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International Governance of Ocean-Based Carbon Dioxide Removal: Recent Developments and Future Directions

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ABSTRACT

With the impacts of climate change intensifying, and progress in reducing the greenhouse gas emissions that cause it continuing to lag, the parties to the Paris Climate Agreement have emphasized the need to accelerate efforts to remove carbon dioxide from the atmosphere, while simultaneously curbing emissions. As the parties have recognized, the ocean is already a major carbon sink, and could play an important role in future carbon dioxide removal ("CDR") efforts. Scientists have proposed a variety of ocean-based CDR approaches, but most require further research to fully evaluate their efficacy, benefits, and risks. In-ocean testing of the approaches, and their subsequent deployment (if deemed appropriate), could prove challenging for a number of reasons. This paper focuses on the governance challenges associated with ocean CDR research and deployment. Because those activities will take place in the ocean, which is a shared resource, they may be subject to a large body of international law, including various international agreements. Most of the relevant agreements pre-date discussion of ocean CDR and adapting them to this new class of activities has proved difficult.

This paper discusses recent efforts to regulate ocean CDR under three long-standing international agreements: (1) the 1982 United Nations Convention on the Law of the Sea ("UNCLOS"), (2) the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (commonly known as "the London Convention"); and (3) the 1996 Protocol to the London Convention (commonly known as "the London Protocol"). As we will see, the latter two agreements have recently been used to restrict ocean CDR activities, even while those same activities are being encouraged under the Paris Agreement. The paper will discuss options for promoting greater coherence in international governance of ocean CDR, including the possibility of using the new Agreement under UNCLOS on the Conservation and Sustainable Use of Marine Biological Diversity of Areas Beyond National Jurisdiction to comprehensively regulate ocean CDR.

1. INTRODUCTION

2023 was the warmest year on record with global average temperatures at least 1.40 degrees Celcius above pre-industrial levels.[1] The elevated temperatures are unequivocally due to the burning of fossil fuels and other human activities, which have resulted in massive greenhouse gas ("GHG") emissions, pushing atmospheric GHG levels to record highs.[2] GHG emissions must be rapidly and dramatically reduced if the global community is to have any hope of limiting further warming.[3] However, the slow rate of progress in reducing emissions to date means that other climate response strategies must also be pursued, including carbon dioxide removal ("CDR"). The Intergovernmental Panel on Climate Change ("IPCC") has described CDR deployment as "unavoidable," concluding that it will be needed to achieve net zero emissions (i.e., to offset residual emissions from hard-to-abate sectors like agriculture), and thus stabilize atmospheric carbon dioxide levels.[4] According to the IPCC, depending on when and how CDR is deployed, it could also help to slow the rate of increase in atmospheric carbon dioxide levels in the short-term and possibly even reduce the total atmospheric carbon dioxide load in the long-term (i.e., by achieving net negative emissions).[5]

The global community has long recognized the potential for CDR to help mitigate climate change. More than 30 years ago, in 1992, countries adopted the United Nations Framework Convention on Climate Change ("UNFCCC") in which they agreed to adopt "programmes . . . to mitigate climate change by addressing [both] anthropogenic emissions by sources *and removals by sinks* of" GHGs (emphasis added).[6] The UNFCCC defined "sink" to mean "any process, activity or mechanism which removes a [GHG] from the atmosphere."[7] This definition is broad enough to encompass not only naturally occurring removals, but also those resulting from human interventions.[8] Thus, from its inception, the global climate change regime has approved of the use of CDR.

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[1] World Meteorological Organization, *2023 shatters climate records, with major impacts*, https://wmo.int/news/media-centre/2023-shatters-climate-records-major-impacts (last visited Feb. 15, 2024).

[2] Intergovernmental Panel on Climate Change, *Summary for Policymakers*, *in* CLIMATE CHANGE 2022: MITIGATION OF CLIMATE CHANGE. CONTRIBUTION OF WORKING GROUP III TO THE SIXTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (Shukla P.R. et al., eds) (Cambridge, UK and New York, USA: Cambridge University Press).

[3] *Id*.

[4] *Id*. at 40.

[5] *Id*.

[6] United Nations Framework Convention on Climate Change, 1711 UNTS 107 (adopted May 9, 1992, entered into force Mar. 21, 1994), Art. 4(1)(b) [hereinafter "UNFCCC"].

[7] *Id*. Art. 1(8).

