Ocean-based Negative Emission Technologies

OCEAN NETs

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Deliverable 2.8: Report on the Future Regulation of Ocean-based NETs

1. Introduction

1.1 Context

The OceanNETs project exemplifies the uniquely interdisciplinary context that negative emission technologies occupy. Under the same cooperative umbrella, the project aims to analyse and quantify the environmental, economic, legal, political and social feasibility of various ocean-based negative emissions technologies (ocean-based NETs). OceanNETs aims to close fundamental knowledge gaps on specific ocean-based NETs by providing in-depth investigations of those technologies that have already been suggested to have high carbon dioxide removal (CDR) potential or likely co-benefits. Additionally, the project aims to identify the extent to which as well as how ocean-based NETs may contribute to the limits set by the Paris Agreement.

1.2 Purpose of Deliverable 2.8

The attention being dedicated to negative emissions technologies is increasing rapidly across all sectors, including within policy and governance structures. The recent Mitigation of Climate Change Report prepared by the Intergovernmental Panel on Climate Change highlights that "CDR is necessary to achieve net zero CO_2 and [greenhouse gas] emissions both globally and nationally, counterbalancing 'hard-to-abate' residual emissions" and that CDR is "an essential element of scenarios that limit warming to 1.5°C or likely below 2°C by 2100".[1] For its part, the European Commission communicated in December 2021 to the European Parliament and Council that the "development and deployment at scale of carbon removal solutions is indispensable to climate neutrality".[2] Recent years have seen the political debate concerning CDR technologies rapidly evolve within the European Union (EU), with a number of calls for a regulatory framework for these technologies to become an integral part of EU climate policy. Fuelling this debate are recent scientific reports that as the ocean warms, marine ecosystems are likely to experience a mass extinction equivalent to past great extinctions, but that reducing global emissions (including through CDR technologies) offers substantial protection against such potentially "catastrophic marine extinctions".[3] Despite increasing desire to develop such

[1] Intergovernmental Panel on Climate Change, Technical Summary. In: *Climate Change 2022: Mitigation of Climate Change* (2022), Contribution of Working Group III to the Sixth Assessment Report, available at https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_Full_Report.pdf.

[2] European Commission, "Sustainable Carbon Cycles", Communication from the Commission to the European Parliament and the Council (COM (2021) 800 final) p. 2, available at https://climate.ec.europa.eu/system/files/2021-12/com_2021_800_en_0.pdf.

[3] J. L. Penn and C. Deutsch, "Avoiding ocean mass extinction from climate warming", *Science* 376 (6592) pp. 524-526.

technologies, however, questions and conflicts remain as to which technologies and policy instruments should be implemented and which priorities should take precedence.[4]

With this in mind, the purpose of the present report is to provide some insights into the most developed international legal frameworks that may have a bearing on the future regulation of research into, or commercial deployment of, ocean-based NETs. The impacts and co-benefits of ocean-based NETs for ecosystems and biodiversity are highly variable (depending on factors such as the method, the site selected and the scale of the implementation). For this reason, the present report aims to provide some insights into future regulation while acknowledging that such regulation may be just as variable and will require a reasonable measure of flexibility in order to adequately adapt. Such an acknowledgment means that any description of a "future regulatory regime" is necessarily hypothetical in some respects. However, any future regulation of ocean-based NETs will develop with reference to existing legal norms and processes at the international and national levels. The consent-based nature of international law together with the often times long processes involved in States developing binding international norms, means that an examination of already existing international frameworks applicable to ocean-based NETs provides useful insight into how existing regimes will respond and/or how such regimes may be required to adapt.

1.3 Scope and Limitations of the Deliverable

The focus of this report is international law, and regional and national instruments are therefore not dealt with. Specifically, the report is primarily concerned with three international instruments: the United Nations Convention on the Law of the Sea (LOSC),[5] the 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter,[6] and the Paris Agreement.[7] The reason for this is threefold. First, the LOSC is an international instrument that will inevitably always apply to a number of ocean-based NETs given its comprehensive regulation of ocean activities and the marine environment. However, since other reports have already detailed the application of the LOSC, this discussion is kept brief. Second, a number of recent developments (within the last 12 months) under the respective instruments require further evaluation. Third, an evaluation of the London Protocol as an instrument that could permit "legitimate scientific research" and the Paris Agreement, as an instrument potentially dealing with large scale (commercial) deployment, offers a unique opportunity to consider the international regulation of ocean-based NETs in their research and/or deployment phases – particularly concerning how these instruments could or should interact.

While other international instruments may find application to ocean-based NETs, they are not dealt with here since they are either not relevant for ocean-based activities or their consequences for ocean-based NETs have somewhat stagnated. The Convention on Biological Diversity, for example, may find application to ocean-based NETs but has not expressly dealt with the topic since 2016.[8]

[4] F. Schenuit, M. Böttcher and O. Geden, "Carbon Dioxide Removal as an Integral Building Block of the European Green Deal", SWP Comment No. 40 (June 2022), available at https://www.swp-berlin.org/publications/products/comments/2022C40_CarbonDioxideRemoval.pdf.

[5] Adopted on 10 December 1982, entered into force 16 November 1994, 1833 UNTS 3 (LOSC).

[6] Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 14 November 1996, ILM 36 (1997), p. 7 (entered into force 24 March 2006).

[7] Paris Agreement, 12 December 2015, C.N.92.2016. Treaties-XXVII.7.d (entered into force 4 November 2016).

[8] See COP to the CBD, IX/16 Biodiversity and climate change, UNEP/CBD/COP/DEC/IX/16 (9 October 2008); COP to the CBD, X/33 Biodiversity and climate change, UNEP/CBD/COP/DEC/X/33 (29 October 2010); COP to the CBD,

Issues surrounding the international liability and responsibility of States – as features that could be seen as important to any future regulatory regime – are not discussed in this report. The responsibility of States, including that for non-State actors, was discussed in deliverable 2.7, while issues surrounding State liability for otherwise lawful acts are beyond the scope of the present report.[9] Lastly, given the transboundary character of many ocean-based NETs, it must be borne in mind that the international regulation of such technologies involves a diverse range of actors and international norms and principles. While this report includes general remarks to some regulatory considerations, it is not possible to provide a detailed examination of what every social or environmental impact may require from a regulatory point of view. Any description of ongoing regulatory processes may, therefore, have to be supplemented by additional considerations associated with, for example, human rights or any agreed upon best practice standards for research into ocean-based NETs.

1.4 Structure of the deliverable

Following this brief introduction, the remainder of the report is divided into four broad sections. First, section (II) briefly highlights general regulatory considerations for ocean-based NETs going forward. Section (II) includes a brief description of the regulation of ocean-based NETs under the law of the sea, particularly the LOSC. The section ends by highlighting some general considerations that any future regulatory regime may need to consider. Section (III) analyses ocean-based NETs and the international regulation of dumping, specifically recent developments concerning the 2013 amendments to the 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter concerning "marine geoengineering" and the assessment framework for scientific research projects established therein. Section (IV) examines the international climate change regime and specifically the application of the Paris Agreement to CDR technologies, including ocean-based NETs. Section (IV) provides valuable insight into how existing international frameworks are developing concurrently and how they may be required to interact for the purposes of regulating ocean-based NETs. Section (V) provides some concluding remarks, emphasizing that regime collisions should be prevented to the highest possible degree and that the development of a regulatory regime will be crucial in facilitating stakeholder engagement and ensuring high environmental protection standards. The report ends by stressing the necessity for a robust and flexible approach to regulating ocean-based NETs going forward.

2. Overarching Regulatory Considerations

The following discussion provides some thoughts on those international norms and obligations under international law that will, to varying degrees, apply to the research or deployment of ocean-based NETs. This discussion is non-exhaustive and, given the variability and uncertainties still surrounding CDR technologies, the report does not define a one size fits all approach to the international regulation of ocean-based NETs. At this point, it should be noted that this report adopts a broad definition of what is meant by "regulation". In this way, regulation could encompass current international norms (as legally binding laws and customs),

XI/20 Climate-related geoengineering, UNEP/CBD/COP/DEC/XI/20 (5 December 2012); and, most recently, COP to the CBD, XIII/14 Climate-related geoengineering, CBD/COP/DEC/XIII/14 (8 December 2016).

