary*, CARBON FINANCE, <http://www.carbon-financeonline.com/index.cfm?section=glossary&letter=C> (follow “glossary” hyperlink; then follow “C” hyperlink) (last accessed Oct. 10, 2010).

27. SALLY BENSON ET AL., *Underground Geological Storage*, in INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CARBON DIOXIDE CAPTURE AND STORAGE 195, 197 (Bert Metz et al. eds., 2005), available at http://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml. See also *Sleipner Vest*, STATOIL (last updated Sept. 12, 2009, 2:14 PM), <http://www.statoil.com/en/TechnologyInnovation/ProtectingTheEnvironment/CarboncaptureAndStorage/Pages/CarbonDioxideInjectionSleipnerVest.aspx>. One method of carbon sequestration involves identifying a spot that produces a lot of CO₂ (like a factory), redirecting the CO₂ away from the atmosphere, and injecting it deep into the seabed. Research indicates that CO₂ can remain safely tucked away for 1000 years, though it requires careful maintenance and has many risks associated with it. BENSON ET AL., *supra* at 197.

28. Pete Smith et al., *Agriculture*, in CONTRIBUTION OF WORKING GROUP III TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 2007 497, 506 (B. Metz et al. eds., 2007) (explaining three categories for mitigating GHGs in agriculture), available at http://www.ipcc.ch/publications_and_data/ar4/wg3/en/contents.html. See also Powell, *Fertilizing the Ocean*, *supra* note 4. For other examples of techniques in the second category of geoengineering, see Gert Jan Nabuurs et al., *Forestry*, in CONTRIBUTION OF WORKING GROUP III TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, 2007 497, 506 (B. Metz et al. eds., 2007), available at http://www.ipcc.ch/publications_and_data/ar4/wg3/en/contents.html; Smith, *supra*, at 506; Lisa Abend, *Carbon: The Biochar Solution*, TIME (Dec. 4, 2008), <http://www.time.com/time/magazine/article/0,9171,1864279,00.html>.

29. Barrett, *supra* note 18, at 47. Climate change is considered “abrupt” if it takes place over one to two decades. *Id.* See also T.M.L. Wigley, *A Combined Mitigation/Geoengineering Approach to Climate Stabilization*, 314 SCI. 452, 454 (2006); Mooney, *supra* note 20; Victor, *supra* note 18, at 2.

30. See Alan Robock, *20 Reasons Why Geoengineering May Be a Bad Idea*, BULL. OF THE ATOMIC SCIENTISTS, May/June 2008, at 17, available at http://www.thebulletin.org/files/064002006_0.pdf. See also

— with terms like speculative, unpredictable, and potential — points to the overarching weakness of geoengineering: pervasive uncertainty.³¹ Geoengineering remains a “fringe topic,” with very little in the way of scientific literature.³² Some environmental groups continue to push a ban on all geoengineering engineering projects, while several major scientific institutions, such as the American Meteorological Society, the American Geophysical Union, and the U.K. Royal Society, encourage the cautious continuation of geoengineering research.³³ The knowledge compiled by such research would promote the establishment of international geoengineering norms resulting in well-informed, more effective international regulation.³⁴ Currently, direct international regulation of geoengineering is in its nascent stage.³⁵ A lack of specific laws and a “paucity of much hard legal analysis” make it difficult to answer questions about the legality of geoengineering.³⁶

B. Ocean Iron Fertilization

October 2010 saw a major development in international law targeting the regulation of one potential geoengineering strategy: ocean iron fertilization (OIF).³⁷ During their October 11-15, 2010, consultative meeting, the Contracting Parties to the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention) and Contracting Parties to the 1996 Protocol thereto (London Protocol) agreed on an Assessment Framework for ocean iron fertilization.³⁸ Debate about the legality and credibility of OIF is gaining steam in the international arena now more than ever.³⁹ OIF had been in danger of a flat, global moratorium, despite the useful insight into marine processes it has provided and its potential as a geoengineering strategy to fight climate change.⁴⁰ Through their recent regulations, however, the London Convention and London Protocol (LC/LP), seem to have saved and

Barrett, *supra* note 18, at 48-49; Biber, *supra* note 21, at 1358-59; Davis, *supra* note 14, at 906; Mooney, *supra* note 20; Victor, *supra* note 18, at 4.

31. Victor, *supra* note 18, at 4.

32. *Id.*

33. Lauren Morello & Climatewire, *At U.N. Convention, Groups Push for Geoengineering Moratorium*, SCIENTIFIC AMERICAN (Oct. 20, 2010), <http://www.scientificamerican.com/article.cfm?id=at-un-convention-groups-push>.

34. Victor, *supra* note 18, at 4.

35. Juliet Eilperin, *First-Ever Congressional Geoengineering Report Released*, POST CARBON, WASHINGTON POST (Oct. 29, 2010, 5:15 PM), http://voices.washingtonpost.com/post-carbon/2010/10/first-ever_congressional_geoen.html.

36. Rex J. Zedalis, *Climate Change and the National Academy of Sciences' Idea of Geoengineering: One American Academic's Perspective on First Considering the Text of Existing International Agreements*, EUR. ENERGY & ENVTL. L. REV., at 19 (Feb. 2010). Further discussion of the legality of geoengineering in general is outside the scope of this paper.

37. Press Briefing, International Maritime Organization, Assessment Framework for Scientific Research Involving Ocean Fertilization Agreed, (Oct. 20, 2010), available at <http://www.imo.org/MediaCentre/PressBriefings/Pages/Assessment-Framework-for-scientific-research-involving-ocean-fertilization-agreed.aspx> [hereinafter Press Briefing].

38. *Id.*

39. Aaron Strong et al., *Ocean Fertilization — Science, Policy, and Commerce*, 22 OCEANOGRAPHY 236 (2009) [hereinafter Strong et al., *Science, Policy, and Commerce*].

40. Press Release, ETC Group, Global Moratorium on Ocean Fertilization? (May 30, 2008), available at http://www.etcgroup.org/upload/publication/693/01/etcnrmay30_08oceanfert.pdf.

legitimized OIF for the purposes of scientific research.⁴¹

1. The Discovery of Ocean Iron Fertilization

While several methods of ocean fertilization exist today, the most common method disperses iron dust.⁴² Research from the Earth's ice ages demonstrated that naturally occurring iron fertilization might have contributed to a substantial planetary cool down by drawing sizeable amounts of CO₂ out of the Earth's atmosphere.⁴³ John Martin, the biogeochemist credited with the first OIF discoveries and experiments, noticed that when he sprinkled iron dust in a particular area of the ocean, giant masses of phytoplankton bloomed as a result.⁴⁴ An optimistic new theory bloomed as well: since phytoplankton naturally absorb atmospheric CO₂ through the process of photosynthesis, scientists wondered if the calculated use of this method could result in a CO₂ sink and combat climate change.⁴⁵

2. The Process of Ocean Iron Fertilization

The thirteen OIF experiments that have taken place to date involved a fertilization process that is long, tedious, and largely dependent on uncontrollable conditions.⁴⁶ First, the waters chosen for OIF are essential; researchers continue to study a variety of high seas locations to determine which waters are most likely to produce successful phytoplankton blooms.⁴⁷ Upon arriving at the selected area in the middle of the ocean, scientists on a research ship release a slurry of iron sulfate, then spend hours diligently spreading the added substance by "zigzagging" through the slurry to promote phytoplankton growth.⁴⁸ Monitoring the bloom's development is extremely difficult because the iron "rapidly dilutes, sinks, and reacts with seawater, becoming virtually undetectable after a few days" and tiny zooplankton that eat the blooms before they can effectively absorb CO₂.⁴⁹ Finally, the fluctuating factors of wind and light affect the

41. Press Briefing, *supra* note 37.

42. Ken O. Buesseler et al., *Ocean Iron Fertilization-Moving Forward in a Sea of Uncertainty*, SCI., Jan. 11, 2008, at 162, 162, available at <http://academics2.vmi.edu/biol/humstonr/GCC/Buesseler%20et%20al%202008.pdf>. For more information on other methods of ocean fertilization, see International Maritime Organization, *Ocean Fertilization: Exploration of Marine Geo-engineering*, submitted by the Chairman of the Scientific Groups to the Contracting Parties to the London Convention and London Protocol, Sess. 32/5, Oct. 11-15, 2010, IMO Doc. LC 32/4 (July 28, 2010); R.S. Lampitt et al., *Ocean Fertilization: A Potential Means of Geoengineering?*, 366 PHIL. TRANSACTIONS OF THE ROYAL SOC'Y A, Aug. 29, 2008, at 3919, available at <http://rsta.royalsocietypublishing.org/content/366/1882/3919.full.pdf+html>.

43. Lampitt et al., *supra* note 42, at 3927. See also Powell, *Fertilizing the Ocean*, *supra* note 4, at 1; Hugh Powell, *Lessons from Nature, Models, and the Past*, OCEANUS (Jan. 9, 2008), <http://www.who.edu/oceanus/viewArticle.do?id=35746§ionid=1000%20> [hereinafter Powell, *Lessons from Nature*].

44. Powell, *Fertilizing the Ocean*, *supra* note 4, at 1.

45. Michelle Alsopp et al., *A Scientific Critique of Oceanic Iron Fertilization as a Climate Change Mitigation Strategy*, GREENPEACE RESEARCH LABS. TECHNICAL NOTE 07/2002, Sept. 2007, at 2, available at http://www.climos.com/imo/Other/Other_greenpeace_iron_fert_critiq_Sep2007.pdf.

46. Abate & Greenlee, *supra* note 7, at 563. See also Hugh Powell, *Will Ocean Iron Fertilization Work?*, 2 OCEANUS (Jan. 7, 2008), <http://www.who.edu/oceanus/viewArticle.do?id=35609§ionid=1000> [hereinafter Powell, *Will Ocean Iron Fertilization Work?*].

47. Powell, *Will Ocean Iron Fertilization Work?*, *supra* note 46, at 2-3.

48. *Id.* at 2.