[8] *See generally* A. NEIL CRAIK & WIL BURNS, CLIMATE ENGINEERING UNDER THE PARIS AGREEMENT: A LEGAL AND POLICY PRIMER (2016), https://www.cigionline.org/publications/climate-engineering-under-paris-agreement-legal-and-policy-primer/; JOSHUA B. HORTON ET AL., IMPLICATIONS OF THE PARIS AGREEMENT FOR CARBON DIOXIDE REMOVAL AND SOLAR GEOENGINEERING (2016), https://www.belfercenter.org/sites/default/files/legacy/files/160700_horton-keith-honegger_vp2.pdf; Matthias Honeggar et al., *Is carbon dioxide removal 'mitigation of climate change'?* 30 REVIEW OF EUROPEAN, COMPARATIVE AND INTERNATIONAL ENVIRONMENTAL LAW 3, 327 (2021).

In the three decades since the UNFCCC was adopted, the parties have repeatedly reiterated their support for CDR. The Kyoto Protocol to the UNFCCC, adopted in 1997, called for the "[p]rotection and enhancement of sinks and reservoirs of" GHGs.[9] The Paris Agreement, adopted in 2015, similarly emphasized the need to "conserve and enhance . . . sinks and reservoirs of" GHGs and set a new goal to "achieve a balance between anthropogenic emissions by sources and removals by sinks in the second half of this century."[10]

Early efforts to use CDR to mitigate climate change focused primarily on land-based activities. The Kyoto Protocol, for example, talked about countries mitigating climate change by enhancing "removals by sinks [through] direct human-induced land-use change and forestry activities" such as "afforestation, reforestation, and deforestation."[11] Over time, however, countries have begun to look beyond forestry and explore a broader range of CDR approaches.

Ocean-based CDR approaches have received particular attention in recent years due, in part, to a growing recognition within the international community of the interlinkages between climate change and the ocean. In 2019, the IPCC released a Special Report on the Ocean and Cryosphere in a Changing Climate, prompting the President of the Conference of the Parties ("COP") to the UNFCCC to "highlight the importance of the ocean . . . as an integral part of the Earth's climate system."[12] The COP subsequently requested "the Subsidiary Body for Scientific and Technological Advice to convene . . . a dialogue on the ocean and climate change" and explore ways to "strengthen ocean-based climate action."[13] This, in turn, led to calls for parties "to consider . . . ocean-based action in their national climate goals" and, in particular, to "scale up . . . ocean-based mitigation action."[14] While the latter term has not been defined, given the previous acceptance of CDR as a climate change mitigation strategy, it would seem to encompass ocean-based CDR activities. Supporting this view, at the most recent COP in 2023, parties "[e]mphasized the importance of conserving, protecting and restoring. . . marine ecosystems" as carbon sinks and called for accelerating carbon removal.[15]

Consistent with these international directives, governments around the world are providing increasing support for CDR generally, and ocean CDR specifically. For example, in 2023 alone, U.S. federal agencies awarded over $60 million in funding for ocean CDR research[16] and the White House established a new interagency

[9] Kyoto Protocol to the United Nations Framework on Climate Change, 2303 UNTS 162 (adopted Dec. 11, 1997, entered into force Feb. 16, 2005), Art. 2(1)(a)(ii) [hereinafter "Kyoto Protocol"].
[10] Paris Agreement, 3156 UNTS 79 (adopted Dec. 12, 2015, entered into force Nov. 4, 2016), Art. 4-5 [hereinafter "Paris Agreement"].
[11] Kyoto Protocol, *supra* note 9, Art. 3(3).
[12] UNFCCC, Decision 1/CP.25: Chile Madrid Time for Action (2020), FCCC/CP/2019/13/Add.1, para. 30.
[13] *Id*. at para. 31.
[14] UNFCCC, Decision -/CP.27: Sharm el-Sheikh Implementation Plan (2023), para. 46; UNFCCC, Draft Decision -/CP.27: Outcome of the First Global Stocktake (2023), FCCC/PA/CMA/2023/L.17, para. 35.
[15] UNFCCC, Draft Decision -/CP.27: Outcome of the First Global Stocktake (2023), FCCC/PA/CMA/2023/L.17, para. 28 & 33.
[16] ARPA-E, *U.S. Department of Energy Announces $36 Million to Advance Marine Carbon Dioxide Removal Techniques and Slash Harmful Greenhouse Gas Pollution*, https://arpa-e.energy.gov/news-and-media/press-releases/us-department-energy-announces-36-million-advance-marine-carbon (last visited Feb. 2, 2024); NOAA, *Announcing $24.3M Investment Advancing Marine Carbon Dioxide Removal Research,* https://oceanacidification.noaa.gov/fy23-nopp-mcdr-awards/ (last visited Feb. 2, 2024).