[9] For a detailed discussion in this regard, see A. Proelss and R.C. Steenkamp, "Geoengineering: Methods, Associated Risks and International Liability". In: P. Gailhofer et al. *Corporate Liability for Transboundary Environmental Harm: An International and Transnational Perspective* (Springer, forthcoming).

principles (as developing norms that are usually evident at the beginning of a process), and policies (as non-binding standards or guidelines that may inform conduct).[10]

With this in mind, section II is divided into two subsections. First, the inevitable application of the LOSC, as an instrument designed to "promote the peaceful uses of the seas and oceans, the equitable and efficient utilization of their resources, the conservation of their living resources, and the study, protection and preservation of the marine environment" is briefly highlighted.[11] Second, other general considerations concerning ocean-based NETs are mentioned. Given that a number of different international laws and institutional systems may apply across various geographic zones and in a different manner to various ocean-based NETs, these considerations are necessarily incomplete and are mentioned only as a benchmark – as considerations that should be adequately reflected in any future regulatory regime.

2.1 Ocean-based NETs under the LOSC

Concerning ocean-based NETs that take place within the waters under coastal State jurisdiction, States are bound by the provisions concerning the protection and preservation of the marine environment in Part XII LOSC as well as the rights and obligations of coastal and other States in the territorial sea (Part II LOSC), and the exclusive economic zone (EEZ) (Part V LOSC) respectively. Given the framework nature of the LOSC, there are numerous provisions that find application to ocean-based NETs and the purpose of this brief section is only to highlight the necessity of incorporating law of the sea related obligations into any future regulatory framework that might apply to such technologies. Following this, the section starts with an examination of those provisions of relevance to the jurisdiction of coastal States over proposed ocean-based NETs in either their territorial sea or their EEZ before discussing those provisions of relevance to pollution and marine scientific research (insofar as they relate to ocean-based NETs). Any activity characterized by the existence of a maritime component, no matter whether it can be regarded as an ocean-based NET *sensu stricto* or not, must be measured against the pertinent requirements of the jurisdictional framework codified in the LOSC.

As far as field experiments carried out with regard to individual ocean-based NETs are concerned, the argument could be made that these activities fall within the scope of Part XIII LOSC on marine scientific research (MSR).[12] In the absence of an authoritative legal definition contained in the LOSC, and notwithstanding all controversy surrounding this notion, MSR must, as a minimum requirement, "meet the purpose to increase knowledge on the marine environment".[13] Furthermore, "MSR must be conducted with scientific methods in accordance with the general principle contained in Art. 240(b)".[14] If these requirements are applied to the present context, while the main purpose of a future deployment of any ocean-based NETs will be to remove CO_2 from the atmosphere (and thus an objective aimed *not* at increasing knowledge on the marine environment), the situation for field experiments must arguably be assessed differently if and to the extent to which these activities are aimed at assessing whether

[10] See M. Honegger et al, "The ABC of Governance Principles for Carbon Dioxide Removal Policy", *Frontiers in Climate* 4 (2022), p. 3.

[11] LOSC, preamble.

[12] This subsection (Section II(A)) is taken from A. Proelss, "Law of the Sea and Geoengineering". In N. Matz-Lück, Ø. Jensen and E. Johansen (eds.), *Law of the Sea: Normative Context and Interactions with other Legal Regimes* (Routledge, United Kingdom, 2022).

[13] N. Matz-Lück, "Article 238", in Proelss (ed.), United Nations Convention on the Law of the Sea – A Commentary (2017), para. 13; see also A.H.A. Soons, *Marine Scientific Research and the Law of the Sea* (1982), p. 124.

[14] Ibid, para. 13.

the intended biochemical processes take place in the marine environment as predicted.[15] This would include, e.g., investigations into seawater temperature, density, nutrients and water currents at the proposed research sites. Consequently, coastal States are entitled to exercise jurisdiction over ocean-based NET experiments carried out under their jurisdiction or the jurisdiction of any other State in their respective EEZs on the basis of Article 56(1)(b)(ii) read in conjunction with Article 246 LOSC.[16] As has been demonstrated elsewhere, this conclusion also includes research equipment (e.g. ocean pipes used for artificial upwelling) used in connection with such experiments.[17] The limitation of the coastal State's discretion foreseen by Article 246(3) LOSC in relation to the granting of permits for MSR conducted by other States or organizations in the EEZ is unlikely to apply with respect to ocean-based NETs. This is because Article 246(5)(b) LOSC renders this limitation inapplicable to the extent that harmful substances are introduced into the marine environment in the course of the MSR project.

Conversely, the sovereign rights and jurisdiction of a coastal State under Article 56 LOSC are not applicable when research activities have left the experimental phase and are carried out for CDR purposes. The fact that ocean-based NETs are also not subject to the rights of third States under Article 58(1) LOSC arguably results in an application of Article 59 LOSC. This provision covers economic uses other than those mentioned in Article 56(1) and Article 58(1) LOSC, as well as other non-economic uses of the EEZ. Given that Article 59 LOSC constitutes a mere conflict rule instead of assigning sovereign rights or jurisdiction to any of the groups of States concerned, activities covered by its terms are, in the absence of a user conflict, generally to be considered as lawful.

As far as the territorial sea is concerned, it is submitted that the coastal State is, based on Articles 21(1)(b) and (g) LOSC, entitled to request foreign ships to avoid certain areas of its territorial sea where ocean-based NETs are carried out.[18] Other States do not have the right to conduct ocean-based NET experiments in a foreign territorial sea without the coastal State's express permission (cf. Article 245 LOSC).

3. Other General Regulatory Considerations

A growing number of studies have been dedicated to policy and regulatory considerations for research into and deployment of CDR technologies. Many of these studies have included recommendations that future CDR regulation and policy should include support for research and development of promising technologies, and integrate CDR into emissions accounting and climate policy frameworks.[19] More recent studies have suggested that in order to overcome key regulatory challenges, the following broad topics may require further examination:

[15] See A. Proelss and H. Chang, "Ocean Upwelling and International Law", *Ocean Development and International Law* 43 (2012), p. 373.

[16] Coastal States therefore "control the extent and nature of any [ocean-based NETs] research they choose to carry out or authorize" (K. Scott, "Geoengineering and the Marine Environment". In R. Rayfuse (ed.), *Research Handbook on International Marine Environmental Law* (2015), pp. 462-463).

[17] See A. Proelss and H. Chang, "Ocean Upwelling and International Law", *Ocean Development and International Law* 43 (2012), pp 373–375, who submit that due to their small size and the fact that their life span is likely to expire within weeks after deployment, upwelling pipes used for ocean-based NETs are to be considered as MSR equipment (see Arts. 260-262 LOSC) rather than installations or structures in terms of Art. 56(1)(b)(i) read in conjunction with Art. 60 LOSC.

[18] See A. Proelss and H. Chang, "Ocean Upwelling and International Law", *Ocean Development and International Law* 43 (2012), pp. 375-376.

[19] G. Lomax et al, "Reframing the Policy Approach to Greenhouse Gas Removal Technologies", Energy Policy 78 (2015), p. 133; see also A. Lin, "Carbon Dioxide Removal after Paris", *Ecology Law Quarterly* 45 (2018), pp. 533-582.

1. the scale and speed of implementation required, and associated challenges for research and development and for monitoring deployment;
2. the substantial incentives that will be needed to scale-up potential CDR options;
3. trade-offs between and interactions with a range of Sustainable Development Goals, for example, food security and water security, that may follow from large-scale implementation of CDR options to achieve climate ends; and
4. the risks to the climate system and to the SDGs that will follow if CDR options are not implemented at the pace or scale required, or if large-scale reversals follow largescale CDR efforts.[20]

While it is not possible to provide a detailed examination off all considerations that any ocean-based NETs regulatory regime should account for, the above studies provide insight into some considerations that international law should account for. Of specific relevance in the present context, are those international norms related to global environmental governance and those norms that could be described as "well-established".