49. *Id.* at 2-3.

success of the photosynthesis process of the phytoplankton.⁵⁰

The ultimate goal of OIF is to store the absorbed CO₂ in either dead phytoplankton cells or fecal pellets produced by phytoplankton-eating organisms.⁵¹ Success then hangs on whether these storage units actually sink into the ocean depths to stay, sequestered away for centuries.⁵² Some OIF proponents argue that even if the CO₂ only sank to mid-level waters to stay for merely a few decades, it would still buy the planet some time while society continues its efforts to reduce CO₂ emissions.⁵³ Early predictions about the effectiveness of OIF raised great hopes of eliminating one to two billion tons of CO₂ from the atmosphere every year.⁵⁴ Although research from the thirteen OIF operations carried out thus far has demonstrated that the OIF process does in fact draw down atmospheric CO₂, the results have shown fairly modest amounts of CO₂ actually sequestered.⁵⁵ Scientists remain undeterred, claiming, “[i]f iron fertilization achieves only 10 per cent of the one-billion-ton-per-year potential for carbon removal, that would . . . perhaps still [be] a large enough number to be of use in mitigating climate change.”⁵⁶ Though opponents use these so-called “modest results” to criticize OIF for its ineffectiveness, perhaps they do so unfairly; the vast majority of OIF experiments focused not on carbon drawdown, but on the effect of carbon on the oceans or the process of OIF itself.⁵⁷

3. The Ocean Iron Fertilization Debate

One area of debate surrounding OIF as a geoengineering technique to reverse climate change concerns its potential environmental consequences, reiterating the recurring geoengineering quandary: are there enough demonstrable benefits to outweigh the potential for adverse consequences?⁵⁸ Besides the potential as a CO₂ sink, OIF may have other positive side effects, such as restoring fish stocks and phytoplankton levels that have dwindled due to CO₂-induced ocean acidification.⁵⁹ But OIF carries a number of risks, and even its proponents recognize doubts about its “practicality, efficacy, and safety.”⁶⁰ For example, as phytoplankton make up the very foundation of the marine

50. Alsopp et al., *supra* note 45, at 7.

51. Powell, *Fertilizing the Ocean*, *supra* note 4, at 2. *See also* Powell, *Will Ocean Iron Fertilization Work?*, *supra* note 46, at 4.

52. Powell, *Fertilizing the Ocean*, *supra* note 4, at 2.

53. Powell, *Will Ocean Iron Fertilization Work?*, *supra* note 46, at 2.

54. Powell, *Fertilizing the Ocean*, *supra* note 4, at 1.

55. *Id.* *See also* Powell, *Will Ocean Iron Fertilization Work?*, *supra* note 46, at 1. The thirteenth OIF experiment, LOHAFEX, took place in 2009. Abate & Greenlee, *supra* note 7, at 556-58.

56. Powell, *Will Ocean Iron Fertilization Work?*, *supra* note 46, at 4.

57. UNESCO-IOC, Statement by the Intergovernmental Oceanographic Commission (IOC), submitted to the Scientific Groups of the London Convention and London Protocol, Sess. 31/2, May 19-23, 2008, IMO Doc. LC/SG 31/2/2 (Apr. 4, 2008) [hereinafter IOC Statement]. *See also* Buesseler et al., *supra* note 42; Strong et al., *Science, Policy, and Commerce*, *supra* note 39, at 239-42; Black, *supra* note 8; Peter Liss et al., *Ocean Fertilization with Iron: Effects on Climate and Air Quality*, 57B TELLUS 269, 270 (2005).

58. *See* Alsopp et al., *supra* note 45, at 3-4.

59. 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>. *See also* Hugh Powell, *What Are the Possible Side Effects?*, OCEANUS (Jan. 8, 2008), <http://www.whoi.edu/oceanus/viewArticle.do?id=35668> [hereinafter Powell, *Side Effects*].

60. Powell, *Fertilizing the Ocean*, *supra* note 4, at 2.

food chain, any alteration to their levels could result in far-reaching damages.⁶¹ The OIF process may also produce greenhouse gases far worse than CO₂, which would outweigh any CO₂ abatement.⁶² Some early research shows that OIF may increase the risk of ocean acidification.⁶³ The artificial stimulation of phytoplankton growth could deplete nutrients from adjacent areas of the ocean.⁶⁴ OIF may also contribute to the formation of a kind of algae that is toxic to certain marine mammals.⁶⁵ Finally, the increased amounts of phytoplankton absorbing sunlight might lead to higher surface water temperature, which would both increase global warming and diminish OIF experiments' effectiveness.⁶⁶ The projects performed to date have been small-scale scientific research-focused projects that have not produced these largely speculative effects, which pose a greater potential threat in the context of projects on a larger scale.⁶⁷

The debate concerning the legality of OIF parallels the debate over environmental consequences; the legal issues grow more problematic in the context of large-scale, commercial, geoengineering-focused OIF projects.⁶⁸ The primary avenue for potential OIF commercialization involves employing it as a geoengineering technique and engaging in carbon trading based on the amount of CO₂ drawn down by the process.⁶⁹ For OIF to generate enough CO₂ drawdown to make it a viable option on the carbon trading market, projects would have to take place on a vastly larger scale than the research projects heretofore executed.⁷⁰ "No scientific basis for issuing such carbon credits" exists, as scientists have yet to develop a reliable method of monitoring the amount of carbon sequestered by OIF.⁷¹ Nevertheless, companies touting the tremendous potential of OIF as a possible carbon trading enterprise are in full swing.⁷² If OIF were to gain undeserved credibility as a lucrative geoengineering operation, these OIF carbon trading companies may jump at the opportunity by launching large-scale OIF projects in exchange for the purchase of carbon credits from customers.⁷³ Whether or not such commercial efforts would enjoy success remains to be seen, but no international law to date has directly barred this kind of commercial OIF.⁷⁴

61. Alsopp et al., *supra* note 45, at 3.

62. *Id.*

63. See Long Cao & Ken Calderia, *Can Ocean Iron Fertilization Mitigate Ocean Acidification*, CLIMATIC CHANGE, Jan. 20, 2010, available at [http://www.stanford.edu/~longcao/Cao&Caldeira\(2010\).pdf](http://www.stanford.edu/~longcao/Cao&Caldeira(2010).pdf).

64. Powell, *Fertilizing the Ocean*, *supra* note 4, at 2.

65. Alsopp, *supra* note 45, at 3.

66. Powell, *Side Effects*, *supra* note 59, at 2.

67. *Id.* at 3.

68. Alsopp et al., *supra* note 45, at 4. See also Hugh Powell, *Dumping Iron and Trading Carbon: Profits, Pollution, and Politics All Will Play Roles in Ocean Iron Fertilization*, OCEANUS (Jan. 10, 2008), <http://www.whoi.edu/oceanus/viewArticle.do?id=35826> [hereinafter Powell, *Trading Carbon*].

69. Strong et al., *Science, Policy, and Commerce*, *supra* note 39, at 245-46.

70. Alsopp et al., *supra* note 45, at 2. See also Strong et al., *Science, Policy, and Commerce*, *supra* note 39, at 245-46.

71. Buesseler et al., *supra* note 42. See also Abate & Greenlee, *supra* note 7, at 571.

72. See CLIMOS, <http://www.climos.com> (last visited Oct. 14, 2010); *The Technology*, OCEAN NOURISHMENT CORP., <http://www.oceannourishment.com/technology.asp> (last visited Oct. 14, 2010); *Other Applications, CO2*, ATMOCEAN INC., http://atmocean.com/Ocean_CO2_Sequestration.htm (last visited Oct. 14, 2010).

73. Strong et al., *Science, Policy, and Commerce*, *supra* note 39, at 248-49.

74. *Id.* at 250.

4. The Argument for OIF Research

Some activists and commentators argue that OIF's inadequate results and potential risks may not justify investment into continued research, and that resources should be redirected toward the continued development of other climate change mitigation strategies.⁷⁵ As it stands now, OIF is nowhere near ready for use as a geoengineering tool to combat global climate change.⁷⁶ On the other hand, the chief scientists from the LOHAFEX experiment support cautious research of OIF, suggesting "larger and longer experiments to test both the geoengineering potential of OIF and the potential for unintended negative side effects."⁷⁷

The majority of the literature analyzing OIF, however, settles on the middle ground, and advocates laying aside projects aimed solely at determining OIF's geoengineering potential in favor of projects directed at building scientific knowledge about marine processes.⁷⁸ Small-scale, scientific research projects have gained the most favor, while large-scale projects remain suspect.⁷⁹ The Convention on Biological Diversity stated the need for legitimate scientific research into the actual outcomes and effectiveness of OIF.⁸⁰ A consultative group from the UN's International Oceanic Commission affirmed OIF research as a tool for studying the ocean, stating that researchers could safely carry out carefully designed research projects.⁸¹

There is a growing consensus that, because OIF has shown moderate success, legitimate scientific research subject to an international legal framework is a reasonable approach to future OIF experiments.⁸² This sliding scale of views on scientific research of OIF, and the middle road struck by many commentators, foreshadowed recent advances in international regulation of OIF.⁸³ These advances are developing out of a "hodge-podge, patchwork of inexact international rules" into an ever more precise, streamlined set of regulations targeted directly at OIF.⁸⁴

75. See Jennie Dean, *Iron Fertilization: A Scientific Review with International Policy Recommendations*, 32-SPG ENVIRONS ENVTL. L. & POL'Y J. 321, 339; Alsopp et al., *supra* note 45, at 8; Powell, *Fertilizing the Ocean*, *supra* note 4, at 4.

76. Strong et al., *Science, Policy, and Commerce*, *supra* note 39, at 256.

77. *Id.* at 246.

78. Aaron Strong et al., *Ocean Fertilization: Time to Move On*, NATURE, Sept. 17, 2009, at 347.

79. *Id.* at 348.

80. SECRETARIAT OF THE CONVENTION ON BIOLOGICAL DIVERSITY, SCIENTIFIC SYNTHESIS OF THE IMPACTS OF OCEAN FERTILIZATION ON MARINE BIODIVERSITY 5 (Secretariat of the Convention on Biological Diversity, CBD Technical Series No. 45 2009) [hereinafter SCIENTIFIC SYNTHESIS].

81. IOC Statement, *supra* note 57.

82. Abate & Greenlee, *supra* note 7, at 571. See also Buesseler et al., *supra* note 42; Dean, *supra* note 75, at 339; Strong et al., *Science, Policy, and Commerce*, *supra* note 39, at 258; Margaret Leinen et al., *Why Ocean Iron Fertilization?*, CLIMOS (Mar. 12, 2009), at 20, http://www.climos.com/pubs/2009/Climos_Why_OIF-2009-03-12.pdf.

