OCEAN FERTILISATION — WHAT NEXT?

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Geo-engineering has sustained renewed interest over the past number of years and raises interesting questions for international law, due to the global scale of the effects of both climate change and potential interventions, such as ocean fertilisation. There is justifiable concern that ocean fertilisation, for the purpose of climate change mitigation, risks undermining marine protection. Ocean fertilisation activity is currently limited, through resolutions under the Convention for Biological Diversity and the London Convention and recent amendments of the London Protocol, to small-scale scientific research studies within coastal waters. This article seeks to respond to the question of ‘what next?’ for international regulation of ocean fertilisation, including an examination of how a recent agreement to amend the London Protocol may be implemented in domestic law, as well as how carbon markets might work to ensure the effectiveness of ocean fertilisation activities. The article first provides an overview of the risks, effectiveness and costs of ocean fertilisation, as well as a glance at the two key trials undertaken. The article then provides an analysis of relevant current instruments and a discussion of the key issues that are of contemporary concern for the future of international and domestic regulation of ocean fertilisation, including the October 2013 amendments to the London Protocol.

I. INTRODUCTION

The Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) entertains a broad range of climate change mitigation measures across a range of sectors. While geo-engineering — ‘intentional modification of the Earth’s climate at the large scale’ — is very likely to be technologically possible, the technology is barely formed and there is no single geo-engineering approach that currently meets the basic criteria for effectiveness, affordability, and environmental impacts.

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3 The Royal Society, Geo-engineering the Climate: Science, governance and uncertainty, (RS Policy Document 10/09, The Royal Society, September 2009), ix; Secretariat of the Convention on Biological Diversity, Geo-engineering in Relation to the Convention on Biological Diversity: Technical and Regulatory Matters,
Geo-engineering is not a new idea — ideas for weather modification date at least as far back as the 1830s — but it has generated renewed interest over the past number of years.\(^4\) Geo-engineering raises interesting questions for international law, due to the global scale of the effects of both climate change and potential geo-engineering interventions.

The term ‘ocean fertilisation’ refers to any activity undertaken by humans — since it is firstly a natural phenomenon\(^5\) — with the principal intention of stimulating primary productivity in the oceans. As a climate change mitigation measure, its purpose is to boost the capacity of oceans to absorb atmospheric carbon dioxide. The IPCC Working Group III reached a ‘medium level of agreement’ that ocean fertilisation is “speculative and unproven, and with the risk of unknown side-effects”.\(^6\) Understandably then, the current focus for international law is on how to regulate scientific research activities.

Ocean fertilisation is one of the most advanced geo-engineering methods, in terms of both its scientific and regulatory advancement, to date. International cooperation on the issue has intensified since the ‘LOHAFEX’ experiment in 2009.\(^7\) While significant progress has been made since then under a number of international instruments to develop an adequate regime, the lack of a clear overarching framework continues to both occupy many international fora with resultant regulatory uncertainty for proponents seeking to undertake further research.\(^8\)

There is justifiable concern that ocean fertilisation, for the purpose of climate change mitigation, risks undermining marine protection. It therefore makes sense that existing international instruments for marine protection form the ‘prohibitive’ backbone of ocean fertilisation regulation, while climate change instruments provide a complementary ‘facilitative’ regulatory role. Both of these elements are discussed in this article.

This article seeks to respond to the question of ‘what’s next?’ for international regulation of ocean fertilisation. Section II provides an overview of the risks, effectiveness and costs of ocean fertilisation, as well as a glance at the two key trials already undertaken. Section III

\(^4\) The Royal Society, above n 3, 4; see also Edward Parson and Lia Ernst, ‘International Governance of Climate Engineering’ [2005] UCLA Public Law & Legal Theory Series, 5 <http://escholarship.org/uc/item/73k076p3>. This article will focus on peaceful uses of geo-engineering, with hostile uses governed under the Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques, opened for signature 18 May 1977, 1108 UNTS 151 (entered into force 5 October 1978). Prohibited items are provided in an Annex, although nutrients like iron, phosphate or nitrogen are not listed. Article III states that “The provisions of this Convention shall not hinder the use of environmental modification techniques for peaceful purposes”.


\(^7\) See Section II E (2) of this article for more detail.

\(^8\) See, eg, Kirsty Kuo, ‘Geoengineering trial cancelled: more regulation needed’, The Conversation (online), 19 June 2012 <www.theconversation.edu.au>.
serves as an analysis of relevant current instruments. Finally, Section IV provides discussion of the key issues that are of contemporary concern for the future of ocean fertilisation regulation at the domestic and international level.

II. RISKS, EFFECTIVENESS AND COSTS

A Definition of Activity

Ocean fertilisation can be most relevantly defined as “any activity undertaken by humans with the principal intention of stimulating primary productivity in the oceans”.9 In other words, it is changing “the ocean’s biological pump”.10 This article uses as its basis the activity of ‘direct ocean fertilisation’, namely the addition of ‘limiting’ nutrients into the ocean from external (non-marine) sources. However, much of the analysis may also be applicable to other similar methods such as ocean alkalization (changing ‘the ocean’s chemistry’), or ‘upwelling modification’, which uses physical means to raise nutrient-rich deep water to the surface, mimicking a natural oceanographic phenomenon.11

The addition of nutrients induces phytoplankton activity and algal growth, which absorbs atmospheric carbon dioxide and ‘permanently’ removes it once the dead algae sink to the bottom of the ocean. Removal of carbon dioxide from the atmosphere is accelerated, and its return to the atmosphere is delayed, since it is transported to depths from which it is unlikely to re-enter the atmosphere as a gas for at least a century.12

Ocean fertilisation may also be used for the primary purpose of increasing fish populations in nutrient-poor areas of the ocean, in which case it is more likely to be carried out in coastal waters.13


11 The work done under the London Convention and the London Protocol outlines three operational scenarios: addition of iron (a micro-nutrient); addition of nitrogen or phosphorus compounds, such as urea, ammonia or phosphate (macro-nutrients), which require significantly larger amounts than iron (e.g. 1000 times more), and are promoted primarily as a means of increasing fisheries production, but with some climate mitigation benefit; and upwelling modification. On the Assessment Framework for Scientific Research Involving Ocean Fertilisation, Resolution LC-LP 2 (2010) (the thirty-second consultative meeting of the contracting parties to the London Convention and the fifth meeting of the contracting parties to the London Protocol) 21.


B Risks

1 Transboundary Ecological Impacts

Ocean fertilisation has the potential to have widespread, long-lasting, and severe impacts on the marine environment, with implications for human health.\(^\text{14}\) The risks include changes in biological diversity and possible damage to marine ecosystems; changes in dominant phytoplankton species; eutrophication (i.e. growth of unexpected and potentially harmful algal blooms); the creation of anoxic areas, or dead zones, in the ocean; the formation of toxic materials; decreasing fish stocks due to nutrient depletion; and the creation and release of greenhouse gases such as nitrous oxide.\(^\text{15}\) These impacts are not confined to any one national jurisdiction, such that activities occurring in one jurisdiction can result in impacts in another, or impacts in one jurisdiction can be transported to another.

2 Social and Geopolitical Impacts

There are significant geopolitical risks associated with geo-engineering.\(^\text{16}\) To take solar radiation management as an example, there are reports of trials being conducted by researchers from developed countries in developing countries without adequate informed consent of the affected population.\(^\text{17}\) The Canadian trial, discussed in Section E (1) of this paper, involved funding from an indigenous group based on a failed promise of revenue from carbon credits. The Solar Radiation Management Governance Institute (SRMGI) also points out that as a response to climate change, geo-engineering may be rejected as unacceptable for the populations of developing countries who played little role in creating the problem or endorsing the response.\(^\text{18}\) There may also be social implications for coastal fishing industries and the livelihood of those who live in adjacent areas.\(^\text{19}\)

C Effectiveness

1 Stimulating Primary Activity

The theory of ocean fertilisation is based on the fact that certain areas of the oceans are missing specific nutrients.\(^\text{20}\) That is, the nutrient first needs to be established as a limiting factor to phytoplankton growth in the area. For example, for the ‘OSPAR region’ (the North-East


\(\text{18}\) Ibid.