committee to develop a "comprehensive federal research and scaled testing program" for promising ocean CDR approaches.[17] Congress is currently considering several bills that would, if enacted, further support ocean CDR research. One example is the Carbon Dioxide Removal Research and Development Act of 2023, which includes approximately $1.1 billion in funding for the National Oceanic and Atmospheric Administration ("NOAA") to develop an ocean CDR research, development, and demonstration program.[18]

The private sector is also playing an increasingly important role in advancing ocean CDR. In recent years, a number of new ocean-CDR focused "start-ups" have been established, with the goal of commercializing different techniques. One example is Ebb Carbon, which has raised over $25 million in seed and venture capital funding to develop and deploy electrochemical ocean alkalinity enhancement ("OAE") technology.[19] Another example is Running Tide, which aims to use a combination of OAE and seaweed cultivation to remove and store carbon dioxide, and has funded early field trials through the sale of carbon credits (among other funding sources).[20]

Even with growing financial support, ocean CDR projects are likely to face a number of challenges, including governance challenges. While the global climate change regime is generally supportive of ocean CDR, it does not establish a comprehensive governance framework therefor. Neither the UNFCCC nor the Paris Agreement, nor decisions taken under them, establish detailed rules governing when, where, and how ocean CDR projects are conducted. However, there are a number of other treaty regimes that govern activities taking place in the ocean, and that could influence the conduct of ocean CDR projects. Those other treaty regimes were not designed to deal with climate change, but rather to protect ocean environments from harms associated with human activities.[21] In seeking to advance that aim, they might restrict activities designed to help to mitigate climate change, thus potentially bringing them into conflict with the global climate regime.

This paper focuses on three key international agreements that are especially relevant to ocean CDR activities: (1) the United Nations Convention on the Law of the Sea[22] ("UNCLOS"), (2) the 1972 Convention on the

[17] Scott Doney & Jane Lubchenco, *Marine Carbon Dioxide Removal: Potential Ways to Harness the Ocean to Mitigate Climate Change,* White House Office of Science and Technology Blog, Oct. 6, 2023, https://www.whitehouse.gov/ostp/news-updates/2023/10/06/marine-carbon-dioxide-removal-potential-ways-to-harness-the-ocean-to-mitigate-climate-change/ (last visited Jan. 30, 2024).
[18] S.2812 – Carbon Dioxide Removal Research and Development Act of 2023, https://www.congress.gov/bill/118th-congress/senate-bill/2812/all-info?s=1&r=8 (last visited Feb. 2, 2024).
[19] Maria Gallucci, *Ebb Carbon wants to pull CO2 from the sky with electricity and seawater,* Canary Media, Aug. 21, 2023, https://www.canarymedia.com/articles/carbon-capture/ebb-carbon-wants-to-pull-co2-from-the-sky-with-electricity-and-seawater.
[20] Susanna Twidale, *Running Tide Delivers 'First Ever' Open Ocean Removal Credits,* Reuters, Aug. 9, 2023, https://www.reuters.com/sustainability/climate-energy/running-tide-delivers-first-ever-open-ocean-carbon-removal-credits-2023-08-09/.
[21] Robert C. Steenkamp & Romany M. Webb, *Legal Considerations Relevant to the Research of Ocean Alkalinity Enhancement, in* GUIDE TO BEST PRACTICES IN OCEAN ALKALINITY ENHANCEMENT RESEARCH 2 (Andreas Oschiles et al. eds, State of the Planet, 2023).
[22] United Nations Convention on the Law of the Sea, 1833 UNTS 397 (adopted 10 December 1982, entered into force 16 November 1994) [hereinafter "UNCLOS"].

Prevention of Marine Pollution by Dumping of Wastes and Other Matter[23] ("London Convention"), and (3) the 1996 Protocol to the London Convention[24] ("London Protocol"). The latter two agreements have, in recent years, been used to restrict ocean CDR activities even while those same activities have been promoted under the global climate regime. The reasons for, and implications of, this growing disconnect between the global ocean governance regime and the climate regime are explored in this paper. The paper also discusses possible alternative approaches to governing ocean CDR activities that better align global ocean and climate goals.

2. THE RELEVANCE OF INTERNATIONAL LAW TO OCEAN CDR

The ocean is a global resource over which no one country has absolute or complete control. Countries' rights and obligations with respect to the ocean are governed by international law which can take two primary forms. The first – customary international law – comprises a set of rules and principles derived from state practice that are, generally speaking, binding on all countries regardless of whether they have specifically consented to be bound. (The only exception is where a country has "persistently objected" to a rule or principle and thus may not be required to comply with it.[25]) The second source of international law – treaties and conventions – takes the form of written agreements between countries. Only those countries that have specifically consented to an international agreement are bound by its terms.