83. See IMO Res. LC-LP.2 (2010) on the Assessment Framework for Scientific Research Involving Ocean Fertilization, adopted Oct. 14, 2010 (advance copy on file with author) [hereinafter LC-LP.2]; IMO Annex 6 Assessment Framework for Scientific Research Involving Ocean Fertilization, adopted Oct. 14, 2010 (advance copy on file with author) [hereinafter Assessment Framework].

84. Zedalis, *supra* note 36, at 32.

III. INTERNATIONAL LAW AND OCEAN IRON FERTILIZATION

A. International Legal Instruments That Speak Indirectly to Ocean Iron Fertilization

Events surrounding the most recent OIF expedition, LOHAFEX, produced a study of the ineffectiveness of international regulation of OIF.⁸⁵ The twelve small-scale OIF research expeditions prior to LOHAFEX were not subject to any specific laws in any country and took place without any kind of permit.⁸⁶ LOHAFEX provided the first exception.⁸⁷ LOHAFEX scientists submitted a proposal for their experiment to the German government, vaguely stating that their project complied with international law, citing the Convention on Biological Diversity's Decision IX/16 statement about ocean fertilization as the authority for granting approval.⁸⁸ The German Research Ministry subsequently issued a permit for the research.⁸⁹ However, amid substantial protest from environmental groups, the German Environment Ministry persuaded the German Research Ministry to revoke permission.⁹⁰ The LOHAFEX vessel waited several days between its point of departure and its destination before the German Research Ministry reinstated its permit, stating that it was "convinced there [were] no scientific or legal objections" to the project.⁹¹ After reviewing the same set of facts, the two German ministries took polar opposite views about the experiment's legality.⁹²

The legal confusion surrounding LOHAFEX brought attention to the insufficiency of existing international law, and the necessity of establishing a coherent international framework to regulate OIF.⁹³ The necessity became urgent in light of private companies gearing up to launch OIF projects with decidedly commercial motives.⁹⁴ One such company, Climos, is preparing to carry out several "OIF demonstration experiments" to explore the appropriateness of using OIF as a climate mitigation strategy.⁹⁵ Climos expresses its willingness to apply for permit under the London Convention and London Protocol, while in the next breath casting doubt about the applicability of the London Convention and London Protocol to OIF, noting a loophole through which they could perhaps escape any direct legal obligation.⁹⁶ This kind of existing legal ambiguity technically means that there is nothing to bar commercial OIF expeditions from moving

85. Abate & Greenlee, *supra* note 7, at 585-87.

86. Strong et al., *Science, Policy, and Commerce*, *supra* note 39, at 250.

87. Bhattacharya, *supra* note 10.

88. CBD Decision IX/16, U.N. Doc. UNEP/CBD/COP/DEC/IX/16, 7 (Oct. 9, 2008) [hereinafter CBD Decision IX/16]; Abate & Greenlee, *supra* note 7, at 586.

89. CBD Decision IX/16, *supra* note 88, at 7; Abate & Greenlee, *supra* note 7, at 557-58.

90. Abate & Greenlee, *supra* note 7, at 557-58; Black, *supra* note 8.

91. Abate & Greenlee, *supra* note 7, at 557-58.

92. *Id.*

93. Abate & Greenlee, *supra* note 7, at 588.

94. *Id.*; David Freestone & Rosemary Rayfuse, *Ocean Iron Fertilization and International Law*, 364 MARINE ECOLOGY PROGRESS SERIES 227, 227 (2008).

95. *Frequently Asked Questions About Ocean Fertilization*, CLIMOS, <http://www.climos.com/faq.php#16> [hereinafter *Frequently Asked Questions*] (last visited Oct. 18, 2010). Australia-based Ocean Nourishment Corporation is another example, though its techniques for fertilization are different. See OCEAN NOURISHMENT CORP., <http://www.oceannourishment.com/default.asp> (last visited Oct. 24, 2010).

96. *Frequently Asked Questions*, *supra* note 95.

forward, permit or not.⁹⁷

Governance of OIF on the international level is ideal as experiments take place on the high seas, beyond any country's exclusive economic zone, and thus outside any particular country's jurisdiction.⁹⁸ However, developing an international regulatory scheme can be difficult given the broad spectrum of opinions about the best way to regulate OIF, ranging from an outright ban to allowing research connected to financial gain.⁹⁹ Studies of international law concerning OIF reveal a handful of treaty provisions that *indirectly* apply to OIF, and a conspicuous absence of laws that *directly* apply to it.¹⁰⁰ For the purposes of this paper, a brief synopsis of these provisions suffices to illustrate the need for more coherent international OIF regulation.

1. United Nations Framework Convention on Climate Change and Kyoto Protocol

The United Nations Framework Convention on Climate Change (UNFCCC) does not contain any provisions directly related to OIF.¹⁰¹ However, one can construe certain provisions as indirectly reaching it.¹⁰² A primary principle of the UNFCCC is that Parties must consider the interests of those other than themselves when it comes to preserving the environment, including the interests of other states and "future generations."¹⁰³ Article 3(3) requires Parties to "take precautionary measures" to combat climate change, encouraging them to consider the viability of carbon sinks and reservoirs in order to do so.¹⁰⁴ When "irreversible damage" to the environment looms, a "lack of full scientific certainty" about remedial measures is no excuse to delay using them under the UNFCCC.¹⁰⁵ Article 4(1)(b) and (d) require Parties to address carbon emissions by using carbon sinks when appropriate, while 4(1)(f) keeps them on the hook for assessing the potential adverse effects stemming from the methods they use.¹⁰⁶ Taken together, Parties could interpret these provisions to reflect no prohibition of OIF due to limited scientific knowledge about the process and its effects, but rather supporting the use of OIF as a carbon sink as long as Parties can adequately assess its safety.¹⁰⁷ Of course, should OIF prove to have harmful effects, using it as a climate mitigation technique would contravene the principles of the UNFCCC.¹⁰⁸ However, if OIF does one day prove useful in the fight against climate change, pursuant to the UNFCCC, Parties could employ it as a means to preserve the environment. In any case, any implied blessing

97. Strong et al., *Science, Policy, and Commerce*, *supra* note 39, at 250.

98. *Id.*; Powell, *Trading Carbon*, *supra* note 68.

99. See Abate & Greenlee, *supra* note 7, at 593. See also Dean, *supra* note 75, at 333.

100. See *infra* notes 97-140.

101. Zedalis, *supra* note 36, at 30.

102. *Id.*; Freestone & Rayfuse, *supra* note 94, at 230; Zedalis, *supra* note 36, at 30.

103. UNFCCC, *supra* note 22, pmbl., art. 3(1); Zedalis, *supra* note 36, at 30.

104. UNFCCC, *supra* note 22, art. 3(3); Freestone & Rayfuse, *supra* note 94, at 231; Zedalis, *supra* note 36, at 31.

105. UNFCCC, *supra* note 22, art. 3(3); Freestone & Rayfuse, *supra* note 94, at 232.

106. UNFCCC, *supra* note 22, art. 4(1)(b), (d), (f); Freestone & Rayfuse, *supra* note 94, at 231; Zedalis, *supra* note 36, at 31.

107. See Freestone & Rayfuse, *supra* note 94, at 231.

108. Zedalis, *supra* note 36, at 31.

upon OIF under the UNFCCC is constructive; the treaty does not supply any direct regulation of OIF.¹⁰⁹

The Kyoto Protocol (KP), designed to give further clarity to the UNFCCC, limits one capacity in which Parties could use OIF as a climate change mitigation strategy.¹¹⁰ The KP's main purpose is to give countries practical tools, such as carbon trading, to reduce carbon emissions.¹¹¹ While the KP mentions carbon sinks as a means for producing carbon credits, Article 3(3) currently limits sinks to afforestation, reforestation, and deforestation.¹¹² According to Article 12, for any new type of carbon sink projects to gain credibility under the KP, their method for calculating emissions reduction must satisfy an executive board.¹¹³ Given the skepticism about the effectiveness of OIF in drawing down carbon, it is unlikely to see admittance as a viable sink under the KP any time soon.¹¹⁴ The KP thus indirectly ousts OIF from major carbon trading schemes.¹¹⁵ Those who hope to derive financial benefits from carbon trading with OIF must seek acceptance on the voluntary carbon trading market.¹¹⁶

2. Convention on Biological Diversity

While the text of the Convention on Biological Diversity (CBD) does not directly address OIF, one can interpret select provisions as reaching the activity.¹¹⁷ Articles 7 and 14 require CBD Parties to “identify 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.”¹¹⁸ Once Parties have identified said processes or activities, Article 8 requires them to “regulate and manage” them.¹¹⁹

The CBD seems to have identified large-scale OIF as an activity likely to have adverse effects on biological diversity, and, as such, have taken steps to regulate it.¹²⁰ In May 2008, the CBD issued Decision IX/16, urging States to “use the utmost caution when considering . . . large-scale” OIF proposals and stated that limited scientific knowledge about OIF did not justify such projects.¹²¹ The CBD added an exception allowing scientific research of OIF within “coastal waters,” though the exception was essentially useless, as effective OIF experiments take place on the high seas.¹²² In 2009,

109. *See id.*

110. *See* Freestone & Rayfuse, *supra* note 94, at 231.

111. *Id.* A full discussion of the carbon trading system is outside the scope of this paper. For more information, *see id.*

112. Kyoto Protocol to the United Nations Framework Convention on Climate Change, art. 3(3), Dec. 10, 1997, 37 I.L.M. 22 (1998) (entered into force Feb. 16, 2005) [hereinafter Kyoto Protocol].

113. *Id.* at art. 12; Freestone & Rayfuse, *supra* note 94, at 231; Dean, *supra* note 75, at 338.

114. *See* Abate & Greenlee, *supra* note 7, at 593; Dean, *supra* note 75, at 338.

115. *See* Dean, *supra* note 75, at 338.

116. *See id.*

117. *See* Zedalis, *supra* note 36, at 29.

118. Convention on Biological Diversity, art. 7(c), art. 14, June 5, 1992, 1760 U.N.T.S. 79 [hereinafter CBD].

119. *Id.* art. 8; Zedalis, *supra* note 36, at 29.

120. CBD, *supra* note 118, art. 7-8.

121. CBD Decision IX/16, *supra* note 88, at 7; Abate & Greenlee, *supra* note 7, at 576; Zedalis, *supra* note 36, at 30.