In this regard, the customary international law principle of prevention and the related obligation not to cause significant transboundary harm should be directly incorporated into any regulatory regime.[21] While the customary international law nature of these obligations necessitates that they will be binding on all States, direct reference to such obligations in future regulatory regimes will assist in common understanding across various international fora – facilitating uniform understanding of what may be required of States when researching or (commercially) deploying ocean-based NETs. The same can perhaps be said of the precautionary approach. Without examining the customary international law nature of this approach, it suffices to say that there is a "trend towards making this approach part of customary international law".[22] In the context of ocean-based NETs, precaution could be interpreted in different ways. It could mean proactively pursuing a broad range of mitigation options (considering the ongoing and increasing impacts of climate change), or it could necessitate caution in research or deployment given possible environmental side effects. It should be noted that these different interpretations are not mutually exclusive but, unlike in a traditional application of the precautionary approach, this may require more complicated risk-risk trade-offs. Any future regulatory regime should, therefore, include "proactive consideration of multi-risk trade-offs [and account for] policy or technology failure risks as well as countervailing risks of omitting policy steps".[23]

Related to the above "risk-risk" considerations, is the concept of sustainable development. The impact that ocean-based NETs may have on the marine environment will necessarily be determined by the scale, location and context in which they are implemented. For the purposes of sustainable development, it should be noted that while a climate portfolio that includes ocean-based NETs may be beneficial for one geographic local, this may either not be the case for a different geographic local or may compromise the needs of future generations within the same local. Considering the impact that large scale deployment of ocean-based NETs may have on food and water security and/or on local and indigenous communities, the concept of sustainable development will add additional considerations to any risk-risk trade-offs. That

[20] M. Mace et al, "Large-Scale Carbon Dioxide Removal to Meet the 1.5°C Limit: Key Governance Gaps, Challenges and Priority Responses, *Global Policy* 12 (2021), p. 69.

[21] See ICJ, *Pulp Mills on the River Uruguay (Argentina v Uruguay)* [2010] ICJ Rep. 14, para. 101, where the ICJ ruled that, as a customary rule, a State is "obliged to use all the means at its disposal in order to avoid activities which take place in its territory, or in any area under its jurisdiction, causing significant damage to the environment of another State".

[22] ITLOS, *Responsibilities and Obligations of States Sponsoring Persons and Entities with Respect to Activities in the Area (Advisory Opinion)*, 1 February 2011, ITLOS Reports 2011, 10, para. 135.

[23] See M. Honegger et al, "The ABC of Governance Principles for Carbon Dioxide Removal Policy", *Frontiers in Climate* 4 (2022), p. 6.

said, sustainable development is a crucial consideration in any contemporary international law regime and has been replicated in a number of existing instruments, including the Paris Agreement (see section 5 for further discussion in this regard).

Additional regulatory considerations include those related to the principle of common but differentiated responsibility. It should be noted that the foundation of the international climate change regime is grounded on this principle.[24] The core elements of this principle are reflected in Principle 7 of the Rio Declaration:[25]

> States shall cooperate in a spirit of global partnership to conserve, protect and restore the health and integrity of the Earth's ecosystem. In view of the different contributions to global environmental degradation, States have common but differentiated responsibilities. The developed countries acknowledge the responsibility that they bear in the international pursuit of sustainable development in view of the pressures their societies place on the global environment and of the technologies and financial resources they command.

Insofar as ocean-based NETs are concerned, this principle may need to be reflected in regulatory frameworks with reference to two specific points. First, in the transfer of technology to strengthen capacity for global research and deployment into such technologies and, second, in the need for differentiation between the capacities and (national) circumstances of developed and developing States.[26] A number of institutions (both public and private) are already funding CDR technologies and the principle of common but differentiated responsibility may require cooperation and consideration of the options available to equally share the risks and responsibilities potentially associated with research and development of certain ocean-based NETs.[27]

Lastly, brief mention should be made of the duty to cooperate and the related duties to negotiate and exchange information. While these duties are typically specified by the purpose for which the duty is obligated,[28] their application in the law of the sea and international environmental law generally will be important in reminding relevant actors to continually strive for improved collaboration and cooperation. The importance of enhancing cooperation between relevant treaty bodies, including the International Maritime Organization and the institutions established under the Paris Agreement, cannot be overstated. Issues related to the measurement, monitoring, reporting and management of emissions and removals have great potential to assist the work of relevant international institutions as well as States and other stakeholders. To this end, such enhanced collaboration may allow relevant bodies and actors to "avoid working at

[24] See Preamble para. 6 and Arts. 3(1) and 4(1) UNFCCC (United Nations Framework Convention on Climate Change (9 May 1992, 1771 UNTS 107 (entered into force 21 March 1994)); see also Preamble and Arts. 2(2), 4(3), and 4(19) Paris Agreement. See also L. Rajamani, "Due Diligence in International Climate Change Law". In: H. Krieger, A. Peters and L. Kreuzer (eds.) *Due Diligence in the International Legal Order* (Oxford University Press, United Kingdom, 2020), pp. 165-166.

[25] *Report of the UN Conference on Environment and Development*, Rio de Janeiro, June 1992, UN Doc. A/CONF.151/26/ Rev.1 (vol. I) (Rio Declaration).

[26] See M. Honegger et al, "The ABC of Governance Principles for Carbon Dioxide Removal Policy", *Frontiers in Climate* 4 (2022), p. 5.

[27] M. Mace et al, "Large-Scale Carbon Dioxide Removal to Meet the 1.5°C Limit: Key Governance Gaps, Challenges and Priority Responses, *Global Policy* 12 (2021), p. 77.

[28] R. Wolfrum, "Cooperation, International Law of", *Max Planck Institute for Comparative Public Law and International Law* (2010) (online), available at https://opil.ouplaw.com/view/10.1093/law:epil/9780199231690/law-9780199231690-e1427.

cross-purposes and help maintain and improve the information base needed to support sound policy-making".[29]

The above has provided a snapshot of the most applicable provisions of the LOSC and has highlighted some general considerations of international law that should be taken account of when developing regulations for ocean-based NETs. The extent to which these provisions or general considerations will apply remains to be seen. However, any activity taking place in the ocean is likely to face scrutiny from various actors and the above discussion has sought to shed light on those considerations that could be classified as a reasonable starting point within the context of public international law. Given recent developments within multilateral institutions concerning CDR technologies, including ocean-based NETs, the next sections examine ocean-based NETs under the international regime established for dumping (section 4) and the climate change regime under the Paris Agreement (section 5).

4. Ocean-based NETs and the International Regulation of Dumping

While not true for all ocean-based NETs, a number of technologies currently undergoing extensive research involve the introduction of substances into the water column. In December 2021, for example, an open ocean experiment conducted by WhaleX involved the placement of 300 litres of "simulated whale poo" (a mix of nitrogen, phosphorus and trace elements) into the ocean around Sydney, Australia.[30] The placement of this and other matter into the marine environment may, in certain situations, classify as dumping under international law. Following this, this section begins by discussing the international regime regulating pollution to the marine environment caused by dumping generally, before examining the same regime's attempts to regulate ocean-based NETs specifically. From the outset it should be highlighted that, following recent developments, the dumping regime discussed below is particularly relevant for ocean-based NETs during the research/experimental phase. In contrast to this, section 5 dealing with the Paris Agreement is more concerned with larger scale CDR technologies – as actions potentially aimed at removing atmospheric CO_2 at commercial scales.

4.1 The London Dumping Convention and the London Protocol

The Convention on the Prevention of Marine Pollution by the Dumping of Wastes and Other Matter (LC or London Convention)[31] is the first global treaty adopted to regulate the dumping of wastes at sea. In 1996, a Protocol to the Convention (LP or London Protocol)[32] was adopted with the intention that the Protocol would, as between the Contracting Parties, replace the Convention and thereby render the Convention obsolete. This has, however, not yet happened

[29] M. Mace et al, "Large-Scale Carbon Dioxide Removal to Meet the 1.5°C Limit: Key Governance Gaps, Challenges and Priority Responses, *Global Policy* 12 (2021), p. 78.

[30] As at 31 October 2022, no public website for WhaleX is available. For news on the experiment, see G. Readfearn, "Can fake whale poo experiment net Australian scientists a share of Elon Musk's US$100m climate prize?", The Guardian (23 December 2021) available at https://www.theguardian.com/environment/2021/dec/24/can-fake-whale-poo-experiment-net-australian-scientists-a-share-of-elon-musks-us100m-climate-prize.