A large number of prior studies have analyzed whether, when, and how international law might apply to different ocean CDR activities.[26] That analysis is not repeated here. Instead, this article zeros in on three key

[23] Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1064 UNTS 120 (adopted 29 December 1972, entered into force 30 August 1975) [hereinafter "London Convention"].
[24] 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matters (adopted 7 November 1996, entered into force 24 March 2006) [hereinafter "London Protocol"].
[25] *See generally*, James A. Green, The Persistent Objector Rule in International Law (2016), https://doi.org/10.1093/law/9780198704218.001.0001.
[26] *See e.g.,* David Freestone & Rosemary Rayfues, *Ocean Iron Fertilization and International Law,* 364 MARINE ECOLOGY PROGRESS SERIES 22 (2008); Philomene Verlaan, *Geoengineering, the Law of the Sea, and Climate Change,* 3 CARBON & CLIMATE LAW REVIEW 446 (2009); Randall S. Abate & Andrew B. Greenlee, *Sowing Seeds Uncertain: Ocean Iron Fertilization, Climate Change, and the International Environmental Law Framework*, 27 Pace Envtl. L. Rev. 555 (2010); Alexander Proelss & Chang Hong, *Ocean Upwelling and International Law,* 43 OCEAN DEVELOPMENT AND INTL. L. 371 (2012); Jeffrey McGee et al., *Geoengineering the Oceans: An Emerging Frontier in International Climate Change Governance,* 10 AUSTRALIAN J. OF MARITIME & OCEAN AFFAIRS 67 (2017); Jesse Reynolds, *International Law, in* CLIMATE ENGINEERING AND THE LAW: REGULATION AND LIABILITY FOR SOLAR RADIATION MANAGEMENT AND CARBON DIOXIDE REMOVAL 57 (Michael B. Gerrard & Tracy Hester eds, Cambridge University Press, 2018); KERRYN BRENT ET AL., GOVERNANCE OF MARINE GEOENGINEERING (2019), https://www.cigionline.org/publications/governance-marine-geoengineering/; Romany M. Webb et al., *International Laws Governing Ocean CDR, in* OCEAN CARBON DIOXIDE REMOVAL FOR CLIMATE MITIGATION: THE LEGAL FRAMEWORK [x] (Romany M. Webb et al. eds., Edward Elgar Publishing, 2023).

international agreements that have been shown, in prior analyses, to be particularly relevant to ocean CDR. They are: (1) UNCLOS, (2) the London Convention, and (3) the London Protocol.

Of the three agreements discussed in this article, UNCLOS has the broadest acceptance within the international community. 167 countries and the European Union are parties to UNCLOS, having both signed and ratified or otherwise adopted it.[27] An additional fourteen countries have signed, but not ratified or adopted, UNCLOS.[28] Generally speaking, signature (without ratification or adoption) is insufficient to establish that a country has consented to be bound by an agreement, but the signing country does have an obligation under international law to refrain from acts that would defeat the object and purpose of the agreement.[29] Moreover, countries that are not party to UNCLOS generally recognize that some of its provisions merely codify customary international law principles, which are binding on all countries. For example, the United States has refused to sign or ratify UNCLOS primarily due to concerns about its provisions on deep sea mining (among other factors), but recognized that the "provisions with respect to traditional uses of the ocean . . . generally confirm existing maritime law and practice," and has pledged to "act in accordance with" them.[30]

Compared to UNCLOS, the London Convention and London Protocol have more limited membership, and none of their provisions are viewed as a codification of customary international law by non-parties. Only eighty-seven countries are party to the London Convention and just fifty-three to the London Protocol.[31] There is, however, an argument that all countries that are party to UNCLOS are required to comply with the London Convention and London Protocol. This is because, as discussed further below, parties to UNCLOS have agreed to establish and abide by "global and regional rules, standards and recommended practices and procedures to prevent, reduce and control [marine] pollution from dumping."[32] Some scholars have argued that the London Convention and Protocol reflect the "global rules and standards" and thus are binding on all UNCLOS parties.[33]

It is important to note that private actors are not directly bound by UNCLOS, the London Convention, or the London Protocol. Generally speaking, international law does not impose obligations on individuals, corporations, or other private (non-state) actors. However, in order to comply with their international obligations, countries may need to adopt domestic laws that govern the conduct of those private actors.