\(\text{19}\) Mayo-Ramsay, above n 13, 832.

Atlantic), there is no evidence to suggest that this is the case. Where it is a limiting factor, it is unequivocally clear that its addition leads to enhanced photosynthetic activity.

2 Extent of Carbon Sequestration

The extent of carbon export and sequestration is hard to measure and the observed results vary greatly. Effectiveness may depend on a number of factors, including initial ocean conditions before iron addition, such as initial abundance of phytoplankton and its major taxonomic groups and size classes, micro- and mesozooplankton; water column stratification; and temperature. Almost as important a factor is the variation in weather conditions after addition, which influences light availability, making the outcomes of commercial scale activities “as unpredictable as the weather”.

3 Mitigating Climate Change

With regard to the effectiveness of ocean fertilisation towards the objective of mitigating climate change, some argue that considering such approaches reduces incentive to address the root cause of increasing greenhouse gas emissions. Scientists hold the hope that about 3% of the current annual global CO₂ emissions could be stored using ocean fertilisation. The current global emission rate (including deforestation) is approximately 10 Gt C/yr, and the natural uptake from the terrestrial biosphere is approximately 2.6 Gt C/yr. To have a positive impact, one or more geo-engineering interventions would need to remove from the atmosphere several Gt C/yr, maintained over decades and more probably centuries, such that geo-engineering is generally seen unlikely to be feasible at the scale needed to address the challenge, or at the speed needed if there was ever a need for ‘emergency action’ to cool the planet.

For these reasons, the verification and accountability standards under the Kyoto Protocol to the United Nations Framework Convention on Climate Change will be the ultimate test of the effectiveness of ocean fertilisation. This is further discussed in Sections III A and IV C.

D Cost

23 Ibid.
25 Ibid.
28 CBD Technical Series No 66, above n 3, 29. I note that the figures provided in the CBD report are in Gigatonnes of ‘carbon’. It is not clear in the report whether this refers to carbon dioxide only, or ‘carbon dioxide equivalent’ taking into account all of the six types of greenhouse gases under the Kyoto Protocol. The preferred unit would be ‘carbon dioxide equivalent’, CO₂e/year.
29 Ibid; see also Greg Rau, Elizabeth McLeod, Ove Hoegh-Guldberg, ‘The need for new ocean conservation strategies in a high-carbon dioxide world’ (2012) 2(10) Nature Climate Change 722.; see also The Royal Society, above n 3, which, while concluding that Geo-engineering is not an alternative to reducing GHG emissions, suggests that it may be the only option to reduce temperatures quickly if needed in the short term.
Geo-engineering technologies are often seen as “fast, cheap, and imperfect”\textsuperscript{30}. Even when compared to more mainstream mitigation options, it is often said that the cost of geo-engineering systems appears to be “shockingly small”.\textsuperscript{31} However, with increasing knowledge of its effectiveness, it is reported that cost estimates undertaken in 2008 are approximately 8 to 40 times higher than cost estimates undertaken in 2001.\textsuperscript{32}

Ocean fertilisation proposals may have potential to generate revenue streams. There is potential to collect revenue from the fishing sector operating in the fertilised area, for example a specific licence could be required to fish within the area, although distinguishing between fish grown as a result of the scheme and ‘wild’ fish would be impossible.\textsuperscript{33} Another example is the generation and sale of carbon credits, though there are currently limitations in linking the activity to carbon markets. This is discussed in Section III B.

A criticism of current cost estimates could be made that they are too optimistic, because there is insufficient market experience to estimate costs reliably. Specifically, there is evidence to suggest that many of the cost estimates made to date focus too narrowly on the direct costs and therefore underestimate the true cost of the activity. For example, cost estimates should, but do not consistently, include monitoring and verification costs, and the cost of meeting future regulatory requirements.\textsuperscript{34} Further, remediation, rehabilitation or compensation costs due to potential negative unintended downstream impacts (e.g. to fisheries) are further complicated since they are difficult to predict and measure.\textsuperscript{35} In agreement with David G. Victor, it can be said that general claims of geo-engineering’s remarkable affordability are likely based on a simple assumption of “silver-bullet geo-engineering”.\textsuperscript{36}

\section*{E Trials}

This section provides an overview of two key trials undertaken in recent years.\textsuperscript{37}

\subsection*{1 Haida Salmon Restoration Corporation}

The most recent significant trial took place off the coast of western Canada in July 2012 and was widely reported in the media in October 2012.\textsuperscript{38} It is significant because it was undertaken

\begin{footnotesize}
\begin{enumerate}
\item Parson and Ernst, above n 4, 9, note: Parson and Ernst are speaking specifically of stratospheric methods, though the sentiment applies to geo-engineering, broadly.
\item Victor, above n 26, 326.
\item Bertram, above n 15, 7.
\item Mayo-Ramsay, above n 13, 832.
\item Bertram, above n 15, 7.
\item Ibid.
\item Victor, above n 26, 327.
\item Attempted trials include the Sulu Sea proposal within the EEZ of the Philippines, where it was proposed to have the coastal States enter into a joint venture agreement of all parties who have EEZ rights over the area to be fertilised; see Mayo-Ramsay, above n 13, 832; see also SRMGI, above n 17, 35.
\end{enumerate}
\end{footnotesize}
not long after key progress was made at the international level seeking to limit such activity.\textsuperscript{39} Undertaken by the Haida Salmon Restoration Corporation (initiated by a United States businessman and presided over by a local government Economic Development Officer), the trial — involving the introduction of 100 metric tonnes of iron sulfate — received financial support from a local indigenous group for the purpose of boosting the local salmon population, with the reportedly unfulfilled promise of returning revenue through sale of carbon credits.\textsuperscript{40}

The impact on the salmon population will not be known for at least two years due to migration patterns. The trial was undertaken without approval or assessment against the relevant Assessment Framework (see Section III E (3)) from Environment Canada, which dubbed the incident “a non-scientific event”.\textsuperscript{41} The incident prompted the International Maritime Organization (as the Secretariat for the London Convention and Protocol) to issue a ‘statement of concern’ in response to the trial, expressing grave concern and recognising the actions of the Government of Canada in investigating the incident.\textsuperscript{42}

2 LOHAFEX

Prior to the introduction of the Assessment Framework (see Section III E (3)), the most significant trial in terms of prompting international dialogue, called “LOHAFEX”, was conducted from January to March 2009 in the South Atlantic, involving 6 tonnes of iron sulfate. It was initiated by the German Federal Ministry of Research and carried out by the German Alfred Wegener Institute. Following the trial, even project leader Professor Smetacek conceded that ocean fertilisation would probably not be a suitable instrument to abate climate change in the southern polar ocean region.\textsuperscript{43}

It is noted that prior to the trial Germany had supported a Convention on Biological Diversity (CBD) decision to place a non-binding prohibition on all ocean fertilisation other than small scale scientific research studies in coastal waters (see Section III C). Due to the non-binding nature of the CBD decision, the implications of this are primarily political, although it is not clear whether the project characteristics met the criteria outlined in the CBD clause.\textsuperscript{44} Concerns were also noted regarding the adequacy of the environmental impact assessment undertaken.\textsuperscript{45} Having given consideration to both the scale and location of the project, Alexander Proellss’ opinion suggests that the project was acceptable under the CBD decision.\textsuperscript{46}

\section{III. Overview and Analysis of Current Instruments}

\textsuperscript{39} See Section III C and III E of this article.
\textsuperscript{40} Jeff Tollefson, above n 38.
\textsuperscript{41} Ibid.
\textsuperscript{42} International Maritime Organization, above n 14.
\textsuperscript{43} Ginzky, above n 20, 61.
\textsuperscript{45} CBD Technical Series No. 66, above n 3, 118.
\textsuperscript{46} Proellss, above n 45, 11; see also further discussion of these issues in Section IV B (1) of this article.
There is no one single treaty or institution addressing all aspects of ocean fertilisation, let alone geo-engineering. Beginning with a brief mention of relevant customary rules, this section will provide an overview and analysis of existing instruments being adapted in response to ocean fertilisation.