[31] Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 29 December 1972, 1046 UNTS 120 (entered into force 30 August 1975).

[32] Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 14 November 1996, ILM 36 (1997), p. 7 (entered into force 24 March 2006).

and more than 30 Contracting Parties to the London Convention (including a number of States that are involved in dumping) have not yet ratified the Protocol.[33]

The purpose of both the Convention and the Protocol is to prevent pollution of the marine environment by the dumping of wastes and other matter.[34] How these instruments do this, however, is quite different. While the Convention only prohibits the dumping of substances listed in its annexes, the Protocol reverses the burden of proof, prohibiting all dumping unless there exists an exception listed in the annex to the Protocol. Under the LC/LP "dumping" is defined as:

i. any deliberate disposal into the sea of wastes or other matter from vessels, aircraft, platforms or other man-made structures at sea;
ii. any deliberate disposal into the sea of vessels, aircraft, platforms or other manmade structures at sea.[35]

Articles III(4) LC and 1(8) LP define "wastes" as "material and substance of any kind, form or description", while the term "sea" is defined as "all marine waters other than the internal waters of States" (Articles III(3) LC and 1(7) LP). Although internal waters are excluded from the definition of "sea", Article 7 LP makes clear that Contracting Parties shall apply the provisions of the LP or other effective measures "to control the deliberate disposal of wastes or other matter in marine internal waters where such disposal would be 'dumping'".[36] The provision to include internal waters within the scope of application of the LP is particularly relevant for ocean-based NETs that involve the placement of matter, such as olivine, on beaches since this matter could inevitably make its way into the ocean and beyond the internal waters of the States concerned.

The LC and the LP also provide a number of instances that do not constitute "dumping", including 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 Protocol".[37] Despite considerable disagreement as to which activities might fall within this exception, the International Maritime Organization (IMO) has indicated that this particular exception would include activities that involve the placement of scientific equipment and aquaculture installations.[38] This exception is of particular importance for ocean-based NETs since various technologies might involve the placement of matter into the marine environment but which placement is aimed at stimulating phytoplankton or other natural processes (ultimately to filter atmospheric CO_2) rather than the "mere disposal thereof". The LP goes on to list one additional exception not included in the LC to the list of activities that may be relevant for certain ocean-based NETs. In this regard, Article 1 No 4.2.3 LP states that dumping does not include the "abandonment in the sea of matter (e.g., cables, pipelines and marine research devices) placed for a purpose other than the mere disposal thereof". This exception might find application in the context of ocean-based NETs such as

[33] The LC has 87 Contracting States while the LP currently has 53 (IMO, *Status of IMO Treaties* (18 October 2022), available at https://wwwcdn.imo.org/localresources/en/About/Conventions/StatusOfConventions/Status%20of%20IMO%20Treaties.pdf).

[34] Art. I LC and Art. 2 LP.

[35] Art. III(1)(a) LC and Art. 1 No. 4.1.1 LP.

[36] See generally R. Churchill, V. Lowe and A. Sander, *The Law of the Sea* (Manchester University Press 2022), p. 670.

[37] Art. III(1)(a) LC and Art. 1 Nos. 4.2.2 and 4.2.3 LP.

[38] See, for example, Report of the Thirtieth Consultative Meeting, Doc. LC 30/16 (2008), para. 8.6.1.

artificial upwelling that makes use of pipes and/or other instruments that are to be placed into the ocean.[39]

Considering the above-mentioned definition of dumping as well as the exceptions for activities that may not qualify as dumping, two broad observations bear repeating. First, the placement of substances for purposes *other than mere disposal thereof* are likely not dumping under the LC/LP. Second, this observation is only true insofar as the placement of the material or substance in question is not contrary to the objective of the LC/LP to prevent pollution of the marine environment caused by dumping. It is generally accepted that the placement of matter or other substances in the context of various ocean-based NETs is aimed at removing atmospheric CO_2 and not for the "mere disposal thereof". However, whether the placement of matter or other substances into the marine environment is contrary to the objectives of the LC/LP is a more difficult question to answer and will have to be evaluated on a case-by-case basis. That said, the way in which the Contracting Parties to the LC/LP have thus far dealt with ocean fertilization is perhaps indicative of how other ocean-based NETs can expect to be dealt with going forward. Commentators have succinctly shaped the legal developments surrounding ocean fertilization under the LC/LP as follows:

> While it is debatable whether ocean fertilisation constitutes dumping, the meetings of the parties adopted a resolution in 2008 in which they agreed that, given the then state of knowledge, ocean fertilization activities other than legitimate scientific research should not be allowed. To this end, such other activities should be considered as contrary to the aims of the Convention and Protocol and not currently to qualify for any exemption from the definition of dumping. "Legitimate scientific research" into ocean fertilisation requires a permit. In 2010 the meetings adopted an Assessment Framework to guide States when dealing with applications for such [legitimate scientific research] permits.[40]

The above-mentioned 2008 resolution together with the subsequent assessment framework developed to evaluate legitimate scientific research involving ocean fertilization formed the basis for the amendments to the Protocol that were adopted in 2013. While not yet in force, the 2013 amendments represent the currently most comprehensive international law instrument aimed specifically at regulating ocean fertilization and potentially a number of other ocean-based NETs.

4.2 The 2013 Amendment to the London Protocol concerning "marine geoengineering"

The (Future) Regulation of Ocean-based NETs under the 2013 Amendments

In October 2013, and following a proposal submitted by Australia, the Republic of Korea and Nigeria, the Meeting of Contracting Parties of the LP (MCP) adopted by consensus an amendment to extend the scope of the Protocol to specifically regulate "marine geoengineering" activities in their entirety.[41] A new Article 1.5*bis* defines "marine geoengineering" as the:

[39] See generally See A. Proelss and H. Chang, "Ocean Upwelling and International Law", *Ocean Development and International Law* 43 (2012), pp. 371-385.

[40] R. Churchill, V. Lowe and A. Sander, *The Law of the Sea* (Manchester University Press 2022), p. 670.

[41] IMO Doc. LC 35/15, Annex 4, Resolution LP.4(8), 18 October 2013, *Amendment to the London Protocol to Regulate the Placement of Matter for Ocean Fertilization and Other Marine Geoengineering Activities*.

> deliberate intervention in the marine environment to manipulate natural processes, including to counteract anthropogenic climate change and/or its impacts, and that has the potential to result in deleterious effects, especially where those effects may be widespread, long lasting or severe.[42]

The amendment furthermore prescribes binding criteria to distinguish scientific research from (commercial) deployment. The applicability of the 2013 amendment to a specific ocean-based NET depends on whether the Contracting Parties have decided to include the activity concerned in a new annex 4 to the Protocol. Currently, only ocean fertilization is listed on annex 4 but recent developments make clear that other ocean-based NETs could also be included in annex 4 in the near future (see below). Notwithstanding inclusion of an activity in annex 4, Article 6*bis* LP goes on to prohibit the placement of matter for "marine geoengineering" activities "*unless* the listing provides that the activity or the subcategory of an activity may be authorized under a permit".[43] Under this regulatory approach, the approvability of an ocean-based NET does not result from the inclusion of the technology concerned in annex 4, but only from the fact that the conditions for approvability mentioned in annex 4 are fulfilled in each specific case. In addition, Article 6*bis*.2 LP requires that the Contracting Parties "adopt administrative or legislative measures to ensure that the issuance of permits and permit conditions comply with [the] provisions of annex 5 and takes into account any Specific Assessment Framework developed for an activity and adopted by the Meeting of the Contracting Parties". Thus, the approval of any ocean-based NET for research or (commercial) deployment purposes, presupposes that:

i. the technology concerned is included in annex 4;
ii. the requirements of the general assessment framework included in annex 5 are met;[44] and
iii. the conditions prescribed in annex 4 regarding the specific ocean-based NET, which are envisaged to include specific assessment frameworks (such as the one that currently exists for ocean fertilization), are fulfilled.