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[27] UN, *Status of Treaties: United Nations Convention on the Law of the Sea*, https://treaties.un.org/pages/ViewDetailsIII.aspx?src=TREATY&mtdsg_no=XXI-6&chapter=21&Temp=mtdsg3&clang=_en (last visited Mar. 6, 2024).

[28] *Id*.

[29] UN, *Glossary of Terms Relating to Treaty Actions,* https://treaties.un.org/pages/Overview.aspx?path=overview/glossary/page1_en.xml (last visited Feb. 15, 2024).

[30] National Archives, *Statement on United States Ocean Policy,* https://www.reaganlibrary.gov/archives/speech/statement-united-states-oceans-policy?_gl=1%2A2ms7j7%2A_gcl_au%2ANjQwNTExNzIwLjE3MDU0Mjg1NDk (last visited Feb. 15, 2024).

[31] International Maritime Organization, *London Convention and Protocol,* *https://www.imo.org/en/OurWork/Environment/Pages/London-Convention-Protocol.aspx* (last visited Mar. 6, 2024).

[32] UNCLOS, *supra* note 22, at Art. 210.

[33] Gi Hoon Hong & Young Joo Lee, *Transitional Measures to Combine Two Global Ocean Dumping Treaties into a Single Treaty,* 55 MARINE POLICY 47 (2015).

Countries vary in terms of how they incorporate international law into their domestic legal frameworks. Some countries treat international agreements as "self-executing," meaning that they automatically become part of domestic law when ratified, even if no formal action is taken to implement them at the domestic level. In other countries, formal action must be taken to implement international agreements (e.g., the legislature may need to enact domestic legislation in order for international agreements to have the force of law domestically).

3. APPLICATION OF UNCLOS TO OCEAN CDR

UNCLOS is often referred to as the "constitution for the oceans" because it establishes a comprehensive framework for international regulation of ocean-based activities.[34] The adoption of UNCLOS in 1982 was "the result of an unprecedented, and so far never replicated, effort at codification and progressive development of international law."[35] As noted above, some parts of UNCLOS simply codify the requirements of customary international law, but other provisions go beyond it, establishing new rules around ocean management and use.

UNCLOS "does not explicitly govern" ocean CDR activities.[36] There is, unsurprisingly, no express reference to ocean CDR in UNCLOS. It was, after all, adopted long before ocean CDR first began to receive widespread attention as a possible climate change mitigation strategy. Even so, however, UNCLOS could have important implications for the conduct of ocean CDR research and deployment. Most notably, jurisdictional boundaries established in UNCLOS will determine which country has regulatory authority over ocean CDR activities, and provisions of the Convention dealing with marine environmental protection may influence countries' regulatory approach.

In considering the implications of UNCLOS for ocean CDR, it is important to note that the Convention "is not a separate or self-contained legal regime."[37] At various points, UNCLOS incorporates "generally accepted international rules and standards" from other treaties which must be considered when interpreting and applying UNCLOS. It is also necessary to consider agreements adopted after UNCLOS, which add detail to its often general and sometimes vague provisions. One example is the 1994 agreement on the implementation of the seabed mining provisions in Part XI of UNCLOS, more commonly known as the Seabed Mining Agreement.[38] A second agreement, commonly known as the Straddling Fish Stocks Agreement, was adopted in

[34] Wil Burns, *Governance of Ocean-Based Carbon Dioxide Removal Research Under the United Nations Convention on the Law of the Sea,* 75 MAINE LAW REV. 1, 52 (2023).
[35] Tullio Treves, *United Nations Convention on the Law of the Sea: Introductory Note*, AUDIOVISUAL LIBRARY OF INTERNATIONAL LAW, https://legal.un.org/avl/ha/gclos/gclos.html (last viewed Mar. 5, 2024).
[36] Lina Röschel & Barbara Neumann, *Ocean-based Negative Emissions Technologies: A Governance Review*, FRONTIERS IN MARINE SCIENCE 10:995130, 10 (2023).
[37] Alan Boyle, *Further Development of the Law of the Sea Convention: Mechanisms for Change*, 54 INTERNATIONAL AND COMPARATIVE LAW QUARTERLY 563, 565 (2005).
[38] Agreement Relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982, 1836 UNTS 3 (adopted July 28, 1994; entered into force Nov. 16, 1994).

1995 with the goal of ensuring effective implementation of UNCLOS provisions relevant to the conservation and management of straddling and highly migratory fish stocks.[39] More recently, in 2023, a third agreement was adopted to supplement UNCLOS' requirements with respect to the management of areas beyond national jurisdiction.[40] That agreement, commonly known as the Biodiversity Beyond National Jurisdiction or BBNJ Treaty, is discussed further in section 5.1 below.