A Relevant Customary Law

1 State Responsibility and Prevention of Transboundary Harm

All states are under a general obligation to ensure that activities within their jurisdiction or control respect the environment of other states or of areas beyond national jurisdiction. The obligation has become customary international law, and a state in breach of this rule could be held responsible by other states under the customary rule of state responsibility. The obligation to prevent transboundary harm requires the state to exercise due diligence.

Further, article 194 of the United Nations Convention on the Law of the Sea (‘UNCLOS’) provides a broad obligation for states to cooperate in preventing pollution of the environment from “all sources”, using the best practicable means at their disposal and in accordance with their capabilities, and an obligation to take all measures necessary to prevent damage by pollution from activities under their jurisdiction or control. As such, a state cannot completely abdicate its responsibility for its environmental obligations merely because, for example, the activities are conducted by its legal or individual nationals on a foreign-flagged vessel.

2 Environmental Impact Assessment

There is general consensus that UNCLOS article 192, being a general obligation to protect and preserve the marine environment, is now customary international law, and that much of the rest of Part XII is as well. The duty to conduct an environmental assessment is included in a number of treaties, and is embedded in various forms in many national instruments. Recently,

49 International Law Commission, ‘Draft articles on prevention of transboundary harm from hazardous activities’, UN Doc. A/56/10, [98], Article 3 [8]. For a good overview of the requirements for attributing responsibility for transboundary harm, see CBD Technical Series No. 66, above n 3, 114-5.
51 Verlaan, above n 12, 449.
52 Ibid.
53 See, eg, CBD, art 14; see also Conference of the Parties, Convention on Biological Diversity, Report of the Seventh Meeting of the Conference of the Parties to the Convention on Biological Diversity, Held in Kuala Lumpur from 9 to 20 February and 27 February 2004, UNEP/CBD/COP/7/21 (13 April 2004) annex (‘Decisions Adopted by the Conference of the Parties to the Convention on Biological Diversity at its Seventh Meeting’) decision VII/16; Conference of the Parties, Convention on Biological Diversity, Report of the Eighth Meeting of the Conference of the Parties to the Convention on Biological Diversity, Held in Curitiba, Brazil, from 20 to 31 March 2006, UNEP/CBD/COP/8/31 (15 June 2006) annex (‘Decisions Adopted by the Conference of the Parties to the Convention on Biological Diversity at its Eighth Meeting’) decision VIII/28;
the International Court of Justice has recognized the ‘due diligence’ importance of environmental impact assessment when there is a risk of significant transboundary harm, and in particular, on a shared resource.54

3 Precautionary Principle

There are a number of treaties that include a formulation of the precautionary principle, with the United Nations Framework Convention on Climate Change (‘UNFCCC’) being the most broadly ratified one.55 Its legal status as customary international law, however, remains debated.56 When considering ocean fertilisation as a climate change mitigation measure that poses its own risks in addition to the risks of climate change impacts, the UNFCC formulation of the principle is relevant. Consistent with the direction of the UNFCC, a lack of full scientific certainty as to the impacts of ocean fertilisation should not be used as a reason for postponing the deployment of ocean fertilisation, at least on a scientific research scale, to mitigate climate change.

On the other hand, when considering ocean fertilisation in relation to protecting the marine environment, the most relevant source of the principle is arguably the London Protocol where general obligations under Article 3 of the Protocol might favour mitigation measures of which there may be more scientific certainty of effectiveness and impacts. Although there is limited scope in this article to explicitly explore the principle in detail, it is hoped that the discussion of ocean fertilisation from the perspective of both climate change mitigation and marine environment protection will indirectly shed some light on the application of the principle in this context.

4 Common but differentiated responsibilities

The idea of ‘common but differentiated responsibilities’ is part of principle 7 of the Rio Declaration on Environment and Development (Rio Declaration) and, most relevantly, in article 3 of the UNFCCC.57 Although there is little scope available here to explore it in detail, it is included to acknowledge the argument that those states who are both able to take the lead on climate change mitigation and possess robust marine protection regimes have an obligation to pursue innovative ocean-based responses to climate change.

B Kyoto Protocol – Ensuring effectiveness

Conference of the Parties, Convention on Biological Diversity, Report of the Tenth Meeting of the Conference of the Parties to the Convention on Biological Diversity, Held in Nagoya, Japan, from 18 to 29 October 2010, UNEP/CDB/COP/10/27a (20 January 2011) annex (‘Decisions Adopted by the Conference of the Parties to the Convention on Biological Diversity at its Tenth Meeting’) decision X/42; see also UNCLOS art 206.

56 CBD Technical Series No. 66, above n 3, 119.
57 Article 3 provides that Parties should protect the climate system for the benefit of present and future generations, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities, and that accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof.
Effective integration of ocean fertilisation activities into the regulated international ‘carbon market’ would ensure that large-scale activities are implemented to complement, rather than undermine, essential climate change mitigation actions that address emissions at the source. Establishment of a recognised methodology for the purpose of the market would provide a reassuring response to the governance and legitimacy concern regarding the conditions, if any, under which ocean fertilisation interventions are justified.

However, there is no current mechanism that recognises the potential contribution of ocean fertilisation activities to global emissions reduction efforts under the Kyoto Protocol to the UNFCCC. Although the definition of “sink” under UNFCCC Article 1 is broad enough to include oceans, the Kyoto Protocol does not include marine sinks or sources for the purpose of national inventories. Further, the Kyoto Protocol currently provides two other key mechanisms for projects undertaken in other countries, Joint Implementation (JI) and the Clean Development Mechanism (CDM), neither of which currently acknowledges ocean fertilisation as an emission reduction or emission removal project.

As far as is currently foreseeable, the currency of any carbon credits generated from ocean fertilisation is limited either to voluntary markets or domestic regulated markets, and even still faces the challenge of meeting some commercial standard of measurement, verification and reporting. These challenges are discussed in Section IV C.

**C Convention on Biological Diversity (CBD)**

Ocean fertilisation may cause, directly and indirectly, negative impacts on biological ecosystems and may therefore interfere with the objectives of the Convention on Biological Diversity (‘CBD’) for conservation of biological diversity and the sustainable use of its components. The CBD has nearly universal membership, representing the consensus of 193 parties. Even the United States of America, although not a Party to the CBD, is a signatory and therefore has an obligation under article 18 of the Vienna Convention on the Law of Treaties (‘Vienna Convention’) to not defeat the CBD’s object and purpose.

In May 2008, the ninth Conference of the Parties to the CBD adopted a decision on ocean fertilisation, as part of a larger decision on biodiversity and climate change (decision IX/16).

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59 Article 1 of the UNFCCC defines “sink” to mean any process, activity or mechanism which removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas from the atmosphere.
60 Kyoto Protocol, above n 59, art 3 [4]: “as to how, and which, additional human-induced activities related to changes in greenhouse gas emissions by sources and removals by sinks in the agricultural soils and the land-use change and forestry categories shall be added to, or subtracted from, the assigned amounts for Parties”.
62 CBD.
64 Conference of the Parties, Convention on Biological Diversity, Report of the Conference of the Parties to the Convention on Biological Diversity on the Work of its Ninth Meeting, Held in Bonn from 19 to 30 May 2008, UNEP/CBD/COP/9/29* (9 October 2008) annex (‘Decisions Adopted by the Conference of the Parties to the Convention on Biological Diversity at its Ninth Meeting’) decision ‘Decision IX/16, Section C Ocean Fertilisation see also Decisions Adopted by the Conference of the Parties to the Convention on Biological Diversity at its Tenth Meeting’ UN Doc UNEP/CBD/COP/10/27, annex Decision X/33.
Acknowledging the ongoing regulatory uncertainty and lack of adequate data to assess potential risks, the decision “requests Parties and urges other Governments, to ensure, in accordance with the precautionary approach, that ocean fertilisation activities do not take place until there is an adequate scientific basis on which to justify such activities”.