122. *See* CBD Decision IX/16, *supra* note 88, at 7; Abate & Greenlee, *supra* note 7, at 577; Strong et al., *Science, Policy, and Commerce*, *supra* note 39, at 255; Zedalis, *supra* note 36, at 30.

the CBD expressed a more moderate stance in its Scientific Synthesis about OIF, acknowledging the validity of “legitimate scientific research,” and expressing the need for an international assessment framework regulating OIF.¹²³ Finally, at their most recent meeting, the CBD stated explicit disapproval of geoengineering in general by placing a ban on all such projects until “there is an adequate scientific basis on which to justify such activities.”¹²⁴ In that same meeting, however, the CBD also acknowledged the LC/LP’s contribution to “global, transparent and effective control” of OIF, perhaps implying acquiescence to letting the LC/LP take the lead in this specific area of geoengineering.¹²⁵

3. United Nations Convention on the Law of the Sea

Known as the “Constitution for the ocean,” many consider the United Nations Convention on the Law of the Sea (UNCLOS) as the codification of customary international law governing most all activities that take place in the ocean.¹²⁶ In general, Article 192 requires all States to “protect and preserve the marine environment.”¹²⁷ In particular, Article 194 requires them to “prevent, reduce and control pollution of the marine environment from any source.”¹²⁸ Article 1 defines pollution, not according to its substance, but as whether it is likely to cause “deleterious effects,” such as harming marine or human life.¹²⁹ Some see OIF as a potential means for satisfying these aims of UNCLOS by preserving the global environment and reducing atmospheric CO₂; others see it as outright pollution because of its potential to harm marine life, with possible adverse consequences on humans as well.¹³⁰

UNCLOS dumping provisions are particularly relevant to OIF.¹³¹ Article 1(5), in relevant part, defines dumping as any “deliberate disposal of wastes or other matter from vessels . . . at sea.”¹³² The provision also contains an exception to the dumping rule for matter placed in the ocean “for a purpose other than the mere disposal thereof, provided

123. SCIENTIFIC SYNTHESIS, *supra* note 80, at 9; Abate & Greenlee, *supra* note 7, at 584.

124. Eilperin, *supra* note 35.

125. Convention on Biological Diversity, COP 10 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, COP 10 Draft Decision 10.L42, §§ 59, 60, Sess. 10, Oct. 18-29, 2010, U.N. Doc. UNEP/CBD/COP/10/L.42 (Oct. 29, 2010); Eilperin, *supra* note 35.

126. Philomene Verlaan, *Geo-engineering, the Law of the Sea, and Climate Change*, 4 CARBON & CLIMATE L. REV. 446, 448 (2009) (reprinted in *Ocean Fertilization, Geo-engineering, the Law of the Sea and Climate Change*, submitted by Int’l Union for the Conservation of Nature to the Contracting Parties of the London Convention and London Protocol, IMO Doc. LC 32/INF.2 (May 26, 2010)); Freestone & Rayfuse, *supra* note 94, at 228.

127. United Nations Convention on the Law of the Sea, art. 192, Dec. 10, 1982, 1833 U.N.T.S. 3 [hereinafter UNCLOS]; Abate & Greenlee, *supra* note 7, at 573; Dean, *supra* note 75, at 334; Verlaan, *supra* note 126, at 449-50; Zedalis, *supra* note 36, at 28.

128. UNCLOS, *supra* note 127, art. 194; Abate & Greenlee, *supra* note 7, at 575; Dean, *supra* note 75, at 334; Verlaan, *supra* note 126, at 449-50; Zedalis, *supra* note 36, at 28.

129. UNCLOS, *supra* note 127, art. 1(4); Dean, *supra* note 75, at 335; Freestone & Rayfuse, *supra* note 94, at 229; Verlaan, *supra* note 126, at 449; Zedalis, *supra* note 36, at 28.

130. See *supra* text accompanying notes 54-70.

131. See *infra* text accompanying notes 129-35.

132. UNCLOS, *supra* note 127, art. 1(5); Dean, *supra* note 75, at 335; Freestone & Rayfuse, *supra* note 94, at 229.

that such placement is not contrary to the aims of this Convention.”¹³³ Article 210 requires States to prevent and manage marine pollution by establishing a process for issuing national dumping permits and to develop international dumping standards under the auspices of an international body (hence the formation of the LC/LP).¹³⁴ A substantial part of the OIF debate has centered on whether OIF experiments impermissibly “dump” iron into the sea or satisfy the dumping exemption by merely “placing” the iron there.¹³⁵ Later sections focusing on the LC/LP will explore this debate further.¹³⁶

Finally, and especially relevant in light of recent OIF regulations, Article 240 sets out the principles for “marine scientific research.”¹³⁷ While providing no clear definition of what constitutes such acceptable research, this provision does mandate that all research “be conducted in compliance with all relevant regulations adopted in conformity” with UNCLOS.¹³⁸ The design and content of the LC/LP complies with UNCLOS and gives effect to its dumping provisions.¹³⁹ It is reasonable to determine that LC/LP regulations for the proper execution of legitimate scientific research of OIF, which specifically require consideration of UNCLOS principles, would likewise comply.¹⁴⁰

B. The London Convention and London Protocol's Direct Regulation of OIF

The LC/LP work concurrently toward the prevention and, ultimately, the elimination of marine pollution caused by dumping.¹⁴¹ The 1975 London Convention was one of the first treaties to give effect to practical protections of the oceans.¹⁴² Its successor, the 1996 London Protocol, was developed to replace the London Convention, but has only been in force for four years and has fewer than half the number of contracting parties as the London Convention.¹⁴³ Despite a few differences, the LC/LP work together — “two instruments — one family,” as Chairman Victor Escobar Paredes paternally proclaimed at their first joint meeting.¹⁴⁴ To date, the LC/LP have performed some of the most extensive work toward regulating OIF.¹⁴⁵

133. UNCLOS, *supra* note 127, art. 1(5); Dean, *supra* note 75, at 335; Freestone & Rayfuse, *supra* note 94, at 229.

134. UNCLOS, *supra* note 127, art. 210; Abate & Greenlee, *supra* note 7, at 575-76; Dean, *supra* note 75, at 335; Freestone & Rayfuse, *supra* note 94, at 229. *See also* UNCLOS, *supra* note 127, art. 194(3)(a).

135. Dean, *supra* note 75, at 335-36.

136. *See infra* text accompanying notes 149-57.

137. UNCLOS, *supra* note 127, art. 240.

138. UNCLOS, *supra* note 127, art. 240(d); Zedalis, *supra* note 36, at 29.

139. Freestone & Rayfuse, *supra* note 94, at 229-30.

140. *See* Assessment Framework, *supra* note 83; Freestone & Rayfuse, *supra* note 94, at 229.

141. IMO BROCHURE, THE LONDON CONVENTION AND PROTOCOL: THEIR ROLE AND CONTRIBUTION TO PROTECTION OF THE MARINE ENVIRONMENT, http://www5.imo.org/SharePoint/blastDataHelper.asp/data_id%3D21278/LC-LPbrochure.pdf (last visited Oct. 15, 2010) [hereinafter IMO BROCHURE].

142. *Id.*

143. *Id.*

144. Alan B. Sielen, *The New International Rules on Ocean Dumping: Promise and Performance*, 21 GEO. INT'L ENVTL. L. REV. 495, 525 (2009) (noting differences between the London Convention and the London Protocol); Verlaan, *supra* note 126, at 453.

145. Sielen, *supra* note 144, at 525.

1. Provisions Relevant to OIF

The LC/LP share closely related objectives, though they differ slightly. The London Convention requires Contracting Parties (CP) “control” and “prevent the pollution of the sea by the dumping of waste,” while the London Protocol employs stronger language, requiring CPs to “prevent, reduce and where practicable eliminate pollution caused by dumping.”¹⁴⁶ The LC/LP contain the exact same dumping and exemption provisions as UNCLOS, but with the added proviso that any exemption must not be “contrary to the aims of” the LC/LP.¹⁴⁷ For OIF proposals to gain LC/LP approval, they must comply with these objectives.¹⁴⁸

Whether the LC/LP can even apply to OIF depends largely on the definition of dumping.¹⁴⁹ Researchers do not place iron in the oceans merely for disposal, so OIF seems to fall within the exemption.¹⁵⁰ If such a determination wholly exempted OIF from dumping regulation, then there is doubt as to whether the LC/LP could even govern such activities.¹⁵¹ However, should OIF prove to have deleterious effects on human or marine health, then it would contravene the LC/LP’s objectives and CPs would have to take steps to prevent or eliminate it.¹⁵² Lists of the permitted and prohibited substances for dumping, as laid out in the LC/LP annexes, shed no light on the question of OIF.¹⁵³ The London Convention first lists substances categorically prohibited from dumping, and then lists substances requiring a special permit from the CP, who has jurisdiction over the dumping project.¹⁵⁴ The London Protocol uses a “reverse list,” prohibiting CPs from dumping any substances except for the few items found in its Annex 1.¹⁵⁵ The iron compound used in OIF is nowhere to be found on these lists, nor have experts persuasively analogized to any listed substance.¹⁵⁶

Unlike the London Convention, the London Protocol incorporates the precautionary principle which requires CPs to exercise great caution should they believe that a substance put in the ocean is “likely to cause harm even when there is no conclusive evidence to prove a causal relation” between the substance and subsequent effects.¹⁵⁷ Some see the addition of this principle to the London Protocol as substantially raising the bar that OIF proponents must meet in establishing the safety of their

146. 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Protocol), preamble, Nov. 7, 1996, 36 I.L.M. 1 (1997) [hereinafter London Protocol]; Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention), art. 1, Dec. 29, 1972, 26 U.S.T. 2403 [hereinafter London Convention].

147. London Protocol, *supra* note 146, art. 4.2(2); London Convention, *supra* note 146, art. III; Dean, *supra* note 75, at 335-36; Zedalis, *supra* note 36, at 26.

148. See IMO, Annex 6, Res. LC-LP.1 (2008) On the Regulation of Ocean Fertilization, IMO Doc. LC 30/16 (Oct. 31, 2008) [hereinafter LC-LP.1].