3.1 UNCLOS Provisions Defining Countries' Jurisdiction Over the Ocean

UNCLOS defines the extent of each country's jurisdiction over the ocean and thus will determine which country is responsible for regulating any particular ocean CDR activity. It should be noted that the UNCLOS provisions defining countries' jurisdiction over the ocean are widely viewed as reflecting customary international law and thus followed by parties and non-parties alike.

UNCLOS begins by declaring that each coastal country (i.e., each country that borders the ocean) has sovereignty over a "belt of sea" located adjacent to its land territory.[41] This area, known as the territorial sea, extends up to 12 nautical miles from the country's baseline.[42] According to UNCLOS, "the normal baseline for measuring the breadth of the territorial sea is the low water line along the coast," but a different baseline may be used in some circumstances.[43] For example, where a country's coastline is heavily indented with bays, the baseline may be drawn by connecting appropriate points on either side of each bay with a straight line to create what are known as "straight baselines."[44]

Each coastal country has full sovereign rights over the water and submerged land within its territorial sea and the airspace above it.[45] In exercising its sovereign rights, the country must act in accordance with international law and must not infringe upon the rights conferred on other countries by international law (e.g., the right of innocent passage). This is typically not a major restriction on coastal countries' authority in practice, however. Coastal countries generally regulate activities in their territorial seas under domestic law in much the same way as they regulate activities taking place on land. Thus, for example, the relevant coastal country's domestic

[39] Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, 2167 UNTS 3 (adopted Aug. 4, 1995; entered into force Dec. 11, 2001).
[40] Agreement Under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas Beyond National Jurisdiction (adopted June 19, 2023, not in force) [hereinafter "BBNJ Treaty"].
[41] UNCLOS, *supra* note 22, Art. 2(1).
[42] *Id*. Art. 3.
[43] *Id*. Art. 5.
[44] *Id*. Art. 7.
[45] *Id*. Art. 2(2).

law may be applied to determine whether an ocean CDR activity can take place in the territorial sea and, if so, the requirements for conducting the activity.[46]

Ocean waters lying beyond a country's territorial sea, up to 200 nautical miles from the baseline, form part of the country's exclusive economic zone ("EEZ").[47] The submerged land underlying a country's EEZ is known as its continental shelf.[48] In some circumstances, a country's continental shelf may extend beyond its EEZ to the outer edge of the continental margin, up to 60 nautical miles from the foot of the continental shelf or the point where sediment thickness is 1 percent of the distance thereto.[49]

Unlike the territorial sea, the EEZ and continental shelf do not form part of the sovereign territory of the coastal country, and thus the country has more limited rights in those areas. Notably, however, each coastal country does have the right to exploit the natural resources in its EEZ and on its continental shelf.[50] Scholars have characterized ocean CDR as an activity involving the exploitation of natural resources because it relies on the natural ability of ocean water to absorb carbon dioxide.[51] This provides a "jurisdictional hook" for the coastal country to regulate ocean CDR activities taking place within its EEZ and on its continental shelf. Coastal countries could also justify regulating such activities based on the fact that they have authority, under UNCLOS, to regulate the conduct of marine scientific research and the establishment and use of artificial islands and other structures in the EEZ.[52] Generally speaking, then, the domestic law of the relevant coastal country will apply to ocean CDR activities conducted within 200 nautical miles of the coast.

Ocean waters lying beyond the EEZ of any country are referred to as the High Seas and the underlying submerged land is referred to as the Area.[53] No country has sovereign rights with respect to the High Seas or the Area. They are open access, meaning that they can be used by all countries, both coastal and landlocked.[54] A country's domestic law may apply to activities taking place on the High Seas or in The Area if those activities are performed by a national of the country or using a ship that is registered or "flagged" by the country. UNCLOS provides that "[s]hips shall sail under the flag of one [country] only and . . . shall be subject to its exclusive jurisdiction on the high seas."[55] If the individuals on the ship are nationals of a different country, that country's domestic law may apply to them. For example, nationals of the U.S. are bound by certain domestic environmental laws when operating on the High Seas. The U.S. Marine Mammal Protection Act, for instance, makes it unlawful "for any person subject to the jurisdiction of the United States . . . to take

[46] Romany M. Webb, *Jurisdiction Over the Ocean, in* OCEAN CARBON DIOXIDE REMOVAL FOR CLIMATE MITIGATION: THE LEGAL FRAMEWORK 41, 44-45 (Romany M. Webb et al., eds, Edward Elgar Publishing, 2023).
[47] UNCLOS, *supra* note 22, Art. 55 & 57.
[48] *Id*. Art. 76.
[49] *Id*.
[50] *Id*. Art. 56 & 77.
[51] Reynolds, supra note 26, at 76; Webb, *supra* note 46, at 45.
[52] Webb, *supra* note 46, at 45.
[53] UNCLOS, *supra* note 22, Art. 1 & 86.
[54] *Id*. Art 87 & 137.
[55] *Id*. Art. 92(1).

any marine mammal on the high seas."[56] There are, however, significant practical challenges to implementing and enforcing domestic law on the high seas.