An exception is made for small-scale scientific research studies within coastal waters subject to thorough assessment and control. The decision specifies that such studies should not be used for generating and selling carbon offsets or any other commercial purposes.

While there are suggestions that the language of the decision may be viewed as “explicitly advisory” and “lacking legal force”, the decision indicates, as Harald Ginzky ultimately argues, that Contracting Parties at minimum entered into a strong political commitment to respect the decision. The broad membership of the CBD lends the commitment further weight and visibility.

In 2010, CBD decision X/33 called for studies on the possible impacts of geo-engineering techniques (broadly, not just ocean fertilisation) on biodiversity and associated social, economic and cultural considerations, and on gaps in the regulatory mechanisms for climate-related geo-engineering relevant to the CBD, noting that such mechanisms may not be best placed under the CBD. Most recently, consistent with the previous prohibition “until there is an adequate scientific basis on which to justify such activities”, Decision XI/20 emphasised that climate change should primarily be addressed by reducing anthropogenic emissions by sources and by increasing removals by sinks under the UNFCCC.

Further comment on the relationship between the CBD and the LC/LP is provided in Section E (4).


Although the relationship between the CBD and the United Nations Convention on the Law of the Sea (UNCLOS) may sometimes be quite complex, the two are complementary and mutually reinforcing when it comes to geo-engineering projects involving the marine environment. As Philomene Verlaan points out, despite UNCLOS’s status as the most powerful legally binding global instrument available for regulating ocean-related geo-engineering, it has not yet been applied or implemented to its full potential for marine environment protection in general, let alone for ocean-related geo-engineering projects in particular.
While the UN Secretary General’s annual reports on Oceans and the Law of the Sea in the General Assembly discuss the issue of ocean fertilisation:72 no decisions have been made to explicitly address ocean-based geo-engineering methods in UNCLOS. Nonetheless, such activities may be subject to the general provisions of the Convention, particularly provisions relating to protection and preservation of the marine environment (Part XII), and marine scientific research (Part XIII). UNCLOS art 1 para 5(b)(ii), defines ‘dumping’, which is prohibited under art 194, as excluding the “placement of matter for a purpose other than the mere disposal thereof, provided that such placement is not contrary to the aims of this Convention”.

Article 192 provides the general obligation of Part XII for states to protect and preserve the marine environment. UNCLOS contains no exception to this unqualified obligation.73 The obligation applies to areas within and beyond national jurisdiction.74 There is general consensus that art 192 is now customary international law, and that much of the rest of pt XII is as well, which means that, via art 18 of the Vienna Convention, non-parties to UNCLOS are also bound to comply.75

Other relevant provisions include the duty to minimise the release of toxic, harmful, or noxious substances into the marine environment (art 194); and the requirement to not transfer, directly or indirectly, damage or hazards from one area to another or transform one type of pollution into another (art 195).

Finally, pt XV provides a compulsory dispute resolution mechanism through the International Tribunal for the Law of the Sea.

E London Convention and London Protocol

The particular rules on which substances may or may not be dumped, and under what conditions, are binding on a smaller set of states party to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (‘London Convention’)76 or the 1996 Protocol to the Convention (‘London Protocol’).77 However, art 210(6) of UNCLOS is the foundation for regulation of dumping activities, and specifies that national laws and measures shall be ‘no less effective’ than the global rules and standards. The high number of signatories to the London Convention and Protocol, discussed as follows, could arguably suggest that the London Convention and Protocol may be considered as the global rules and standards that, via art 210(6) of UNCLOS, are more broadly applicable to all those that are party to UNCLOS.

72 Oceans and the law of the sea—Report of the Secretary-General, 68th sess, Agenda Item 76 (a), UN Doc A/68/71 (8 April 2013); see especially at [94].
73 Verlaan, above n 12, 449.
74 UNCLOS art 87 states that the freedom of the high seas is exercised under the conditions laid down by the Convention (including the obligation under art 192) and by other rules of international law.
75 Verlaan, above n 12, 449.
1 Overview of London Convention and London Protocol

Eighty-seven (87) states are party to the London Convention, and forty-four (44) are party to the Protocol.\textsuperscript{78} The Protocol was agreed in 1996 to further modernize the Convention and eventually replace it. The Protocol is said to be ‘a modern version’ of the Convention because it is founded on the precautionary principle.\textsuperscript{79} The Convention and Protocol apply to dumping ‘at sea’, which is defined as ‘all marine waters other than the internal waters of states’; that is, including territorial waters, the Exclusive Economic Zone (EEZ) and the high seas.

The work undertaken so far under the London Convention and the London Protocol (‘LC/LP’) represents the most advanced and detailed progress to date of international regulation of ocean fertilisation. While this advancement has been recognized as commendable, it has also been criticized for potentially undermining marine protection for the sake of climate change mitigation. For example, Verlaan warns that nowhere in the LC/LP are to be found exceptions to its marine environmental protection rules justified for climate change mitigation purposes; nor is such an exception to be found in the environmental protection architecture of UNCLOS, with which the LC/LP must remain compatible.\textsuperscript{80} This article contends that this is precisely the reason why the LC/LP framework is the most appropriate tool for regulating the impacts of ocean fertilisation — in that it provides a regulatory environment protection framework for broad prohibition of activities that pose some form of risk and then permits them under specified conditions and controlled circumstances.

The following sections outline the evolution of the LC/LP up to the recent amendments of the Protocol in October 2013. Section IV then discusses the potential implications of these amendments once they come into force.

2 Ocean fertilisation — ‘dumping’ or ‘placement’?

Article 4 para 1, of the Convention prohibits the dumping of wastes and other matter listed in Annex I of the Convention. For all other types of waste, prior permission is required. It is not clear whether nutrients like iron, phosphate or nitrate fall under the list in Annex I of the Convention.

Unlike the Convention, which provides a list of prohibited wastes, art 4 of the Protocol contains a general prohibition of dumping. Exemption to the prohibition is made for wastes that are listed in Annex 1 of the Protocol (a ‘reverse list’)\textsuperscript{81} that may be considered for dumping with consideration to be given to the objectives and general objectives of the Protocol in arts 2 and 3.\textsuperscript{82} Iron and other substances suitable for ocean fertilisation do not clearly fit in any of the permitted substances in Annex 1. The Protocol inherently sets out a narrower list of permissible wastes than the Convention, and, further to the requirements of the Convention, requires

\textsuperscript{78} International Maritime Organization, <http://www.imo.org/OurWork/Environment/LCLP/Pages/default.aspx> at 30 January 2013. According to article 23 of the Protocol, the Protocol supersedes the Convention for those Contracting Parties who are Contracting Parties for both.

\textsuperscript{79} Ginzy, above n 20, 63.

\textsuperscript{80} Verlaan, above n 12, 457.

\textsuperscript{81} For reference, the relevant clauses of Annex I of the London Protocol are provided as Appendix B of this article.

\textsuperscript{82} It is noted that Annex I of the London Protocol was amended in 2006 to include ‘carbon dioxide streams from carbon dioxide capture processes for sequestration’ among matter that may be considered for dumping.
application of the precautionary approach in its general obligations (art 3), resulting in a more stringent regime than the Convention.

The applicability of the Convention and Protocol to ocean geo-engineering was initially subject to legal debate, revolving largely around the distinction between the definitions of “dumping” and “placement”. Non-binding resolution LC-LP.1 (2008) provided agreement that the scope of both the London Convention and Protocol includes ocean fertilisation. It was agreed that in order to provide for legitimate scientific research, such research should be regarded as “placement of matter for a purpose other than the mere disposal thereof” which means that it is not considered dumping under art III.1(b)(ii) of the Convention and art 1.4.2.2 of the Protocol, provided that it is not contrary to the aims of the Convention or the Protocol respectively.