Concerning point (iii) above, and taking into account the assessment criteria adopted for scientific research involving ocean fertilization, any specific assessment framework developed for future ocean-based NETs included in annex 4 might require the following:

i. an initial assessment, which should be conducted to determine whether a proposed activity falls within the provided definition of the ocean-based NET concerned, the scientific attributes of the activity and, thus, whether the activity is eligible to be considered and evaluated under the assessment framework;
ii. a detailed environmental impact assessment (EIA), including an evaluation of the experiment site selected and mitigation and contingency planning;
iii. decision-making on the experiment concerned (i.e. whether the proposed activity is "legitimate scientific research" and not contrary to the aims of the LP), including

[42] With this in mind, references to "marine geoengineering" for the remainder of this section are largely synonymous with the report's use of the term "ocean-based NETs".

[43] Emphasis added.

[44] It should be noted here that annex 5 para.3 states that "Parties meeting the terms of any Specific Assessment Framework that has been adopted by the Parties shall be deemed to be in compliance with [annex 5]."

consultation with States and relevant stakeholders with jurisdiction or interests in the potentially affected region; and

iv. subsequent monitoring.

The regulatory regime in place for ocean fertilization under the 2013 amendment may indicate that any ocean-based NET listed in annex 4 in the future will also not be permitted unless the technology constitutes "legitimate scientific research", which determination will require fulfilment with any specific assessment criteria adopted for the proposed technology.[45] This is a particularly strict approach to the regulation of activities conducted for scientific research purposes. However, this process exemplifies the precautionary approach encapsulated in the Protocol – relying on elements of risk characterization and risk management – and, thereby, connects the law of the sea as encapsulated in the LP with international environmental law generally. Importantly, and despite these strict requirements, the regime established under the 2013 amendments to regulate ocean-based NETs is indeed precautionary and not prohibitory. Read in light of the climate change regime discussed below (see section 5), and given the particularly precautionary nature of the LP, any future efforts to scale up ocean-based NETs may require the mobilization of substantial investment.

Recent developments concerning the 2013 Amendments

Having considered the above, the question can be asked what possibilities exist for other ocean-based NETs to be listed on the new annex 4 and for specific assessment frameworks to be developed for these newly listed activities? In answering this question, two points should be highlighted. First, Article 22 LP foresees that a tacit acceptance procedure be applied in relation to amendments of the annexes to the LP. The approach taken by the 2013 amendments therefore allows for the regime established for ocean-based NETs to be sufficiently flexible, as it can be adapted to future developments more easily by merely amending annex 4. Second, developments in 2022 highlight that Contracting Parties are increasingly interested in listing additional activities in annex 4. In this regard, Working Group 41(the *GESAMP Working Group on Ocean Interventions for Climate Change Mitigation*) suggested seven techniques, including ocean-based NETs, "that the London Protocol Parties might wish to consider for listing in the new Annex 4 of the Protocol".[46] Acting on the report produced by Working Group 41, the Scientific Groups of the LC/LP re-established the Correspondence Group on Marine Geoengineering which provided its first progress report in August 2022. Finding that the Working Group had adequately identified the feasibility and environmental risks of seven techniques, the Correspondence Group agreed on the following four techniques to be prioritised and considered for listing in the new annex 4 to the Protocol:

- enhancing ocean alkalinity (CDR);
- macroalgae cultivation and other biomass for sequestration including artificial upwelling (CDR);
- marine cloud brightening (SRM); and

[45] IMO, Res. LC-LP.1 (2008) defines legitimate scientific research as "those proposals that have been assessed and found acceptable under the assessment framework" (para. 7).

[46] The seven techniques suggested were (1) fertilization for fish stock enhancement; (2) macroalgae cultivation for sequestration including artificial upwelling; (3) microbubbles/reflective particles/material; (4) marine cloud brightening; (5) alkalinization of the ocean by adding alkaline material directly to the ocean or by electrochemistry; (6) mineralization of CO2 in rocks under the seabed; and (7) extraction of CO2 from seawater (IMO Doc. LC/SG 44/16, Report of the Forty-fourth Meeting of the Scientific Group of the London Convention and the Fifteenth Meeting of the Scientific Group of the London Protocol, para. 3.6).

- microbubbles/reflective particles/material (SRM).[47]

Importantly for a discussion concerning the future regulation of ocean-based NETs, the Correspondence Group highlighted that "legal analysis is needed for these four techniques to determine whether they are already within the scope of LP, either as dumping or as regulated placement (e.g. ocean fertilization that is already in annex 4), as they may not need additional listing to be assessed and controlled under LP, at least in the short term".[48] The progress report further recommends that the Contracting Parties take the following steps: "(1) consider whether the four marine geoengineering techniques identified are within the scope of the London Convention and London Protocol; (2) consider how existing assessment frameworks apply and if they are adequate for assessing these four techniques; (3) if needed, adjust existing frameworks or develop new frameworks to address gaps; and (4) consider which of the techniques are suitable for listing in annex 4 to the London Protocol".[49]

Following this, the Consultative Meeting of Contracting Parties to the LC and the Meeting of Contracting Parties to the LP adopted a "Statement on Marine Geoengineering" in October 2022.[50] This statement agrees with the four techniques identified by the Correspondence Group as requiring priority evaluation, and highlights the need to evaluate their potential to mitigate the effects of climate change while also considering the adverse impact that they may have on the marine environment. The statement ends by acknowledging the precautionary approach enshrined in Article 3 LP and encourages:

> Contracting Parties to apply annex 5 (the marine geoengineering assessment framework) to evaluate proposed marine geoengineering projects, including the four techniques mentioned above, to apply the utmost caution to their consideration, and to provide information to LP/LC about ongoing and planned marine geoengineering activities.[51]

These latest developments surrounding the 2013 amendments raise a number of questions. First, encouraging States to apply annex 5 in assessing "proposed marine geoengineering projects" as well as to provide information on ongoing and future projects runs the risk of *ipso facto* applying a regulatory regime that has not yet entered into force. While the statement makes clear that States are only "encouraged" and are therefore not bound, any problems that may arise in application of annex 5 will allow for States to deal with such problems outside of the LP framework – potentially increasing fragmentation risks. Second, the objective of the LP is to prevent pollution of the marine environment by the dumping of wastes and other substances and the specific techniques listed will require detailed legal evaluation in order to access the applicability of the LP to their use. Specifically, the listing of marine cloud brightening (MCB) as an activity that may involve dumping and therefore subject to regulation under the LP is questionable. While solar radiation management technologies are beyond the scope of the present report, MCB can briefly be explained as a technique that aims to disperse aerosols

[47] IMO, Doc. LC 44/5, Marine Geoengineering Including Ocean Fertilization: Progress report from the Correspondence Group on Marine Geoengineering, para. 4.

[48] IMO, Doc. LC 44/5, Marine Geoengineering Including Ocean Fertilization: Progress report from the Correspondence Group on Marine Geoengineering, para. 7.

[49] IMO, Doc. LC 44/5, Marine Geoengineering Including Ocean Fertilization: Progress report from the Correspondence Group on Marine Geoengineering, para. 9.

[50] The statement is reproduced here: IMO, *Marine geoengineering techniques for climate change mitigation - LP/LC evaluates potential for marine environment effects* (10 October 2022), available at: https://www.imo.org/en/MediaCentre/PressBriefings/pages/Marine-geoengineering.aspx.

[51] The statement is reproduced here: IMO, *Marine geoengineering techniques for climate change mitigation - LP/LC evaluates potential for marine environment effects* (10 October 2022), available at: https://www.imo.org/en/MediaCentre/PressBriefings/pages/Marine-geoengineering.aspx.

(commonly sea salt particles) into low-level clouds which form over the ocean.[52] The ultimate aim of MCB is to increase the number of smaller droplets in a cloud (as opposed to fewer larger droplets) and thereby increase cloud reflectivity – cooling a particular area or region.[53] The environmental impacts of MCB remain uncertain, however, in situations where sea salt particles are dispersed into the air, it is questionable whether such an activity is dumping under the LC/LP. This is of course notwithstanding any negative effects that may manifest in the marine environment, but it will of course have to be shown that a planned MCB activity is indeed an activity regulated by the LC/LP in order for Contracting Parties to list such a technique in annex 4.