149. Freestone & Rayfuse, *supra* note 94, at 229-30.

150. Zedalis, *supra* note 36, at 26.

151. Dean, *supra* note 75, at 335-36. See Freestone & Rayfuse, *supra* note 94, at 229.

152. Freestone & Rayfuse, *supra* note 94, at 229.

153. London Protocol, *supra* note 146, Annex 1; London Convention, *supra* note 146, Annex I, II.

154. London Convention, *supra* note 146, Annex I, Annex II.

155. London Protocol, *supra* note 146, Annex 1; Sielen, *supra* note 144, at 531.

156. London Protocol, *supra* note 146, Annex 1; London Convention, *supra* note 146, Annex I, II; See Dean, *supra* note 75, at 336.

157. London Protocol, *supra* note 146, art. 3(1); Abate & Greenlee, *supra* note 7, at 578; Verlaan, *supra* note 126, at 453.

experiments.¹⁵⁸ Notably, however, the most well-known articulation of the precautionary principle for environmental protection states that “lack of full scientific certainty shall not be used as a reason for postponing . . . measures to prevent environmental degradations.”¹⁵⁹ Proponents of OIF could invoke the precautionary principle to argue in favor of continued research despite the scientific uncertainty involved, given its unknown potential to prevent environmental degradation.¹⁶⁰

Finally, the LC/LP’s reach is limited to the States who are its Contracting Parties.¹⁶¹ Even if OIF regulation does fall within the jurisdiction of the LC/LP, only those who are party to the treaties would have an obligation to abide by it.¹⁶² It may be possible for OIF researchers to evade regulation by simply approaching a non-Contracting Party from which to launch its operation.¹⁶³ For the LC/LP to have loophole-free, global regulation of OIF, its hopes lie in the strength of its regulations to eventually establish international OIF norms by which all nations will abide.¹⁶⁴

2. Ownership of OIF

Despite the debate once kicked around regarding the LC/LP’s applicability to OIF, most consider the LC/LP the primary “international legal framework” regulating OIF today.¹⁶⁵ The first step that the LC/LP took toward claiming ownership of OIF began with the “Statement of Concern” on large-scale ocean fertilization issued by the Scientific Groups to the LC/LP in 2007.¹⁶⁶ After the Intergovernmental Panel on Climate Change found OIF to be a potential, albeit speculative and potentially risky, means to sink CO₂ and fight climate change, the Scientific Groups’ “Statement of Concern” encouraged the CPs to consider regulations aimed at reining in large-scale OIF.¹⁶⁷

About one year later, the CPs adopted a resolution agreeing amongst themselves that OIF activities fell within the purview of the LC/LP.¹⁶⁸ On one hand, the resolution declared that OIF, for the purposes of large-scale commercial use, was unjustified and “contrary to the aims” of the LC/LP.¹⁶⁹ On the other hand, the resolution brought OIF

158. See Kerstin Güssow et al., *Ocean Iron Fertilization: Why Further Research Is Needed* 16 (Kiel Inst. for the World Econ., Working Paper No. 1574, 2009), available at <http://www.ifw-members.ifw-kiel.de/publications/ocean-iron-fertilization-why-further-research-is-needed/kwpl1574>. See also Sielen, *supra* note 144, at 525.

159. Güssow et al., *supra* note 158, at 15. This articulation of the precautionary principle for environmental protection originates in the Rio Declaration. *Id.*

160. See Güssow et al., *supra* note 158, at 15-16.

161. Freestone & Rayfuse, *supra* note 94, at 230.

162. *Id.*

163. *Id.*

164. See Victor, *supra* note 18, at 3.

165. Strong et al., *Science, Policy, and Commerce*, *supra* note 39, at 256.

166. IMO, Statement of Concern Regarding Iron Fertilization of the Oceans to Sequester CO₂, IMO Doc. LC-LP.1/Circ.14 (July 13, 2007) [hereinafter Statement of Concern]; Abate & Greenlee, *supra* note 7, at 579; Sielen, *supra* note 144, at 521.

167. Statement of Concern, *supra* note 166; Sielen, *supra* note 144, at 521; Verlaan, *supra* note 127, at 456.

168. LC-LP.1, *supra* note 148 at 1; Verlaan, *supra* note 126, at 456.

169. IMO, Rep. of the 31st Meeting of the Scientific Group of the London Convention and the 2d Meeting of the Scientific Group of the London Protocol, May 19-23, 2008, Annex 2 - Outcome of the Working Group on Ocean Fertilization, 1-2, IMO Doc. LC/SG 31/16 (July 7, 2008) [hereinafter LC/SG 31/16]; LC-LP.1, *supra*

within the shelter of the dumping exemption for the purposes of legitimate scientific research.¹⁷⁰ In order to determine the status of OIF proposals as legitimate scientific research, the resolution called for the development of an assessment framework for CPs to use in evaluating OIF proposals on a case-by-case basis.¹⁷¹ In the absence of and until the development of the requested assessment framework, the resolution provided a list of the “best available guidance” for CPs to use for OIF proposals.¹⁷² The list included a jumble of sources, including any “previous agreements” made by the CPs and a few waste assessment guidelines written for the evaluation of other types of dumping projects; however, none of these evaluations transferred smoothly to OIF evaluation.¹⁷³ The waste assessment guides contained provisions that stood in direct opposition to permitting OIF projects at all.¹⁷⁴ One example of such a provision states, “If a waste is so poorly characterized that proper assessment cannot be made of its potential impacts on human health and the environment, that waste shall not be dumped.”¹⁷⁵ CPs could have easily construed this language as automatically invalidating any OIF proposal, as lack of scientific knowledge is pervasive in the field of OIF research.¹⁷⁶ The urgent need for an assessment framework tailored specifically for OIF manifested itself early on.¹⁷⁷

Through a variety of working groups, the CPs delved into the study of their newly acquired field of regulation and attempted to understand the science of OIF. They sought input from scientists who had researched OIF and other marine processes.¹⁷⁸ They called upon international organizations with expertise in marine and environmental studies to submit their recommendations on OIF issues.¹⁷⁹ An ad hoc committee of OIF experts from the International Oceanographic Commission (IOC) supplied an important report in 2008 about “large-scale” OIF.¹⁸⁰ The report encouraged the CPs to consider a broader array of factors for evaluating OIF proposals for legitimate scientific research, rather than ban projects based solely on scale.¹⁸¹ During 2009-2010, the CPs received a plethora of scientific reports on OIF, including the CBD’s “Scientific Synthesis on the Impacts of Ocean Fertilization” on Marine Biodiversity and a draft of UNESCO-IOC’s

note 148, at 2; Abate & Greenlee, *supra* note 7, at 579; Verlaan, *supra* note 126, at 456. The Working Group on Ocean Fertilization later clarified “contrary to the aims” of the LC/LP as any activity that is “likely to result in such deleterious effects as harm to living resources and marine ecosystems, hazards to human health, and harm to other legitimate uses of the ocean.” LC/SG 31/16, *supra* note 169.

170. LC-LP.1, *supra* note 148, at 1-2.

171. *Id.* at 2.

172. *Id.* at 2 n.4; Abate & Greenlee, *supra* note 7, at 580.

173. LC-LP.1, *supra* note 148, at 2 n.4. CPs were to consult “previous agreements of the Consultative Meetings/Meetings of Contracting Parties.” *Id.* This guidance was vague compared to other, specifically listed documents. *Id.*

174. See Abate & Greenlee, *supra* note 7, at 579, nn.145-49.

175. IMO, Annex 3 - Revised Guidelines for the Assessment of Wastes or Other Matter That May Be Considered for Dumping, ¶ 4.1, IMO Doc. 30/16 (Dec. 19, 2008).

176. See *supra* text accompanying notes 54-63.

177. See LC-LP.1, *supra* note 148.

178. See generally IMO, Ocean Fertilization: Sources of Information on Ocean Fertilization and Related Matters, Submitted by the U.K. to the Scientific Groups of the London Convention and London Protocol, Sess. 31/2, May 19-23, 2008, IMO Doc. LC/SG 31/INF.15 (Apr. 1, 2008).

179. IMO, Rep. of the 30th Consultative Meeting and the 3d Meeting of Contracting Parties, Oct. 27-31, 2008, ¶ 4.5, IMO Doc. LC 30/16 (Dec. 9, 2008).

180. See generally IOC Statement, *supra* note 57, Annex.

181. LC/SG 31/16, *supra* note 169, ¶ 2.28.2.

“Summary for Policymakers on Ocean Fertilization.”¹⁸² The LC/LP legal correspondence group has not yet agreed on the degree to which they will use these last two reports, although the new Assessment Framework reflects scientific information and concerns presented therein.¹⁸³

3. Options for Making OIF Regulation Legally Binding

The CPs also commissioned several legal working groups to study the legal correlation between provisions of the London Convention/London Protocol and OIF. The first legal working group stated in April 2008 that, although the LC/LP are “the most appropriate legal instruments to regulate [OIF],” the treaties would need textual amendments to bring OIF officially within their regulatory scope.¹⁸⁴ Drafts of the legally binding options and a new assessment framework began to materialize, leading the CPs to state that they were “on the right track” in satisfying the goals laid out in resolution LC-LP.1¹⁸⁵

A full discussion of the legally binding options is outside the scope of this paper; a brief examination will suffice.¹⁸⁶ The legal working groups reminded the CPs that they must consider every legally binding option in light of several “‘overarching’ issues.”¹⁸⁷ Most significantly, first, the CPs must remember that any placement of materials and any marine scientific research contrary to the aims of the LC/LP fall within the definition “dumping.”¹⁸⁸ Second, any changes that the CPs make to the LC/LP should interpret the language of the treaties as it currently stand, rather than place new requirements on CPs or expand the instruments’ scopes.¹⁸⁹ In March 2010, the CPs considered eight legally binding options to bring OIF officially within the purview of the LC/LP.¹⁹⁰ As of August 2010, the CPs were still considering Options 4-8.¹⁹¹ These options include an

182. SCIENTIFIC SYNTHESIS, *supra* note 80; IMO, Ocean Fertilization: Development of Science Overviews on Ocean Fertilization, Rep. of the Ocean Fertilization Correspondence Group to the Scientific Group of the London Convention and London Protocol, Extraordinary Sess., ¶ 4, Oct. 7-8, 2010, 1, IMO Doc. LC/SG/ES.2/1 (July 30, 2010) [hereinafter Development of Science]. See also *id.* ¶¶ 9, 10, Annex 2, Annex 3; IMO, *Ocean Fertilization: Exploration of Marine Geo-engineering*, submitted by the Chairman of the Scientific Groups to the 32d Sess. of the Contracting Parties of the London Convention & 5th Sess. of the Contracting Parties to the London Protocol, Oct. 11-15, 2010, Annex, 1, IMO Doc. LC 32/4 (July 28, 2010).