This means that scientific research proposals need to demonstrate they are not contrary to the aims of the Convention nor Protocol, while any ocean fertilisation undertaken for non-research purposes may still be interpreted as ‘dumping’ and would need to meet the criteria in Annex 1 of both the Convention and Protocol.

3 Assessment Framework

In response to this need, non-binding resolution LC-LP.2 (2010) adopted the ‘Assessment Framework for Scientific Research Involving Ocean Fertilisation’ (‘Assessment Framework’), as set out in an annex to the Resolution. The Assessment Framework is to be interpreted and applied in conformity with the relevant rules of international law, including UNCLOS. It was decided that, in accordance with para 4 of resolution LC-LP.1 (2008), scientific research proposals should be assessed on a case-by-case basis using the Assessment Framework “to determine, with utmost caution, whether a proposed activity constitutes legitimate scientific research that is not contrary to the aims of the Convention or Protocol”. The term ‘scientific research’ is further discussed in Section IV B of this article.

The ‘Initial Assessment’ to be undertaken under the Assessment Framework, which specifies criteria to determine whether the proposed activity has proper scientific attributes, specifies that economic interests should not influence the design, conduct and/or outcomes of the proposed activity, nor should there be any financial and/or economic gain arising directly from the experiment or its outcomes. This is consistent with CBD decision IX/16, which specifies that scientific studies should not be used for generating and selling carbon offsets or any other commercial purposes.

It is noted that the framework has been modelled after the ‘Risk Assessment and Management Framework for CO₂ Sequestration in Sub-seabed geological Structures’ (CS-SSGS), adopted

83 Verlaan, above n 12, 455; see also LC 30/4, 5.
in 2006. This is an indication that CCS is proving a useful forerunner to ocean fertilisation for navigating international regulatory development. This will be further discussed in Section IV C (2) of this article.

4 Relationship between the Convention, Protocol and CBD

According to CBD art 22, para 2, the Contracting Parties shall implement the CBD with respect to the marine environment consistently with the rights and obligations of States under the law of the sea. Following analysis by Ginzky, CBD decision IX/16 and the emerging LC/LP framework so far have the essential in common, in that only scientific research ocean fertilisation activities are permitted; all other activities are currently prohibited, and scientific research proposals have to be assessed for scientific legitimacy and environmental impact.

Specifically, further to Section III C, Decision X/29 of the CBD invited Parties to the CBD and other Governments to act in accordance with the resolution LC-LP.2 (2010) of the London Convention and Protocol, including the ocean fertilisation Assessment Framework. The CBD has a far broader membership than the smaller number of parties to the LC/LP, thus widening (though not mandating) the application of the LC/LP. It may be suggested that any indication from UNCLOS processes of endorsement of the LC/LP advancement could similarly enhance a broader application of the LC/LP resolution.

\[ F \] OSPAR

The Convention for the Protection of the Marine Environment of the North-East Atlantic (‘OSPAR Convention’) is a regional convention, with sixteen Parties including the EU, to protect the marine environment of the North-East Atlantic. A 2009 OSPAR report recommends focus on the management and regulation of new activities at sea such as marine renewables and to ensure that these activities do not have negative impacts on the marine environment. Further to this, there are two key developments under OSPAR that relate to the regulation of ocean fertilisation.

The first is an amendment to the OSPAR Convention adopted in 2007 to permit injection and storage of CO$_2$ in geological formations under the seabed, ensure its environmentally safe storage, prohibit storage in the water column and on the seabed, and adopt the OSPAR

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87 Ginzky, above n 20, 70.

88 Decision Adopted by the Conference of the Parties to the Convention on Biological Diversity at its Tenth Meeting, UN Doc UNEP/CBD/COP/10/27, annex Decision X/29(13)(e).

89 CBD Technical Series No. 66, above n 3, 203.


91 Christophersen et al, above n 21, 28.


93 OSPAR Decision 2007/2 on the Storage of Carbon Dioxide Streams in Geological Formations, Convention For The Protection Of The Marine Environment Of The North-East Atlantic, Annex 6 (Ref. §2.10c), Ostend, 25-
Guidelines for Risk Assessment and Management.\textsuperscript{94} Seven ratifications were reached on 23 June 2011, from seven countries with CCS demonstration projects, entering the amendments into force. This is another indication that CCS is likely to prove a useful forerunner to ocean fertilisation for the development of international regulatory standards.

The second OSPAR development is the adoption the ‘OSPAR Code of Conduct for Responsible Marine Research in the Deep Seas and High Seas of the OSPAR Maritime Area’, which could apply to marine geo-engineering research activities though it does not specifically address them.\textsuperscript{95}

\textit{G Summary of existing obligations}

In summary of the analysis of obligations as outlined in this previous section (being those in effect prior to the October 2013 amendments to the London Protocol that will be discussed in the following section), we are at a stage where the CBD prohibition, while far-reaching, is non-binding and application of the Assessment Framework remains non-binding even for Contracting Parties to the London Protocol. As such, any nation would be within its international legal rights to conduct ocean fertilisation scientific research in any sea and would be within its rights even to deploy it, so long as they were to meet their general UNCLOS obligations as applicable and avoid territorial intrusion and demonstrable hostile intent.\textsuperscript{96} However, as Edward Parson and Lia Ernst remind us, the absence of prohibition still leaves the option for states to exert political pressure to prevent or stop such activity, and invoke a number of broad legal principles (such as those outlined in Section III A).\textsuperscript{97}

On the other hand, keeping within the limitations of the current non-binding regime, a Contracting Party to the Protocol that is also Party to the CBD and UNCLOS would restrict activities to scientific research trials within ‘coastal waters’\textsuperscript{98} and ensure assessment of the proposal against the Assessment Framework.

The next section of this article explores a number of issues that are of importance for clarifying and strengthening this current regime.

\textbf{IV. \textit{Next Steps – Key Issues for Future Regulation}}


\textsuperscript{95} OSPAR Code of Conduct for Responsible Marine Research in the Deep Seas and High Seas of the OSPAR Maritime Area, Convention For The Protection Of The Marine Environment Of The North-East Atlantic, Annex 6 (Reference Number 2008-01).

\textsuperscript{96} Parson and Ernst, above n 4, 15.

\textsuperscript{97} Ibid 14.

\textsuperscript{98} See discussion of interpretation of the term ‘coastal waters’ in Section IV C (1).
There is an emerging body of literature discussing principles and governance frameworks for geo-engineering, more often than not focused around solar radiation management. Ocean fertilisation activities arguably give a little more freely to existing regulatory instruments than do activities such as solar radiation management. While discussion of governance principles is also essential for ocean fertilisation, the following section of the article will focus on the particular current instruments that have direct implication for ocean fertilisation activities.

**A Permitting regime**

As discussed in Section III E, the resolutions under the London Protocol relating to ocean fertilisation, including the Assessment Framework, were originally non-binding resolutions. The Reports of the 2nd and 3rd Meetings of the Intersessional Working Group on Ocean Fertilisation provide an inventory of proposals that were recently being examined for further development of a regulatory framework for ocean fertilisation.

The key options (not mutually exclusive) recently examined are as follows.

- That no further work on an instrument be pursued, rather that the Assessment Framework be implemented, evaluated and improved. This was proposed by the United States.
- The creation of a permitting authority for a limited category of placement, namely, a new type of permit for legitimate scientific research for ocean fertilisation, initially proposed by Canada. Two approaches were considered by the Intersessional Working Group to give effect to this proposal -- amendment of the Protocol using one article and one annex (Option 1), and using one article and multiple annexes (Option 2). For expediency, this article will focus on the practical effect of the approach, and will not discuss the legal intricacies of the two options. The notion was further developed by Australia, Nigeria and the Republic of Korea (‘the Australian proposal’) by way of a proposed amendment to the Protocol to provide a legally binding

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102 Unfortunately, the text of the Canadian proposal (LP CO2 4/2/1) was not available to the author. The overview provided in LC 33/4 has been relied upon.
mechanism to regulate the placement of matter for ocean fertilisation through the existing permitting mechanisms under the Protocol.104

- Development of an interpretative resolution, which would effectively make the previous LC/LP resolutions binding, in accordance with article 31(3)(a) of the Vienna Convention.105

The Australian proposal was further developed and, on 18 October 2013, amendments to the Protocol were adopted to define both marine geo-engineering and ocean fertilisation as a regulated ‘placement’ activity; and prohibit such placement unless deemed as scientific research using the Assessment Framework, and authorised under a permit.106 The amendments will enter into force sixty days after two thirds of Contracting Parties deposit an ‘instrument of acceptance’ of the amendment with the International Maritime Organisation.