As mentioned, the 2013 amendments have not yet entered into force.[54] The proactive attempts to list additional activities in annex 4 together with calls for States to already begin applying the general assessment framework included in annex 5 – annexes to an amendment that has thus far struggled to gain any momentum in ratifications – runs the risk of increasing rather than negating the hesitancy of States to ratify the 2013 amendments. Understandably though, Contracting Parties to the LC/LP find themselves between a rock and a hard place insofar as the regulation of ocean-based NETs are concerned. The increased attention that stakeholders and States are paying to ocean-based NETs, means that the Contracting Parties cannot be found to do nothing in light of the potentially adverse impacts that these technologies could have on the marine environment – especially insofar as it relates to those technologies that may result in pollution caused by dumping. Considering this, and with the 2013 amendments still not in force, perhaps encouraging States to apply the general assessment framework and to provide their views on the four priority techniques identified might result in increased understanding amongst States and a subsequent shift in momentum. At this point, it is worth repeating the results of Milestone 24 in which a select group of Contracting Parties to the LP were asked to provide their reasons, if any, on whether ratification of the 2013 amendment is planned within their national systems.

In this regard, five States were forthcoming with answers to this question (Australia, Canada, Chile, Denmark and the Republic of Korea). The exact responses of these States can be found in Milestone 24. Needless to say, Australia, Canada, Chile and the Republic of Korea announced a timely implementation of the 2013 amendment, albeit mostly without references to legislative processes that have been set in motion. While it is doubtful that this is indicative of a general shift in favour of the willingness of Contracting Parties to ratify the 2013 amendment, the most recent developments associated with listing additional activities in annex 4 is at least indicative of a shift in the international discussions concerning the regulation of ocean-based NETs. Such discussions have the potential to increase understanding of the necessity for international regulation, which understanding may be accompanied by an increase in ratification interest – particularly in light of the increasingly tangible consequences of climate change.

The above analysis has demonstrated how the 2013 amendments might regulate ocean-based NETs that are listed in annex 4 in the future, especially insofar as this relates to "legitimate scientific research"; has highlighted that despite a strictly precautionary approach, the LP does

[52] K. Brent et al, "Governance of marine geoengineering: Special report". Centre for International Governance Innovation (2019), available at https://www.cigionline.org/static/documents/documents/MarineGov-web.pdf.

[53] For an overview see A Proelss, "International Legal Challenges Concerning Marine Scientific Research in the Era of Climate Change". In H.N. Scheiber et al (eds.), *Science, Technology, and New Challenges to Ocean Law* (2013) pp. 291–294.

[54] The London Protocol currently has 53 State parties, while the 2013 amendments have thus far only attracted 6 ratifications (the most recent acceptance instrument for the 2013 amendments was deposited by Germany in March 2020, see https://wwwcdn.imo.org/localresources/en/About/Conventions/StatusOfConventions/Status%20of%20IMO%20Treaties.pdf, p. 571).

not prohibit ocean-based NETs; and that recent developments surrounding the 2013 amendment are progressing quickly and interest in listing additional technologies for regulation is certainly increasing. With this in mind, the following section examines the international climate change regime. Specifically, section IV considers the implications for considering ocean-based NETs as mitigation action under the Paris Agreement and what this may mean for the future (commercial) deployment of such technologies.

5. Ocean-based NETs and the International Climate Change Regime

The following discussion proceeds with a general discussion of the Paris Agreement, before examining the implication of categorizing ocean-based NETs as "mitigation action" under the Agreement. This discussion highlights recent developments concerning the adoption of rules, modalities and procedures under Article 6 of the Agreement – especially insofar as this relates to the development of carbon market mechanisms. Finally, the section ends with a discussion on the way forward and the interaction between recent developments under the Paris Agreement and those mentioned in section III in the context of the London Protocol and its 2013 amendment. As mentioned above, and unlike the discussion pertaining to the LP/LC, the below discussion of the Paris Agreement (given the aims of the Agreement) is more concerned with large scale deployment of CDR technologies rather than research/experimentation into such technologies. Additionally, the global scope of the Paris Agreement means that ocean-based NETs are only one form of CDR that State Parties may consider and reference in this section to CDR are, therefore, also aimed at those CDR technologies that are ocean-based.

5.1 The UNFCCC and the Paris Agreement

With 197 State parties, the 1992 United Nations Framework Convention on Climate Change (UNFCCC) is the primary legal instrument regulating the protection of the Earth's climate and aims to stabilise greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the global climate system.[55] Article 4(1)(d) UNFCCC requires States to "promote and cooperate in the conservation and enhancement, as appropriate, of sinks and reservoirs of all greenhouse gases […] including biomass, forests and oceans." In line with its framework nature, the obligations under the UNFCCC have been fleshed out in subsequent instruments – most notably for the current purposes, the 2015 Paris Agreement.

In operationalising the objectives of the UNFCCC, the Kyoto Protocol[56] obligates those States listed in Chapter 11 UNFCCC (mostly developed States) to ensure that their greenhouse gas emissions do not exceed the individually determined reduction commitments contained in Annex B to the Protocol itself.[57] However, given that the emission reduction commitments under the Kyoto Protocol are tied to a specific time frame, and that the most recent time frame expired in December 2020, this discussion is focussed on the Paris Agreement. Unlike the Kyoto Protocol, the Paris Agreement's "core obligations" do not expire and require that States

[55] United Nations Framework Convention on Climate Change, 9 May 1992, 1771 UNTS 107 (entered into force 21 March 1994) (UNFCCC).

[56] Kyoto Protocol to the United Nations Framework Convention on Climate Change, 11 December

1997, 2303 UNTS 162 (entered into force 16 February 2005).

[57] W. Rickels, G. Klepper, J. Dovern et al. (2011) Large-scale intentional interventions into the climate system? Assessing the climate engineering debate. Scoping report conducted on behalf of the German Federal Ministry of Education and Research (BMBF), Kiel Earth Institute, Kiel, p. 87.

commit to certain processes and targets. The Paris Agreement, therefore, provides for a continuous and ongoing process of national submissions for climate action.[58]

Pursuant to this, the Paris Agreement sets specific "climate criteria" with the aim that States limit the global temperature increase to well below 2°C, ideally pursuing efforts to limit the increase to 1.5°C, and establishes binding commitments for all State parties to prepare, communicate and maintain nationally determined contributions (NDCs).[59] In this regard, State parties "shall pursue domestic mitigation measures, with the aim of achieving the objectives of such contributions".[60] That said, it should be stressed that State Parties to the Paris Agreement are not legally obliged to achieve the NDCs which they have set for themselves,[61] and it is arguably also not possible to "apportion" the average temperature goal to be achieved on the global level among the State Parties in the sense of an individual obligation or result.[62]

5.2 Carbon Dioxide Removal Technologies as "Mitigation" under the Paris Agreement

Important for the present discussion is Article 1 of the Paris Agreement which incorporates the definitions contained in the UNFCCC, including that for "sinks" and "reservoirs". In this regard, a "sink" is defined as "any process, activity or mechanism which removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas from the atmosphere".[63] This definition is not limited to naturally occurring processes and would appear to cover CDR technologies associated with greenhouse gas removal, including ocean-based NETs.[64] This conclusion is supported by commentators who have found that the terms "mitigation" and "CDR", together with the definitions in the UNFCCC, mean that "CDR is a form of mitigation for the purposes of the UNFCCC and related legal instruments, including the Paris Agreement".[65] More recently, other commentators have found that "[r]paid near-term mitigation is needed across all sectors, and this effort needs to be complemented by the deployment of sustainable CDR

[58] P. Sands P and J. Peel, *Principles of international environmental law*, 2018 (Cambridge University Press, New York), p. 299.

[59] Paris Agreement, Arts. 2(1)(a) and 4.

[60] Paris Agreement, Art. 4(2).

[61] See B. Mayer, "Obligations of conduct in the international law on climate change: A defence", *Review of European, Comparative & International Environmental Law* 27 (2018), p. 135; and L. Rajamani, "Due diligence in climate change law". In: H. Krieger, A. Peters and L. Kreuzer (eds.) *Due diligence in the international legal order* (Oxford University Press, Oxford, 2020), p. 169.