183. Development of Science, *supra* note 182, ¶ 2.

184. IMO, Ocean Fertilization: Interim Report of the Legal and Intersessional Correspondence Group on Ocean Fertilization to the Scientific Groups, submitted by the U.K. to the Scientific Groups of the London Convention and London Protocol, Sess. 31/2, May 19-23, 2008, IMO Doc. LC/SG 31/2/1 (Apr. 1, 2008).

185. Ocean Fertilization: Draft Assessment Framework for Scientific Research Involving Ocean Fertilization, in note by the Secretariat to the Scientific Groups of the London Convention and London Protocol, ¶ 7, IMO Doc. LC/SG 33/2 (Feb. 23, 2010); IMO, Rep. of the 32d Meeting of the Scientific Group of the London Convention and the 3d Meeting of the Scientific Group of the London Protocol, May 25-29, ¶¶ 2.6, 2.21, 2.24, 2.28, 2009, IMO Doc. LC/SG 32/15 (June 29, 2009) [hereinafter LC/SG 32/15].

186. For further information on the development of the legally binding options, see Rep. of the 1st Meeting of the LP Intersessional Legal and Related Issues Working Group on Ocean Fertilization, Feb. 11-13, 2009, IMO Doc. LP/COP 2/5 (Feb. 20, 2009).

187. IMO, Rep. of the 2d Meeting of the LP Intersessional Working Group on Ocean Fertilization, Mar. 1-5, 2010, ¶ 4.1, IMO Doc. LP CO2 3/7 (Mar. 19, 2010) [hereinafter 2d Meeting of the LP Intersessional Working Group].

188. *Id.* ¶¶ 4.1.1, 4.1.2, 4.1.3.

189. *Id.*

190. 2d Meeting of the LP Intersessional Working Group, *supra* note 187.

191. IMO, Ocean Fertilization: Development of Regulation on Ocean Fertilization, submitted by Canada to

interpretive resolution about OIF, various suggested amendments to Annex 1 of the LP, changes to the definitions of dumping and placement, and the addition of an article to the LP that specifically addresses OIF.¹⁹²

Once the CPs adopt one of these options to legally bind regulation of OIF under the LC/LP, the Assessment Framework on OIF will have legal effect on the CPs for evaluating future assessment of OIF proposals. Given the CPs momentum in working through the legally binding options before them, this paper will treat the Assessment Framework as though it will soon no longer be an optional tool, but a required method for assessing all OIF proposals brought before CPs.

IV. THE ASSESSMENT FRAMEWORK FOR SCIENTIFIC RESEARCH INVOLVING OCEAN FERTILIZATION

A. *Development of an Assessment Framework*

In February 2009, the Intersessional Technical Working Group on Ocean Fertilization, as well as Greenpeace and other NGOs, gathered for their first meeting on development of an assessment framework on OIF and to begin sorting out the issues related to it.¹⁹³ Significantly, the Working Group first resolved that all OIF projects that failed to qualify as legitimate scientific research automatically violated LC/LP dumping regulations.¹⁹⁴ Disagreement ensued about how strictly they should define “legitimate scientific research” and how to define the “competent body” that would eventually administer assessment framework evaluations, but they reached no conclusions on the matter.¹⁹⁵ The Working Group also had to decide on, among a host of other things, a glossary, a means for communicating the results of risk analyses, and the extent to which the governing bodies established by the CPs had to consult with countries that OIF experiments might affect the most.¹⁹⁶

Additionally, according to resolution LC-LP.1, the assessment framework also had to provide tools for CPs to examine OIF proposals on a case-by-case basis, each on its independent merits.¹⁹⁷ The attributes of individual OIF proposals could differ widely, thus each one carries its own set of potential risks.¹⁹⁸ The Working Group faced the difficulty of drafting practicable evaluation tests, all while balancing the need to make provisions broad enough for CPs to recognize all potential risks with the need to tailor their assessment to each individual proposal.¹⁹⁹

the Contracting Parties of the London Convention and London Protocol, ¶ 9, IMO Doc. LC 32/4/1 (Aug. 3, 2010). Canada proposed an additional option in August 2010 which would involve the creation of a “permitting authority for a limited category of placement” which would “expand the scope of the Protocol” to take into account resolution LC-LP.1 and avoid the need to change the longstanding dumping definition. *Id.* ¶ 12.

192. 2d Meeting of the LP Intersessional Working Group, *supra* note 189, ¶ 5.1

193. LC/SG 32/15, *supra* note 187, ¶ 2.28; Abate & Greenlee, *supra* note 7, at 580-81.

194. Strong et al., *Science, Policy, and Commerce*, *supra* note 39, at 255.

195. LC/SG 32/15, *supra* note 187, ¶ 2.21-2.22.

196. *Id.* ¶ 2.24.

197. Abate & Greenlee, *supra* note 7, at 581.

198. *Id.*

199. *Id.*

The Working Group eventually managed to reach a consensus on these issues.²⁰⁰ In October 2010, the London Convention and London Protocol issued resolution LC-LP.2 (2010) in which the CPs adopted the Assessment Framework for Scientific Research Involving Ocean Fertilization (Assessment Framework) and stated their intent for the Assessment Framework to meet the objectives of resolution LC-LP.1.²⁰¹ Resolution LC-LP.2 instructs the CPs to continue to use the “utmost caution” when using the Assessment Framework to evaluate whether OIF activities constitute legitimate scientific research.²⁰² The resolution states the LC/LP’s goal to “work towards providing a global, transparent, and effective control and regulatory mechanism for ocean fertilization activities,” echoing language found in the CBD’s Scientific Synthesis on OIF.²⁰³ The resolution also emphasized the importance of consistent application of the Assessment Framework among CPs.²⁰⁴ Finally, the resolution reaffirmed that OIF activities failing to qualify as legitimate scientific research under the Assessment Framework must fall within the definition of dumping and are thereby prohibited. After years of consultation between the LC/LP and other international organizations and hammering out legal principles, the newly completed Assessment Framework is the culmination of the London Convention and London Protocol’s work on ocean iron fertilization.

B. *Structure of the Assessment Framework*

The key players in the Assessment Framework include the applicants who submit an OIF proposal for consideration; the Contracting Parties to the LC/LP (CPs), a term that encompasses the governing body appointed by each CP to administer the Assessment Framework; and the ultimate decision-maker appointed by the government of the CP, who evaluates the completed Assessment Framework.²⁰⁵ The language of the Assessment Framework is permissive, as demonstrated by the pervasive use of the word “should,” indicating that CPs have considerable discretion in what to require of OIF proposals and, to a degree, how to administer the evaluation.²⁰⁶

The first step in the Assessment Framework evaluation is the Initial Assessment.²⁰⁷ Every proposal must meet the threshold of having “proper scientific attributes” that the applicant should submit to “scientific peer review,” with no implication of direct financial gain from the project.²⁰⁸ Next, CPs submit the proposal to

200. For more details on the development of the Assessment Framework, see IMO, Draft Ocean Fertilization Assessment Framework, submitted by the U.S. to the Scientific Groups of the London Convention and London Protocol, Sess. 33/4, Apr. 19-23, 2010, IMO Doc. LC/SG 33/2/2 (Feb. 12, 2010) [hereinafter LC/SG 33/2/2]; IMO, Rep. of the 1st Meeting of the Intersessional Technical Working Group on Ocean Fertilization, Feb. 9-13, 2009, IMO Doc. LC/SG-CO2 3/5 (Feb. 16, 2009).

201. LC-LP.2, *supra* note 83; Press Briefing, *supra* note 37; Güssow et al., *supra* note 158, at 14.

202. LC-LP.2, *supra* note 83.

203. *Id.* ¶ 5; SCIENTIFIC SYNTHESIS, *supra* note 80, at 5.

204. LC-LP.2, *supra* note 83.

205. Assessment Framework, *supra* note 83. For further discussion on the debate surrounding the term “Contracting Party” to denote the competent body for carrying out the Assessment Framework, see LC/SG 33/2/2, *supra* note 200, at 2.

206. Assessment Framework, *supra* note 83.

207. *Id.* at 1.3.1, 2.

208. *Id.* at 1.3.1, 2.2.1-2.2.4. To clarify, “[t]his should not preclude payment for services rendered in support

a rigorous review under the Environmental Assessment, which leads the CP in combing through vast amounts of technical, scientific information that proposals should provide.²⁰⁹ The section also acknowledges that, given the lack of scientific certainty in the field of OIF, “gaps and uncertainties” are likely to exist and applicants should identify them and explain how they plan to deal with them.²¹⁰ Under this section, applicants submit a Problem Formulation that goes into meticulous detail about attributes such as the location where the fertilization is to take place, a description of the iron substance intended for release, and the anticipated movement of the substance as it spreads throughout the waters.²¹¹

The largest subsection of the Environmental Assessment — Risk Characterization — evaluates the applicant’s Impact Hypothesis, which “provide[s] an estimate of the likelihood of adverse impacts and the magnitude of those impacts.”²¹² CPs use this information to evaluate the potential risks that the proposed OIF activity poses to every aspect of the ecosystem, such as effects on ocean waters due to new phytoplankton blooms, changes in the ocean water’s pH level, and increase in fish populations.²¹³ The applicant is responsible, should the CP require it, for determining a “baseline,” or the “state of the ecosystem” as it exists prior to receiving the fertilization.²¹⁴ The purpose of the baseline is to allow for easier monitoring of changes caused by the OIF activity, though such a baseline is difficult to establish due to the ever-fluctuating nature of the ocean.²¹⁵

Once the CPs have gathered this information, they are to plug it into some form of “logic framework” to determine the level of magnitude and degree of likelihood of each individual risk.²¹⁶ They then must take the aggregate of those individual risk levels to determine an “overall description of risk” for the entire proposed OIF project.²¹⁷ Each CP may use the logic framework suggested in the Assessment Framework or choose its preferred logic framework methodology to arrive at this overall risk determination.²¹⁸ CPs must also address any uncertainties within the project that limit the accuracy of risk conclusions once potential unknown factors are added in.²¹⁹

Three final sections wrap up the Assessment Framework. The Risk Management section contains precautionary preventive strategies and contingency plans to minimize the environmental impact of the OIF project.²²⁰ The Decision Making section discusses, foreseeably, that CPs should disallow OIF projects deemed unacceptably risky and allow

of the experiment or future financial impacts of patented technology.” *Id.* at 2.2.2.