The following section of this article focuses on the potential flow-on effects of these recent amendments, which this article anticipates may lead to the introduction of a domestic permitting regime. Using the Commonwealth of Australia as an example, and assuming that the amendments will enter into force, this section will explore how these newfound obligations under the London Protocol may be fulfilled through the Environment Protection (Sea Dumping) Act 1981 (Commonwealth) (‘Sea Dumping Act’).

The Sea Dumping Act applies to all vessels, aircraft and platforms in Australian waters (defined as including territorial waters and the EEZ107), and to all Australian vessels and aircrafts in any part of the sea.108

1 Applying the Assessment Framework in the current regime

Insofar as scientific ocean fertilisation research is considered ‘placement’ and not ‘dumping’ under the Protocol, and insofar as domestic requirements are no more stringent than those of the Protocol,109 the placement (carried out by an Australian vessel, whether within Australian

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105 International Maritime Organisation, Report of the 3rd Meeting of the LP Intersessional Working Group on Ocean Fertilization, 3rd mtg, Agenda Item 4, UN Doc LC 33/4 (20 June 2011); See International Maritime Organisation, Report of the 2nd Meeting of the LP Intersessional Working Group on Ocean Fertilization, 2nd mtg, Agenda Item 7, LP CO2 3/7 (19 March 2010), 6., which explains that while article 31(3)(a) refers to interpretative resolutions being “taken into account” in the interpretation of a Treaty, the practical effect would be that it would be difficult for a Party that has agreed to the resolution to interpret its legal obligations under the LC/LP inconsistently with the resolution.


109 Ibid, s 4(1). Controlled materials are defined in accordance with the Protocol.
waters or at high seas) does not currently require a permit under Australian legislation to meet Australia’s Protocol obligations.

However, as party to the Protocol, Australia will have an obligation (once the amendment comes into force) to use the Assessment Framework to determine that any ocean fertilisation research activity constitutes legitimate scientific research that is not contrary to the aims of the Convention or Protocol. Currently there appears to be no ‘regulatory hook’ in the Sea Dumping Act for capturing proposed scientific research activities for assessment against the Assessment Framework. In other words, there needs to be a clear trigger in domestic legislation for a proponent to refer a proposal for assessment against the Assessment Framework for the jurisdiction to be able to demonstrate the legitimacy of scientific research.

2 Proposed permitting regime for placement activities

The introduction of a permit framework for a limited set of ‘placement’ activities places an obligation on Contracting Parties to adopt administrative or legislative measures to introduce this into the existing domestic permitting framework. This would likely mean that the missing ‘regulatory hook’ identified previously would need to be introduced. The most obvious place to introduce this in Australia would be through amendment of the Sea Dumping Act. This could then be reported to the IMO along with other permits and published on an annual basis by the IMO.

Based on the interpretation of the CBD decision (as outlined in Section III C) that ‘coastal waters’ includes both territorial waters and the EEZ, the Sea Dumping Act (hypothetically amended to reflect the limited ‘placement’ permit proposal) would therefore apply to any scientific research-activity that may be undertaken by other States in the Australian EEZ. Consequently, a flag state vessel operating scientific research in the Australian EEZ would be required to comply with the relevant domestic legislation and obtain a permit from the relevant Australian authority for the limited ‘placement’ activity. Domestic processes for assessment and permitting of scientific ocean fertilisation research would need to be consistent with the Assessment Framework under the London Protocol. In addition, the vessel would be required to comply with the laws and regulations of its flag state in so far as they are compatible with those of the coastal state.

In waters beyond coastal states’ EEZ, articles 256 and 257 of UNCLOS provide that all states and competent international organizations have the right, in conformity with the provisions of

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110 Noting again that the text of the Canadian proposal LP CO2 4/2/1 was not able to be located, and the reading is therefore based on the overview provided in LC 33/4; See International Maritime Organisation, above n 105, Annex 1 and Annex 2 for draft examples of how the Protocol could be amended to give effect to this approach.

111 Under the reporting requirements of of the London Convention art VI(4); see also London Protocol,art 9.4.

112 For example, the final report on permits issued in 2008 is available as LC-LP.1/Circ.52. The report for 2008 is the last available on the IMO website <http://www.imo.org/blast/blastDataHelper.asp?data_id=31073&filename=52.pdf> at 17 February 2013.

113 The scientific research activity could be undertaken in the Australian EEZ as a freedom of the high seas under UNCLOS art 87, subject to the consent and laws and regulations of Australia in accordance with UNCLOS art 56, para 1, and art 245-6.

114 UNCLOS art 58, para 3 requires that States shall comply with the laws and regulations adopted by the coastal State when within the EEZ of the coastal State.

115 Art 94, para 1 obliges every State to exercise its jurisdiction over ships flying its flag at high sea. Art 58, para 2 extends this obligation to flag state ships in another coastal state’s waters, in so far as they are not incompatible with Part V.
Part XI relating to the Area, to conduct marine scientific research in the Area and the water column beyond the EEZ. In accordance with article 94, any scientific ocean fertilisation research activities undertaken by Australia, for example, would require a permit under the Sea Dumping Act, to meet the flag state’s obligations under the Protocol. This is reflected in section 10A of the Sea Dumping Act, which makes it an offence to dump controlled material (within the meaning of the Protocol) into any part of the sea from any Australian vessel.

A decision by Australia that a proposed activity is legitimate scientific research and is not contrary to the aims of the Convention or Protocol should be made with consent from all countries with jurisdiction and/or in the region of potential impact, without prejudice to international law, including UNCLOS.116

If the London Protocol were to permit larger scale ocean fertilisation activity, the required Protocol amendment could follow the precedent set by CCS, where Annex 1 of the Protocol would be amended to permit ‘dumping’ of ocean fertilisation substances, thereby making ocean fertilisation a regulated dumping activity at the deployment scale.

3 Compliance

While there is an argument that UNCLOS is the most comprehensive and powerful instrument available for the regulation of ocean fertilisation, and that the Convention and Protocol are the most effectively implemented of relevant national instruments,117 the Protocol is not without its implementation challenges.

In particular, there are no reliable LC/LP compliance mechanisms. Writing in 2009, David VanderZwaag reports of the compliance challenges that the Convention and Protocol suffer.118 VanderZwaag analysed the annual report for 2007 and noted that only 35 contracting parties provided a national report; 53 contracting parties did not report; and 33 contracting parties had not submitted reports in the last five years.119 At the time of the writing of this article, the most recent annual report available on the IMO website was for permits issued in 2008. There is a current stream of work under the “Joint Long-Term Programme for the London Convention and Protocol (2013-2015)” outlining actions to improve LC/LP compliance, including initiatives such as electronic reporting and enhanced collaboration.120 Nonetheless, VanderZwaag’s cautionary note — that the consistency of demonstrating compliance remains to be seen — remains relevant today.

The Australian proposal would at least facilitate the implementation of the Assessment Framework by adoption into the domestic law of Contracting Parties. The broader compliance challenges under the Protocol would still need to be addressed separately in order for the domestic application of the permitting regime to be consolidated at the international level.

116 International Maritime Organization, above n 89, [4.2].
117 Verlaan, above n 12, 457.
119 Ibid 250.


Ocean Fertilisation – What Next?