[62] C. Voigt, "The Paris Agreement: What is the standard of conduct for parties?", *Questions of International Law* 26 (2016), p. 27.

[63] UNFCCC Art. 1(8). "Reservoirs" are defined in Art. 1(7) as "a component or components of the climate system where a greenhouse gas or a precursor of a greenhouse gas is stored".

[64] The French version of the UNFCCC includes the words "*naturel ou artificiel*" in the definition of "sinks", whereas the English, Spanish, Chinese and Russian versions of the text do not make this differentiation. See also N. Craik and W. Burns, "Climate engineering and the Paris Agreement", *Environmental Law Report* 49 (2019), p. 11,122; S. Schäfer S et al, (eds.), "The European Transdisciplinary Assessment of Climate Engineering (EuTRACE): Removing greenhouse gases from the atmosphere and reflecting sunlight away from earth". Final report of the FP7 CSA project EuTRACE. European Transdisciplinary Assessment of Climate Engineering, available at https://www.iass-potsdam.de/sites/default/files/files/rz_150715_eutrace_digital_0.pdf, p. 84.

[65] M. Honegger, W. Burns and D. Morrow, "Is carbon dioxide removal 'mitigation of climate change'?", *Review of European, Comparative & International Environmental Law* 30 (2021), p. 328; see also J. Horton, D. Keith, and M. Honegger, "Implications of the Paris Agreement for Carbon Dioxide Removal and Solar Geoengineering", Harvard Project on Climate Agreements (July 2016), available at https://www.belfercenter.org/sites/default/files/files/publication/160700_horton-keith-honegger_vp2.pdf.

options".[66] Therefore, even though ocean-based NETs are not expressly incorporated into the Paris Agreement, such technologies are nevertheless integrated into the Paris Agreement's central mechanisms to achieve its central aims.[67] The categorization of CDR technologies as mitigation for the purposes of the Paris Agreement, results in a number of implications. First, Article 4(1) of the Paris Agreement calls on States "to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases". Together with mounting evidence that certain CDR technologies may be needed in order to achieve the goals set under the Paris Agreement, the explicit reference to "anthropogenic removals" and commitments to reach a "balance" between emissions and removals may necessitate serious consideration of CDR under the Paris Agreement. This is not to suggest that State Parties to the Paris Agreement are bound to undertake CDR, however, "serious contemplation of Paris' 2°C goal underscores the need for concrete examination of how CDR will contribute to achieving that goal".[68]

Second, Article 2(2) of the Paris Agreement highlights that the agreement is to be "implemented to reflect equity and the principle of common but differentiated responsibilities and respective capabilities, in the light of different national circumstances." Article 4(3) goes on to state that:

> Each Party's successive nationally determined contribution will represent a progression beyond the Party's then current nationally determined contribution and reflect its *highest possible ambition*, reflecting its common but differentiated responsibilities and respective capabilities, in the light of different national circumstances.[69]

Read in conjunction, and if CDR technologies are to be considered as mitigation under the Paris Agreement, developed States may be expected to lead efforts in their development and use in climate mitigation policy. Considering the reference to "highest possible ambition", some commentators have concluded that:

> Particularly for developed country parties, failure to include some form of CDR as a component of an NDC arguably means or will soon mean that the NDC falls short of the party's highest possible ambition. Whatever efforts the party is making with respect to emission reduction, it could *also* invest in research, development and deployment of one or several nationally appropriate approaches to CDR. […] In the longer term, when some parties have eliminated emissions from all but the hardest-to-abate sectors, it might be plausible for parties' successive NDCs to focus on CDR as a means of cleaning up emissions from those sectors. Until then, however, the call for NDCs to reflect parties' 'highest possible ambition' implies an emphasis on rapid and deep emission reductions, as well as – where appropriate – preparing the ground for responsible applications of CDR.[70]

In line with this, the following three points can be highlighted in considering a future regulatory framework – especially as this relates to the Paris Agreement's application to ocean-based NETs. First, it is possible that various CDR technologies, including ocean-based NETs, may be considered in a State's NDCs. Second, any CDR technologies that could be implemented should not be done at the exclusion of other mitigation efforts that are (or are yet to be) pursued under the Paris Agreement. Lastly, the common but differentiated responsibilities principle

[66] M. Mace et al, "Large-Scale Carbon Dioxide Removal to Meet the 1.5°C Limit: Key Governance Gaps, Challenges and Priority Responses, *Global Policy* 12 (2021), p. 69.

[67] Paris Agreement Art. 1 read in conjunction with Arts. 4 and 5.

[68] A. Lin, "Carbon Dioxide Removal after Paris", *Ecology Law Quarterly* 45 (2018), p. 550.

[69] Paris Agreement Art. 4 (3), emphasis added.

[70] M. Honegger, W. Burns and D. Morrow, "Is carbon dioxide removal 'mitigation of climate change'?", *Review of European, Comparative & International Environmental Law* 30 (2021), p. 333.

presupposes that any acceptance of CDR technologies as a form of mitigation must account for the different capacities and (national) circumstances of developed and developing States.[71]

The third implication of CDR technologies being categorized as "mitigation" relates to Article 6 of the Paris Agreement. Article 6 acknowledges that there may be some States that opt to pursue voluntary cooperation in the implementation of their NDCs to allow for higher ambition in these States' mitigation and adaptation actions.[72] In particular, Article 6 identifies mechanisms aimed at "internationally transferred mitigation outcomes" (emissions trading) and the use of offsets.[73] The use of such "market mechanisms" may potentially play a central role in the acceptance and development of certain ocean-based NETs since many of these technologies may require private sector involvement in order to be financially feasible. Following the above discussion, it seems realistic to assume that any decision to integrate ocean-based NETs into a State's NDCs will naturally be "accompanied by a corresponding demand to integrate CDR into national and international market mechanisms".[74] At the most recent Conference of the Parties of the UNFCCC in 2021, which also serves as the meeting for the State Parties to the Paris Agreement, States adopted Decision 3/CMA.3. This decision contains rules, modalities and procedures (RMP) for the mechanism established by Article 6(4) and establishes a Supervisory Body tasked with supervising the implementation of the Article 6(4) mechanism. The RMP makes no reference to CDR technologies. However, as in the case of the Paris Agreement itself, such technologies are not expressly excluded either. In particular, any activity that public or private entities wish to participate in and register under the Article 6(4) mechanism, "[s]hall be *designed to achieve mitigation of GHG emissions* that is additional, including reducing emissions, increasing removals and mitigation co-benefits of adaptation actions […] and not lead to an increase in global emissions".[75] In accordance with this mechanism then, a company in State A may potentially reduce its own emissions in State A and have those emission reductions credited so that the company can sell them to another company in State B. Following this, the second company may then be entitled to use those credits in order to comply with its own emission reduction obligations or to help it meet net-zero.[76] However, the modalities for how this will be ironed out in practice are far from clear. By way of example, and in the context of a particular ocean-based NET, should the potential credits received take into account all additional carbon sequestered, or will the carbon that the ocean would have removed naturally also be accounted for? The accounting protocols that may be necessary for CDR are far from developed and pose additional steps and challenges to uncertainties that have already plagued traditional carbon accounting systems.[77]

While it is as yet uncertain whether the newly established Supervisory Body will engage with CDR technologies as activities that may be subject to registration under the Article 6(4) mechanism, these recent developments make clear that the traditional gap between ocean-based

[71] See generally, M. Honegger et al, "The ABC of Governance Principles for Carbon Dioxide Removal Policy", *Frontiers in Climate* 4 (2022), pp. 1-15.

[72] United Nations Climate Change, Cooperative Implementation

[73] See Paris Agreement Arts. 6(2) and (4).

[74] N. Craik & W. Burns, "Climate Engineering under the Paris Agreement: A Legal and Policy Primer, Centre for International Governance Innovation Special Report (2016), available at https://www.cigionline.org/sites/default/files/documents/GeoEngineering%20Primer%20-%20Special%20Report.pdf.

[75] UNFCCC Doc. FCCC/PA/CMA/2021/10/Add.1, Report of the Conference of the Parties serving as the

meeting of the Parties to the Paris Agreement on its third session, held in Glasgow from 31 October to 13 November 2021, p. 33 (emphasis added).