209. *Id.* at 3.1, 3.2, 3.3, 3.4.

210. *See, e.g.*, Assessment Framework, *supra* note 83, at 3.1.3.2.

211. *Id.* at 3.1.2.

212. *Id.* at 3.5.1.

213. Assessment Framework, *supra* note 83, at 3.5.2.

214. *Id.* at 3.5.5. The applicant may gather data from existing scientific literature or “targeted surveys.” *Id.* at 3.5.7.

215. *See* SCIENTIFIC SYNTHESIS, *supra* note 80, at 50.

216. Assessment Framework, *supra* note 83, at 3.5.12.

217. *Id.* at 3.5.12.

218. *Id.* at 3.5.12.1.

219. *Id.* at 3.5.13.

220. *Id.* at 3.6.1, 3.6.5.

only those projects that they deem legitimate scientific research.²²¹ Finally, the Results of Monitoring section encourages the communication of results from applying the Assessment Framework, as well as the outcomes of OIF experiments.²²² Importantly, this section gives CPs the right to modify or revoke authorization of OIF activities at any time, which implies that all permits issued, even after satisfying the Assessment Framework, remain provisional.²²³

C. Concerns with the Assessment Framework

1. Potential for Inconsistent Application

Resolution LC-LP.2 expressed the need for consistent application of the Assessment Framework.²²⁴ However, with so few OIF experiments completed to date and little to no precedent to compare to new proposals, every time a CP uses the Assessment Framework to evaluate an OIF project, it will constitute a sort of *de novo* review.²²⁵ Precedents for evaluation will likely be a long time in coming because CPs will apply the Assessment Framework on a case-by-case basis to potentially widely differing proposals.²²⁶ This lack of precedent may lead to inconsistent application of the Assessment Framework, despite the desire expressed in LC-LP.2 for consistent application.²²⁷

Given its permissive language allowing individual CPs significant discretion in, for example, determining what they require in proposals and establishing their own logic framework for risk assessment, evaluation under the Assessment Framework could lead to polar opposite decisions among CPs about what constitutes legitimate scientific research.²²⁸ Considering the differing views taken by the two German ministries who evaluated the LOHAFEX proposal, it does not stretch the imagination to foresee similar inconsistent application.²²⁹

Some have suggested that an international organization assist in the OIF project evaluations using the Assessment Framework, as certain nations may have limited capacity to implement it effectively.²³⁰ It seems that the LC/LP could easily dispatch a team of experts to bolster the CPs' scientific understanding of OIF and assist in assessing the technical aspects of the proposals. Additionally, resolution LC-LP.2 itself emphasizes the importance of consultation among CPs using the Assessment Framework and that sharing the results of its application would "facilitate consistency in its application."²³¹ It

221. Assessment Framework, *supra* note 83, at 4.3.

222. *Id.* at 5.1, 5.2.

223. *Id.* at 5.3.

224. LC-LP.2, *supra* note 83, ¶ 4.

225. Abate & Greenlee, *supra* note 7, at 563.

226. LC-LP.2, *supra* note 83.

227. *Id.*

228. See Assessment Framework, *supra* note 83, ¶¶ 2.2, 3.5.12.1.

229. Abate & Greenlee, *supra* note 7, at 557-58.

230. IMO, *Ocean Fertilization: Mitigating Environmental Impacts of Future Scientific Research*, submitted by Canada to the Scientific Groups of the London Convention and London Protocol, Extraordinary Sess., Oct. 7-8, 2010, 2, IMO Doc. LC/SG/ES.INF.4 (July 30, 2010).

231. LC-LP.2, *supra* note 83.

is up to the CPs to follow this suggestion in order for such communication to achieve this goal. It seems reasonable for the LC-LP to require such reporting among its CPs. The team of experts dispatched to assist with the project evaluations could aid the CPs by performing a reporting function during and after the Assessment Framework evaluation and after the completion of the experiment.

2. Risk of Manipulation of the Information

Applicants know the pervasive uncertainty of the effects of OIF projects; they also know that the less risky their proposals appear, the more likely they are to gain approval. Though one could legitimately assume that the majority of OIF applicants will submit proposals with the best of intentions, there may be room in the Assessment Framework for manipulation of information by those who understand how to take advantage of uncertainties and the inexperience of the CPs who will appraise their proposals. For example, the Assessment Framework states that applicants should provide information about the proposed region where they will place the iron, predictions of how much the iron will spread, and finally, a predicted region of impact.²³² Due to natural fluctuation of conditions that applicants cannot control, it may be difficult for them to make accurate predictions.²³³ It may be possible for applicants to underestimate purposely their areas of impact to make their proposal seem less risky; then, should the area of impact shift or grow larger than predicted, applicants could chalk up their incorrect prediction to uncontrollable circumstances. Applicants who have an eye toward performing OIF research with hopes of profiting from OIF at some point down the road may have incentive to manipulate the information at the end of their experiment by overstating the success of their results.²³⁴

The risk of manipulation increases due to the CPs' lack of experience with assessing OIF projects and, indeed, with OIF itself. The Assessment Framework encourages the use of "scientific peer review" and monitoring plans.²³⁵ Language that *required* such peer review of proposals and monitoring throughout the stages of the Assessment Framework would create stronger protection against manipulation of information.²³⁶ The LC/LP could assist by providing a team of observers to monitor the experiment, comparing the predictions to what actually happens, and to give researchers incentive not to exaggerate the results of their projects.²³⁷

3. Heavy Burden on Small-Scale Applicants

The Assessment Framework's purpose and design is to limit OIF activities to legitimate scientific research and to bar large-scale, commercial OIF. However, the massive amount of information that the Assessment Framework requests may prove too stringent and burdensome for qualified scientists of even the most legitimate OIF

232. Assessment Framework, *supra* note 83, at 3.2.4, Fig. 2.

233. Alsopp et al., *supra* note 45, at 7; Powell, *Lessons from Nature*, *supra* note 43, at 2-3.

234. Abate & Greenlee, *supra* note 7, at 595-96.

235. Assessment Framework, *supra* note 83, at 2.2.3, 3.6.6.

236. See Abate & Greenlee, *supra* note 7, at 594.

237. *Id.* at 595-96.

scientific research project.²³⁸ Members of the Working Group on Ocean Fertilization discussed setting a “threshold” under which small-scale projects would have a lower bar for satisfying the Assessment Framework; the assumption was that smaller-scale projects constitute a lower degree of risk, and therefore could be on a fast track assessment process.²³⁹ Members who opposed the threshold exception pointed out that small-scale projects will inherently need less documentation than larger projects and that applicants will naturally address “the key elements of the guidelines” “to a degree appropriate to the project.”²⁴⁰

Drafts of the Assessment Framework originally included language indicating that the Assessment Framework could strike some sort of balance between the level of risk of an OIF activity and level of effort required for its evaluation.²⁴¹ However, given the limited amount of knowledge about OIF, and the fact that small-scale does not necessarily equate with low-risk, the Working Group cut that language from the final Assessment Framework.²⁴² Despite the decision to leave out such language in the initial Assessment Framework, the CPs have asked the Scientific Groups to provide guidance at future meetings on the possibility of establishing such a threshold exception.²⁴³

D. Does the Assessment Framework meet the objectives of resolution LC-LP.1 (2008)?

Two of the primary objectives stated in resolution LC-LP.1 were the limitation of OIF activities to legitimate scientific research and the development of an assessment framework to aid in determining whether an OIF proposal compliments or contravenes the aims of the London Convention and London Protocol.²⁴⁴ The Assessment Framework is a substantial achievement in satisfying both objectives.

Resolution LC-LP.1 marked the emergence of the legitimate scientific research doctrine for OIF projects. The Assessment Framework provides CPs with the means for defining what OIF activities qualify as such research. No doubt the definition is a lengthy one, but the nature of OIF necessitates flexibility with so many possible permutations of factors from proposal to proposal. Resolution LC-LP.1 acknowledges this need where it states that the legitimacy of the scientific research “should be defined as those proposals that have been assessed and found acceptable under the assessment framework” on a case-by-case basis.²⁴⁵ Hence, CPs need multi-faceted, adjustable standards by which to define legitimate scientific OIF research. Despite its copious and meticulously detailed information requirements, the Assessment Framework remains accessible and supplies clearly delineated steps for applicants to follow in developing their proposals and for CPs

238. Güssow et al., *supra* note 158, at 14.

239. IMO, *Draft Assessment Framework for Scientific Research Involving Ocean Fertilization*, submitted by the Chairman of the Correspondence Group to the Scientific Groups of the London Convention and London Protocol, Extraordinary Sess., Oct. 7-8, 2010, ¶ 6, IMO Doc. LC/SG/ES.2 (July 30, 2010) [hereinafter LC/SG/ES.2]

240. *Id.* ¶ 7.

241. *Id.* at Annex 1, 2; Annex 2, 2.

242. *Id.* ¶ 7.

243. *Id.* ¶ 11.2.

244. LC-LP.1, *supra* note 148.

245. *Id.*

to follow in crafting case-specific definitions of legitimate scientific research.

In its call for an OIF assessment framework, resolution LC-LP.1 states the importance of “tools for determining whether the proposed activity is contrary to the aims” of the LC/LP.²⁴⁶ For London Convention members, the Assessment Framework provides guidelines for controlling OIF as a potential source of marine pollution by making sure the projects that go forward qualify as legitimate scientific research.²⁴⁷ By serving as a bar to large-scale, commercial OIF projects, which pose the greatest threat of deleterious effects and, thus, of marine pollution, the Assessment Framework assists London Convention members in preventing pollution that occurs from dumping wastes.²⁴⁸ Members of the London Protocol must meet the somewhat stricter requirement to “prevent, reduce and where practicable eliminate pollution by dumping.”²⁴⁹ The Assessment Framework helps Protocol members in meeting this objective. Theoretically, by following these guidelines, absolutely no OIF project that would result in pollution would receive permission to take place. Extensive though the provisions may be, if CPs pay proper attention to the details, it would be difficult for an OIF project that fails to meet the requirements of legitimate scientific research to slip through the cracks. When CPs of both the London Convention and London Protocol put forth the effort to effectively use all that the Assessment Framework offers for OIF project evaluation, they will take affirmative steps toward the LC/LP’s objectives of promoting the protection of the oceans.²⁵⁰

E. Does the Assessment Framework meet the objectives of resolution LC-LP.2 (2010)?

In resolution LC-LP.2, the CPs emphasized their commitment to continued work “towards providing a global, transparent, and effective control and regulatory mechanism for ocean fertilization activities”²⁵¹ This phrasing echoes language stated by the CBD; the LC-LP also acknowledged this aim in resolution LC-LP.1.²⁵² This linguistic parallel may indicate an attempt among international organizations to harmonize their stances on OIF, so it is important for OIF regulation under the LC/LP to work toward meeting these standards.