3.2 UNCLOS Provisions Defining with Marine Environmental Protection

As well as defining the extent of countries' jurisdiction over ocean CDR activities, UNCLOS might also influence the way in which countries regulate those activities. This section discusses the potential influence of Part XII of UNCLOS, dealing with "protection and preservation of the marine environment." Prior work has explored other potentially-relevant UNCLOS provisions, including those in Part XIII on "marine scientific research."[57]

Part XII of UNCLOS imposes a general obligation on countries to "protect and preserve the marine environment."[58] Consistent with that obligation, UNCLOS requires countries to take "all measures . . . necessary to prevent, reduce and control pollution of the marine environment from any source."[59] UNCLOS defines "pollution" broadly to mean:

> the introduction by man, directly or indirectly, of substances or energy into the marine environment. . . which results or is likely to result in such deleterious effects as harm to living resources and marine life, hazards to human health, hinderance to marine activities, including fishing and other legitimate uses of the sea, impairment of qualify for use of sea water and reduction of amenities.[60]

While countries are expected to "deal with all sources of pollution," they are especially encouraged to adopt measures "designed to minimize to the fullest possible extent" pollution resulting from "the release of toxic, harmful or noxious substances . . . from land-based sources . . . or by dumping" from vessels, aircraft, platforms, or other manmade structures and "pollution from . . . installation and devices operating in the marine environment."[61] In particular, UNCLOS requires countries to "adopt laws and regulations to prevent, reduce and control pollution of the marine environment from land-based sources," "from or in connection with seabed activities," and as a result of "dumping."[62]

Exactly what these obligations mean for ocean CDR activities is somewhat uncertain. Applying the UNCLOS definition, ocean CDR activities might be viewed as either a source of marine pollution or a means of pollution

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[56] 16 U.S.C. δ 1372.
[57] Burns, *supra* note 34; Alexander Proelss & Robert Steenkamp, Deliverable D2.8: Report on the Future Regulation of Ocean-Based NETs (2022), https://oceanrep.geomar.de/id/eprint/57225/1/Ocean NETs Deliverable 2.8.pdf; Romany M. Webb et al., *International Law Governing Ocean CDR, in* Ocean Carbon Dioxide Removal for Climate Mitigation: The Legal Framework 47 (Romany M. Webb et al. eds, Edward Elgar Publishing, 2023).
[58] UNCLOS, *supra* note 22, Art. 192.
[59] *Id*. Art 194(1).
[60] *Id*. Art. 1(1)(4).
[61] *Id*. Art. 194(3).
[62] *Id*. Art. 201 & 207.

control, or both simultaneously.[63] Many ocean CDR approaches involve the introduction of materials into the ocean – e.g., nutrients in ocean fertilization, alkaline substances in OAE, and equipment in artificial upwelling and downwelling. In each case, there is a risk that the introduction will harm marine ecosystems or hinder marine activities, thus bringing it within UNCLOS' definition of pollution. The definition could, at least in theory, also encompass excess carbon dioxide in the ocean. As has been previously written, the carbon dioxide "was indirectly introduced [into the ocean] by humans through their release of carbon dioxide into the atmosphere and negatively affects the marine environment, including by causing ocean acidification."[64]

Because ocean CDR activities could be both a source of pollution and a method of pollution remediation, a case-by-case assessment is required to determine whether and how Part XII of UNCLOS applies. Some scholars have suggested that, in evaluating the applicability of Part XII, one should balance the risks of each individual activity against its potential climate benefits.[65] Others have pointed out that there is nothing in UNCLOS to suggest that sort of balancing is permissible.[66] In fact, Article 195 of UNCLOS suggests the opposite, directing parties "not to transfer . . . damage or hazards from one area to another or transform one type of pollution into another" (emphasis added).[67]