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**B Scientific research**

Effective enabling and regulation of scientific research is needed to both reduce uncertainty regarding the risks and their mitigation measures, but also to inform development of laws and institutions that will likely be needed to mitigate the risks. The following section addresses two key issues in relation to scientific research of ocean fertilisation. The first is a discussion of the parameters that frame the definition of scientific research, which is important to clarify, particularly in order to provide certainty and guidance to researchers. The second (Section C 2) is a discussion of strategic planning of research activities and how these relate to the regulatory frameworks discussed in Section III.

1 Defining scientific research

Part XIII of UNCLOS is dedicated to marine scientific research, although the term remains undefined in the Convention. Under UNCLOS article 87(f) marine scientific research has the status of a ‘freedom of the high seas’ and needs to be conducted with appropriate methods and means compatible with the Convention.

Under the London Protocol, the key function of the Assessment Framework is to help determine whether a proposed activity constitutes legitimate scientific research that is not contrary to the aims of the Convention or Protocol. As set out in the Initial Assessment of the Assessment Framework, a proposed activity must meet a number of criteria reflecting ‘proper scientific attributes’. It is noted that none of the criteria in the Assessment Framework relate to the scale of the activity. As outlined in Section III C, the exception to the prohibition in CBD decision IX/16 is for ‘small-scale scientific research studies within coastal waters subject to thorough assessment and control’. Ginzky identifies two complicating elements within the CBD terminology, both of which were strongly disputed in relation to the LOHAFEX project.

The first is that the term ‘coastal waters’ is not a defined term under UNCLOS. Acknowledging that fertilisation of waters close to the coast that are usually already rich in nutrient, Ginzky suggests that it would be more meaningful to interpret this as ‘waters of national sovereignty’. Proelss suggests further semantic and geographical restriction on the term by reference to the European Community Biodiversity Clearing House Mechanisms’ Glossary of Biodiversity Related Terms to comprise “marine benthic and pelagic ecosystems having substantial influence from the land”.

The second element is the term ‘small scale’. Proelss analyses and ultimately dismisses the potentially analogous definition used in the 1976 UN Convention on the Prohibition of Military

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121 International Maritime Organisation, above n 89, [2.2]. For reference, these include requirements around how the proposal should demonstrate that it is designed to answer questions that will add to the body of scientific knowledge; that economic interests should not influence the design, conduct and/or outcomes of the proposal; that it should be subject to appropriate scientific peer review; and that the proponent make a commitment to making the outcomes appropriately available to peer-reviewed scientific publications as well as the public.

122 Ginzky, above n 20, 68; Proelss, above n 45, 10-11.

123 Ginzky, above n 20, 68.

124 Proelss, above n 45, 11. The Clearing House Mechanism was established by CBD COP 1 in accordance with CBD art 18(3) to facilitate the implementation of the CBD.
or Any Other Hostile Use of Environmental Modification Techniques which refers to activities with “widespread, long-lasting or severe effects”, where widespread was interpreted to mean “an area on the scale of several hundred square kilometers”, suggesting that this particular definition should not be relevant to ‘small scale’ for ocean fertilisation. Further to the CBD decision, the CBD Scientific Group later explained that the spatial aspect is just one aspect, with others including the amount introduced, the substance’s properties, and the vulnerability of the receiving environment.

CBD decision X/33 also adds that the studies need to be “justified by the need to gather specific scientific data”. It is acknowledged that application of this criterion remains subject to the determination of each party.

This discussion suggests that the line between research and deployment is not an easily defined one. While there is currently guidance to determine whether the proposed activity possesses proper scientific attributes, there remains a lack of clarity as to the acceptable scale of activities still permitted, particularly under the CBD prohibition. Indeed, the notion of ‘large scale’ in relation to the ocean can be a complex one. Further, the assessment of scale is perhaps better applied to the impact rather than the activity.

It is noted that, although falling under a different regulatory framework, the literature on solar radiation management has begun to examine the delineation of the various possible scales of research activities, distinguishing indoor and passive observation activities; small, medium and large scale field trials; and deployment. Although relating to considerably different activities and risks, these distinctions could prove a useful starting point for similar examination of ocean fertilisation in order to determine whether and how the proposed scale of activity or impact should trigger oversight needs.

2 Strategic planning of research programs

Writing in 2009, the Royal Society reports no major directed programmes of research undertaken anywhere in relation to geo-engineering broadly. Early investigations into international geo-engineering governance have argued for the value of informal cooperation in matters of research, emphasizing open exchange of information about proposed studies and results, and possibly including joint ventures in international research programs, with suggestions to involve collaborative risk assessment and broad consultative processes.
Following the direction set out by Parson and Ernst, these types of activities should seek to develop norms through a decentralised process from ‘the ground up’, with a view to organically growing a sufficiently robust set of experiences to support future decision-making. As suggested by Victor, enlisting multiple strong assessment institutions such as academies of science, the assessment would work towards delivering a plurality of ideas and evaluations through research, including trial deployment, rather than aiming for any sort of consensus. Doing this in a transparent way while engaging a wide range of countries with current or aspiration capabilities, Victor argues, would socialise a community of responsible geoengineers, while exploring safe and effective options.

While in agreement with these suggestions to the extent of acknowledging the necessity of optimizing and coordinating research efforts, this article suggests that any ‘ground up’ research should, from a governance perspective, be targeted towards the ‘on the ground’ testing of emerging decision making frameworks, rather than seeking to generate norms in and of itself. That is, coordinated research programs should be acknowledged and pursued as a complement to ‘top down’ regulation, rather than as an alternative.

An obvious successful example of international research collaboration in a field that is, similarly to geo-engineering, potentially hazardous and politically sensitive, is that of the European Organisation for Nuclear Research (‘CERN’). Its purpose is to provide for collaboration among European States in nuclear research of a pure scientific and fundamental character. It was historically focused on nuclear research, and now concerns itself with particle physics more broadly. Its mandate provides that CERN should have no concern with military requirements, and that the results of its experimental and theoretical work are to be published or otherwise made generally available.

Victor suggests that CERN is reflective of the kind of approach that should be considered for geo-engineering research. However, it is useful to bear in mind here the distinction made by a former Director-General of CERN, between ‘basic science’ and ‘applied science’, the former being motivated by curiosity and the latter designed to answer specific questions. Framed this way, the activities of CERN fall largely into the former, while ocean fertilisation research increasingly falls into the latter, as seen by the examples discussed in section II E of this article. This distinction should serve as a cautionary note when consideration is given to institutional frameworks for any type of geo-engineering research. As an applied scientific research activity, ocean fertilisation research should be contributing to the development of emerging ‘prohibitive’ regulatory frameworks by testing them and highlighting their

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134 Parson and Ernst, above n 3, 16.
135 Ibid 325. Noting that this is consistent with UNCLOS art 243 which provides an obligation for cooperation in the creation of favourable conditions for the conduct of marine scientific research.
136 CERN was established by an international convention, the Convention for the Establishment of a European Organisation for Nuclear Research, opened for signature 1 July 1953 (entered into force 29 September 1954), as amended 17 January 1971. It now has 20 member states. (‘CERN Convention’).
137 CERN Convention art 2.
139 CERN Convention art 2.
140 Victor, above n 25, 325.
142 The Solar Radiation Management Research Initiative also admits with respect to solar radiation management that it is strategic research and is not only born out of scientific curiosity. SRMGI, above n 16, 24.
limitations, rather than working within its own ‘facilitative’ regulatory framework, as CERN comparably does.

C  Ensuring effectiveness through carbon markets

As discussed in Section III, both the CBD decision IX/16 and the Assessment Framework under the London Protocol specify that ocean fertilisation research activities are not to provide any financial and/or economic gain arising directly from the experiment or its outcomes.\(^{144}\) This limits the potential for ocean fertilisation as a viable participant in carbon markets until such a time as it is a demonstrated commercial activity and a regulatory framework is in place to manage the verified environmental impacts of commercial-scale activities. This brings us back to the Kyoto Protocol framework, with which Section III began. The following section will now explore the key issues that will require some resolution in order to ensure that the effectiveness of any commercial-scale ocean fertilisation activities is driven through integration into regulated carbon markets.