At first glance, the LC/LP does not have truly global reach as it only legally binds States who are party to it.²⁵³ However, between the two of them, the London Convention and London Protocol bind 125 nations, including some that are most likely to receive OIF proposals, such as Australia, U.K., U.S., and nations within the E.U.²⁵⁴ Moreover, since the Assessment Framework provides an accessible, clearly delineated evaluation

246. *Id.*

247. London Convention, *supra* note 146, at art. 1.

248. *Id.*

249. London Protocol, *supra* note 146, at art. 2.

250. *Id.*

251. LC-LP.2, *supra* note 83.

252. SCIENTIFIC SYNTHESIS, *supra* note 80, at 5; Convention on Biological Diversity, COP 10 draft Decision 10.L36, *supra* note 125; LC-LP.1, *supra* note 148.

253. Freestone & Rayfuse, *supra* note 94, at 230.

254. London Convention and Protocol, IMO, <http://www.imo.org/OurWork/Environment/SpecialProgrammesAndInitiatives/Pages/London-Convention-and-Protocol.aspx> (last visited Oct. 15, 2010); IMO, Status of the London Convention and Protocol, Sess. 30/3, Oct. 27-30, 2008, IMO Doc. 30/2 (Oct. 2, 2008).

process, it is likely to gain credibility among nations who are not party to the LC/LP as a basic format for OIF evaluation. Finally, the Assessment Framework is likely to eventually set international norms and standards that will lead to consistent governance of OIF globally.²⁵⁵

By directly addressing the pervasive uncertainties inherent in OIF experiments, the Assessment Framework contributes to the level of transparency needed to regulate OIF. LOHAFEX researchers merely made vague claims of compliance with international law; with no framework to assess LOHAFEX's statements more thoroughly, the German government decided that these claims sufficed.²⁵⁶ The Assessment Framework, however, promotes full disclosure of the uncertainties, assumptions, and gaps in data in OIF proposals, providing the sort of transparency needed to determine whether an OIF project is, in fact, legitimate scientific research.²⁵⁷

The effectiveness of the Assessment Framework will be easier to determine once it has seen some action. It certainly provides a means for meticulous evaluation of OIF proposals. However, certain conclusions of the CBD's Scientific Synthesis on OIF could cast doubt on the effectiveness of several Assessment Framework provisions.²⁵⁸

First, Scientific Synthesis cites the difficulty of establishing "baselines against which any short- or long-term changes and impacts resulting from [OIF] activities could be measured or monitored."²⁵⁹ The Assessment Framework intends for applicants to describe this kind of baseline in their Impact Hypothesis and then devotes an entire section to predicting such short- and long-term effects assessments.²⁶⁰ The Assessment Framework also asks applicants to "discuss the implications of limited knowledge" of baseline conditions in relation to their experiment, but they may not concretely know, or even have the capacity to know, what those implications might be.²⁶¹ This lack of information limits the effectiveness of these provisions, though their effectiveness may increase concurrently once CPs begin compiling results of OIF experiments.

Lack of scientific knowledge in OIF similarly limits the effectiveness of other Assessment Framework provisions. The Scientific Synthesis points out that "the impact on biological processes and marine biodiversity is . . . difficult to forecast," yet the Assessment Framework requests applicants predict them in their Impact Hypothesis.²⁶² The "extent and duration of the impact caused by [OIF] . . . can only be estimated," yet OIF proposals are judged for riskiness based on these very factors.²⁶³

While these conclusions point out inherent weaknesses in certain Assessment

255. See Victor, *supra* note 18, at 3.

256. Abate & Greenlee, *supra* note 7, at 586.

257. Assessment Framework, *supra* note 83, at 3.5.13.

258. SCIENTIFIC SYNTHESIS, *supra* note 80, at 50-51. Although the LC/LP is still considering how it will use the CBD's study, given the LC/LP's acknowledgement of the CBD's views on OIF, the Scientific Synthesis is likely to influence the continued development of regulation. Development of Science, *supra* note 182, at 2. See also LC-LP.1, *supra* note 148; LC-LP.2, *supra* note 83 (citing language echoed in the Scientific Synthesis of "global, transparent, and effective" regulation of OIF.)

259. See SCIENTIFIC SYNTHESIS, *supra* note 80, at 50.

260. Assessment Framework, *supra* note 83, at 3.4.

261. *Id.* at 3.3.

262. *Id.* at 3.4. See SCIENTIFIC SYNTHESIS, *supra* note 80, at 50.

263. *Id.* at 3.5.9. See SCIENTIFIC SYNTHESIS, *supra* note 80, at 50-51.

Framework provisions, they also indicate that the provisions' effectiveness will likely strengthen as the CPs allow legitimate scientific OIF research projects to proceed. As the scientific knowledge base grows, applicants will be able to provide increasingly accurate predictions about what will happen during OIF experiments and the resulting effects. The key is for CPs to recognize the limitations placed on applicants by a lack of scientific knowledge about OIF and to make their decisions in light of what applicants have the reasonable capacity to know. It would be extremely problematic if CPs disapproved of OIF projects because they viewed the applicants' inability to make solid predictions as a failure to meet the Assessment Framework's provisions. If that happened, then the Assessment Framework's own provisions would destroy its objectives by prohibiting legitimate scientific OIF research. However, if CPs recognize these limitations, place realistic expectations on applicants, and allow legitimate scientific research OIF projects to proceed, despite uncertainties, then the Assessment Framework will effectively satisfy OIF regulation objectives.

F. The Effect of the Assessment Framework on OIF as a Geoengineering Strategy

Although OIF is not currently a valid geoengineering strategy, no one has come remotely close to conclusively disproving its potential to combat climate change. On the one hand, the LC/LP's Assessment Framework has brought OIF under its protection in the context of legitimate scientific research, thereby protecting its potential as a future geoengineering technique. On the other hand, the same legal instrument has presently relegated OIF as a geoengineering method to the backburner.

Critics of OIF as a geoengineering method should find the Assessment Framework a satisfactory step toward controlling OIF by limiting its operation to legitimate scientific research. In its recent call for a ban on geoengineering, the CBD appeared to demonstrate trust in the LC/LP's work on OIF regulation, which seemed to save OIF from getting lumped in with the other banned geoengineering activities.²⁶⁴ The LC/LP's regulation through the Assessment Framework has served to legitimize OIF as a field of research by separating it from the context of geoengineering. While simultaneously legitimizing OIF research, the regulation has stigmatized OIF as a geoengineering method for the present. Resolution LC-LP.1 affirmed the LC/LP's concern with the large-scale ocean fertilization generally associated with geoengineering.²⁶⁵ The Assessment Framework does not specifically disallow large-scale OIF, but it does ask CPs to consider scale in their decision, noting that, "[i]n general, risk increases with . . . the size of the area over which [OIF] occurs."²⁶⁶ In addition, by stating that "[t]here should not be any financial and/or economic gain arising directly from the experiment or its outcomes" the Assessment Framework is likely to block the kind of large-scale commercial projects with a view toward carbon trading that raised concern among opponents to OIF.²⁶⁷

264. Eilperin, *supra* note 35.

265. *Id.*; LC-LP.1, *supra* note 148.

266. Assessment Framework, *supra* note 83, at 3.5.14.

267. *Id.* at 2.2.2. Earlier drafts of the Assessment Framework used more direct language against commercial OIF, stating, "[T]here is no scientific basis for pursuing ocean fertilization activities with the expectation that carbon credits, deferments, or offsets could be issued . . . Thus, there should be no direct financial gain for either carbon sequestration or fisheries enhancement for the organization responsible for the experiment . . . it

Stigmatization or not, no one can see the future of OIF's development. Although the LC/LP regulations block OIF as a geoengineering method now, they also keep the possibility of OIF as future geoengineering strategy alive by allowing continued research. The door is open for unanticipated results from some future legitimate scientific OIF research experiment that could change the game for OIF as a method geoengineering. Given its potential to affect the entire global population, one geoengineering skeptic stated, "geoengineering proposals should receive detailed, precautionary scrutiny" under "sophisticated legal instruments and implementation systems."²⁶⁸ Should OIF become a valid geoengineering method, the Assessment Framework foreshadows the likelihood of effective international regulation of the activity. Not only will its provisions help establish international norms for conducting OIF experiments now, but the international bodies that would seek to control OIF as a geoengineering method would not have to start from scratch in developing adequate regulations.

The LC/LP stated their intent to continue refining the Assessment Framework, both at the next scheduled meeting in Montreal, Canada in June 2011 and as they learn of developments in the science of OIF.²⁶⁹ Given its commitment to learning about all aspects of ocean iron fertilization, should OIF eventually show true potential for geoengineering without the associated risks, the LC/LP will certainly reconsider its regulations.

V. CONCLUSION

The London Convention and London Protocol have taken substantial and commendable steps toward international regulation of ocean iron fertilization. As the LC/LP decide on a legally binding option to bring OIF officially within their scope, the new Assessment Framework will give effect to their objective of limiting OIF to legitimate scientific research. The Assessment Framework thoroughly covers all the bases of inquiry into OIF research. Although the general lack of knowledge surrounding OIF limits the full effectiveness of some of its provisions, it would appear that their effectiveness will strengthen as Contracting Parties use the Assessment Framework to permit legitimate scientific research. Although the LC/LP's reach is limited to its own Contracting Parties, it is likely to establish international norms and standards for the regulation of OIF. The move toward global, transparent, and effective international OIF regulation is progressing steadily, with the London Convention and London Protocol standing competently at the helm.

-Melissa Eick

should preclude activities such as sale of carbon credits from the experiment." LC/SG/ES.2, *supra* note 239, at Annex 1, 8.

268. Verlaan, *supra* note 126, at 446-47.

269. Press Briefing, *supra* note 37.