[76] United Nations Climate Change, Article 6.4 Mechanism, available at https://unfccc.int/process-and-meetings/the-paris-agreement/article-64-mechanism, accessed 30 October 2022.

[77] See A. Lin, "Carbon Dioxide Removal after Paris", *Ecology Law Quarterly* 45 (2018), p. 579.

NETs regulation under the London Dumping regime (see section 4) and the international climate change regime is narrowing. In addition to the uncertainty that already surrounds most CDR technologies, issues related to the accounting of net carbon emissions under mechanisms such as that envisaged in Article 6(4) adds an additional layer of complexity. In line with this, it is increasingly important that the State Parties to the Paris Agreement remain aware of developments within the LC/LP and, in an attempt to ensure coherence, not prohibit or regulate activities in a different manner as to how the same activities are regulated under other international frameworks.

Lastly, mention should be made of the fact that even if it is accepted that certain ocean-based NETs may be undertaken as mitigation measures under the Paris Agreement, the Agreement notes that "Parties may be affected not only by climate change, but also by the impacts of the measures taken in response to it".[78] A number of provisions in the Paris Agreement make further reference to the fact that when taking action to combat climate change (including through mitigation action), States should "respect, promote and consider their respective obligations on human rights, the right to health, the rights of indigenous peoples, local communities, migrants, children, persons with disabilities and people in vulnerable situations and the right to development, as well as gender equality, empowerment of women and intergenerational equity".[79] The above analysis does not advocate for State Parties to deploy CDR technologies within the framework of the Paris Agreement. However, should State Parties deem it appropriate to do so, specific reference to "sustainable development", "environmental integrity" and "common but differentiated responsibilities" within the Agreement will be crucial in incorporating other international norms and principles into any evaluation of the risks that CDR technologies may pose to human health and the environment. States will need to remain acutely aware of the impact that such technologies may have, and any decision to integrate CDR approaches and polices must be done with the utmost care, viewing "mitigation efforts as an ongoing learning process requiring participatory decision making and mutual learning on the international stage".[80]

5.3 The Way Forward

The above discussion has highlighted that there is little doubt that the scope of application of the Paris Agreement extends to CDR technologies, especially insofar as such technologies can be considered as mitigation action. Recent reports highlight that the ability for States to reduce greenhouse gas emissions by 2030 will be crucial in evaluating the extent to which CDR may be needed to meet the goals of the Paris Agreement – greater reductions in global greenhouse gas emissions by 2030 will lead to "a smaller need for CDR over the 21st century to achieve the long-term temperature goal", while reliance on CDR "increases depending on the 2030 emissions level".[81] That said, there appears little disagreement that at least some level of CDR deployment will be required. Additionally, there is growing concern that the timeframe in which to actively deploy CDR technologies is quickly closing and "technologies will need to be rolled

[78] Paris Agreement, preamble.

[79] Paris Agreement, preamble.

[80] M. Honegger, W. Burns and D. Morrow, "Is carbon dioxide removal 'mitigation of climate change'?", *Review of European, Comparative & International Environmental Law* 30 (2021), p. 334.

[81] M. Mace et al, "Large-Scale Carbon Dioxide Removal to Meet the 1.5°C Limit: Key Governance Gaps, Challenges and Priority Responses, *Global Policy* 12 (2021), p. 68.

out sooner rather than later, because delays will reduce the ability to scale up a portfolio of options in the necessary timeframe".[82]

Despite no obligation on States to undertake CDR, the goal of the Paris Agreement to limit warming to well below 2°C necessitates that State Parties seriously contemplate the (potentially crucial) role that CDR might play. Moreover, the potential for CDR to play a central role in market mechanisms established under the Paris Agreement will require careful consideration, and protocols and polices developed for carbon accounting will have to be both robust and adaptable. Underlying the development or application of any CDR technologies under the Paris Agreement, is the need for sensible examination of what this may mean for sustainable development and its links to human health, food security and the environment. On the eve of the fourth Conference of the Parties serving as the meeting of the Parties to the Paris Agreement, State Parties must keep recent developments concerning "marine geoengineering" under the LC/LP in mind. This is especially true given that the ocean is set to take a more prominent role under the climate change regime, with the Glasgow Climate Pact inviting "relevant work programmes and constituted bodies under the UNFCCC to consider how to integrate and strengthen ocean-based action in their existing mandates and workplans".[83] The extent to which ocean-based NETs will be regulated by the Paris Agreement rests on the decisions adopted by the meeting of the Parties to the Paris Agreement, the central decision-making body tasked with implementing the Agreement. However, it is becoming increasingly clear that the gap that once existed between ocean-based regulation under the Paris Agreement and regulation of the same technologies under the LC/LP is closing.

6. Conclusion

Considerable work remains in order to establish which ocean-based NETs, and CDR technologies more generally, can be considered as appropriate. The effectiveness of ocean-based NETs as a climate change mitigation action are far from certain, but their effectiveness will likely depend on a number of factors – including deployment across several States and/or regions and for prolonged periods of time. The balance between taking action by implementing CDR technologies and inaction, given potential risks, remains delicate. The future regulation of ocean-based NETs is not unaffected in this regard and "policy makers face a delicate task of [potentially] incentivizing CDR development without prematurely committing to any specific CDR technology or to CDR technologies in general".[84] That said, this report has highlighted that these uncertainties are not taking place in a legal vacuum. As evidenced by the increased attention being paid to the ocean by the State Parties to the Paris Agreement, there remains scope for synergies between relevant institutional frameworks. The 2013 amendment to the London Protocol is thus far the most developed international instrument aimed at regulating ocean-based NETs, while the Paris Agreement remains of paramount importance in facilitating mitigation action aimed at combatting climate change.

While these regimes have naturally developed separately, opportunities exist for direct or indirect cooperation in their application to ocean-based NETs. Particularly, the London Protocol seeks to prohibit the (commercial) deployment of ocean-based NETs but to permit those activities that may qualify as "legitimate scientific research". Conversely, the Paris

[82] M. Mace et al, "Large-Scale Carbon Dioxide Removal to Meet the 1.5°C Limit: Key Governance Gaps, Challenges and Priority Responses, *Global Policy* 12 (2021), p. 69.

[83] UNFCCC, "Glasgow Climate Pact", Decision -/CP.26, advance unedited version available at https://unfccc.int/sites/default/files/resource/cop26_auv_2f_cover_decision.pdf; for a discussion of the increased reference to the ocean under the climate change regime, see M. Lennan and E. Morgera, "The Glasgow Climate Conference (COP26)", *International Journal of Marine and Coastal Law* 37 (2022), 137-151.

[84] A. Lin, "Carbon Dioxide Removal after Paris", *Ecology Law Quarterly* 45 (2018), p. 581.

Agreement's design is more suited to the potential regulation of ocean-based NETs deployed at a larger (commercial) scale. This is supported by a number of provisions of the Paris Agreement, including the prominence given to market mechanisms. Given that further research into ocean-based NETs is expected to precede any (commercial) deployment, these instruments offer room for complementary, rather than conflictive, application. To this end, the institutional arrangements of the UNFCCC, together with that of the Paris Agreement (such as the newly established Supervisory Body under the Article 6.4 Mechanism), should remain cognisant of developments regarding ocean-based NETs under the London Protocol. Although the Paris Agreement has potential for greater scope – applying to all CDR technologies, not only ocean-based ones – the Protocol offers States a unique opportunity to strive for uniformity with regards to the regulation of ocean-based NETs across various international fora. Given the already well-established practice of IMO participation in the United Nations Climate Change Conferences, the separate institutional frameworks relevant for the LC/LP and the Paris Agreement should ensure that relevant outcomes of their work are brought to the attention of the IMO or UNFCCC Secretariats, as the case may be.

Ultimately, any future regulatory regime will have to account for a wide array of already existing international regulations (including newly and well-established norms and principles). The robust application of such regulations will encourage a holistic understanding of their application in practice. Additionally, States and relevant stakeholders will need to remain acutely aware of developments under various institutional frameworks dealing with ocean-based NETs and aim to reduce, as far as possible, the risk of trade-offs with other policy goals – especially as this may relate to the concept of sustainable development and, where applicable, the interests of vulnerable and indigenous communities.