1 Verification and accountability

Verification, reporting and accountability are integral parts of a well-functioning carbon market.\(^{145}\) As established in Section III B, some level of standard of measurement, verification and reporting would be required to establish a methodology for commercially viable carbon-credit generation.

As noted in Section III B, the Kyoto Protocol does not currently include marine sinks or sources for the purpose of national inventories. Although marine sinks and sources are not specifically excluded either, it is likely that clarification would be required through amendment of Kyoto Protocol article 3, paragraph 4, to extend the scope of national inventories to include changes to ocean sinks. This would enable the generation of carbon credits from ocean fertilisation undertaken at high sea by one state (recalling from Section II that ocean fertilisation is most effective in deep waters outside national waters), to be accounted for under the national inventory, and designated as ‘Assigned Amount Units’ (AAUs) for the purpose of International Emissions Trading.

Despite there being general arguments (not specific to ocean fertilisation) that JI and CDM projects are more effective, efficient and politically acceptable than an IET system,\(^{146}\) there are convincing arguments that the CDM could not easily be extended to ocean iron fertilisation.\(^{147}\) Christine Bertram concludes that the most problematic issue is likely to be the difficulty with measurement, monitoring and verification, a lack of which would likely alleviate the credibility

\(^{144}\) Decisions Adopted by the Conference of the Parties to the Convention on Biological Diversity at its Tenth Meeting’ UN Doc UNEP/CDB/COP/10/27, annex Decision IX/16.; International Maritime Organisation, above n 89, 5.

\(^{145}\) Kyoto Protocol art 12 (7), art 17.


\(^{147}\) For example, Bertram’s analyses if and how the existing CDM scheme for afforestation and reforestation activities (‘land sinks’) could be applied to ocean fertilisation (‘ocean sinks’) by giving consideration to the following elements: project site boundary; additionality and baselines; measurement, monitoring and verification; non-permanence; leakage; and host party approval and sustainability. See generally Bertram, above n 14, 12.
of the projects and contribute to ongoing public concern. Further, the purpose of IJ and CDM is to account for activities carried out by one state in another state (in Annex B party countries, and in developing countries, respectively). If effective ocean fertilisation (i.e. larger scale activity that is not scientific research) is generally limited to the high seas, then it appears likely that credits generated from ocean fertilisation may be limited to International Emissions Trading with no benefit to be gained from JI or CDM mechanisms.

In the absence of an international regulatory mechanism for verification and accounting of the greenhouse gas benefits of ocean fertilisation, and in line with suggestions from Julia Mayo-Ramsay, the International Organization for Standardization’s current series of voluntary standards for environmental management may be a useful starting point. Future opportunities for application of such standards should be considered as a basis for road-testing ongoing development of accountability standards for ocean fertilisation activities.

2 Carbon capture and storage — setting a precedent

Recent discussions relating to carbon capture and storage (CCS) and its implementation under the Kyoto Protocol are here discussed with a view to examining how the emerging governance for CCS might also extend to ocean fertilisation.

Of all the geo-engineering methods, only CCS in geological formations has been considered for inclusion in the CDM. Most recently, Decision 10/CMP.7 adopted, mutatis mutandis, the modalities and procedures for CCS as a CDM activity. The decision also agreed to consider at its following session the eligibility of CCS activities that involve the transport of carbon dioxide from one country to another or which involve geological storage sites that are located in more than one country.

A consequently released UNFCC technical paper considers these issues and provides potential governance structures for managing scenarios of transboundary CCS under the CDM, and

149 Mayo-Ramsay, above n 12, 833.
151 Recalling from Section III E that the Assessment Framework for ocean fertilisation under the London Protocol has been modelled after the “Risk Assessment and Management Framework for CO2 Sequestration in Sub-seabed geological Structures” (CS-SSGS), adopted in 2006 under the London Protocol: International Marine Organisation, Report Of The 1st Meeting Of The LP Intersessional Legal And Related Issues Working Group On Ocean Fertilization, 1st mtg. Agenda Item 5, UN Doc LP/CO2 2/5 (20 February 2009) [2.2].
152 UNFCCC, Report of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol on its seventh session, held in Durban from 28 November to 11 December 2011, CMP Dec 10/CMP 7, 7th Sess, (15 March 2012).
153 This phased progress is consistent with submissions made to a technical and legal workshop convened by the UNFCCC secretariat, which debated the views as to whether CCS should be included in CDM, and suggested that trans-boundary projects be initially excluded since their legal complexity will delay the process. See for example Bader Saeed Al Lamki, ‘CCS as CDM – view of the United Arab Emirates’ (Speech delivered at UNFCCC Technical workshop on modalities and procedures for carbon dioxide capture and storage in geological formations as clean development mechanism project activities, Abu Dhabi, 7 September 2011) para 5 <http://unfccc.int/methods_and_science/other_methodological_issues/items/6144.php>
possible mechanisms for resolving any disputes arising between Parties as a result. The paper considers a number of possible scenarios involving capture, transport and storage within the territory of two or more Parties. If ocean fertilisation is proposed within national waters, the frameworks proposed in the technical paper will be useful in navigating the governance options available, including where more than one state is involved as a proponent. However, the potential for analogy reduces significantly when we recall that ocean fertilisation is most likely to be effective in deep, nutrient-limited waters.

Since no State may claim or exercise sovereignty or sovereign rights over any part of the Area or its resources, the report concludes that CCS project activities are precluded from involving storage in international waters, since it would constitute ‘permanent occupation’ of a geological storage space. Even at the research scale, marine scientific research activities may not form the basis for any claim to any part of the marine environment or its resources. According to the paper, it remains arguable that exploration and research may take place in the Area on a temporary basis. The question for ocean fertilisation proponents then becomes whether ocean fertilisation undertaken in international waters might constitute ‘permanent occupation’ of the Area.

V. CONCLUSION

Ocean fertilisation activity is currently limited through non-binding resolutions under the CBD and the LC/LP to small scale scientific research studies within coastal waters. Once in force, the October 2013 amendments to the London Protocol will provide a basis for a permitting regime for research-scale ocean fertilisation activities. The CBD and UNCLOS serve the emerging LC/LP framework by providing principles and context to detailed LC/LP requirements, while also arguably extending the reach of the more limited (in terms of number of Parties) LC/LP framework.

The ‘prohibitive’ nature of existing and emerging maritime regulation is targeted towards ensuring that future ocean fertilisation does not impact on the marine environment. Any methodologies established under national or international carbon regulatory frameworks, such as the Kyoto Protocol, will provide evidence of the effectiveness of any future large scale ocean fertilisation for climate change mitigation purposes, while relying on maritime regulation to ensure that marine environment protection is not compromised. This will ‘facilitate’ ocean fertilisation by ensuring that it is of benefit to the international community in terms of its effectiveness in relation to climate change mitigation.

The next challenges for the regulation of ocean fertilisation will be encouraging consistent and effective application of the Assessment Framework; administering the permitting of research-scale ocean fertilisation through domestic approval and permitting regimes; as well as strategic planning of research activities, to support and complement the development of emerging regulatory frameworks, while gathering sufficient scientific evidence to demonstrate whether

154 UNFCCC, Transboundary carbon capture and storage project activities, UN Doc FCC/TP/2012/9 (1 November 2012); For related overview and analysis see also Viviane Romeiro and Virginia Parente, ‘Carbon Capture and Storage and the UNFCCC: Recommendations to Address Trans-Boundary Issues’ (2012) 3 Low Carbon Economy 130.
155 UNCLOS art 1, para 1; Part X.
156 UNFCCC, above n 158, para 45.
157 UNCLOS art 241.
the marine environment protection risks are justifiable for the purpose of climate change mitigation. Despite its compliance challenges, LC/LP remains the best instrument to manage the risks of ongoing ocean fertilisation research, and should be developed further to serve as the basis for future permitting mechanisms.