There is no doubt that adoption of a balancing test would represent an innovation in the application of UNCLOS. However, UNCLOS should not be viewed as "a static instrument, cast in stone somewhere around 1982."[68] Rather, UNCLOS is an "inherently evolutionary" document, designed "to have the flexibility to respond to change."[69] This is clear from the many references in UNCLOS to "generally accepted international rules and standards," which may change over time, as well as from the fact that UNCLOS envisions the adoption of subsequent agreements and other instruments to flesh out and operationalize its requirements. UNCLOS must, therefore, be interpreted and applied within the context of the broader international legal framework. That framework includes, among other things, the global climate change regime which emphasizes the urgency of climate change mitigation and the potential contribution of ocean CDR thereto. The success or failure of efforts to address climate change under the UNFCCC / Paris Agreement will clearly have major implications for the exercise of rights and obligations under UNCLOS and vice versa. It is, therefore, important to ensure a coherent approach that aligns to the two regimes to the maximum extent possible. But exactly what that might look like in practice is uncertain.

Some clarity around the interaction of UNCLOS and the global climate change regime could come in 2024 when the International Tribunal for the Law of Sea ("ITLOS") is expected to respond to a request for an

[63] Jesse Reynolds, *Climate Engineering and International Law, in* CLIMATE CHANGE LAW 178, 183 (Daniel A. Farber & Marjan Peeters eds, Edward Elgar Publishing, 2016); Reynolds, *supra* note 51, at 77-78; Webb et al., *supra* note 57, at 51-52.
[64] Webb et al., *supra* note 57, at 51-52.
[65] Reynolds, supra note 26, at 77-78; Webb et al., *supra* note 57, at 52.
[66] Burns, *supra* note 34, at 64.
[67] *Id*. Art. 195.
[68] Boyle, supra note 37, at 568.
[69] *Id*. at 568 & 584.

advisory opinion on climate change. The request was submitted in December 2022 by the co-chairs of the Commission of Small Islands States on Climate Change and International Law.[70] The co-chairs referred the following legal questions to ITLOS for an advisory opinion:

> What are the specific obligations of State Parties to the United Nations Convention on the Law of the Sea (the "UNCLOS"), including under Part XII:
>
> (a) to prevent, reduce and control pollution of the marine environment in relation to the deleterious effects that result or are likely to result from climate change . . . [and]
>
> (b) to protect and preserve the marine environment in relation to climate change impacts, including ocean warming and sea level rise, and ocean acidification?[71]

ITLOS held an oral hearing on the request in September 2024 and received written submissions from thirty-two states and nineteen intergovernmental and non-governmental organizations.[72] Many of the written submissions asserted that carbon dioxide qualifies as a marine pollutant under the UNCLOS definition and that countries have an obligation under UNCLOS to prevent pollution resulting from carbon dioxide emissions.[73] Most emphasized the need to interpret UNCLOS "in a way that systematically integrates obligations outlined in the UNFCCC and the Paris Agreement."[74] However, a small number of submissions advocated for separation of the two regimes, with some emphasizing that UNCLOS does not impose any obligations with respect to climate change mitigation, which instead falls under the exclusive purview of the UNFCCC and Paris Agreement.[75] How ITLOS approaches these issues could have major implications for future ocean CDR activities.

[70] Letter from Commission of Small Island States on Climate Change and International Law to International Tribunal for the Law of the Sea (Dec. 12, 2022), https://climatecasechart.com/wp-content/uploads/non-us-case-documents/2022/20221212_Case-No.-312022_points-of-claim.pdf.
[71] *Id*. at 2.
[72] Maria Antonia Tigre & Korey Silverman-Roati, ITLOS Advisory Opinion on Climate Change: Summary of Briefs and Statements Submitted to the Tribunal 9 (2023), https://scholarship.law.columbia.edu/sabin_climate_change/208/.
[73] *Id*. at 10
[74] *Id*.
[75] *Id*.

4. APPLICATION OF THE LONDON CONVENTION AND LONDON PROTOCOL TO OCEAN CDR

Building on the general obligations set out in UNCLOS, the London Convention and London Protocol establish detailed rules with respect to ocean dumping. The London Convention was adopted first in 1972.[76] The London Protocol was adopted twenty-four years later in 1996, but did not enter into force until 2006, and even now, has significantly fewer parties than the London Convention.[77] This may be due to the fact that the London Protocol is much more restrictive than the London Convention.

Parties to the London Convention agree to "individually and collectively promote the effective control of all sources of pollution of the marine environment and pledge themselves especially to take all practical steps to prevent the pollution of the sea by the dumping of waste or other matter."[78] Specifically, the London Convention requires parties to prohibit the dumping of eight substances listed in Annex I to the Convention (the so-called "blacklisted substances"),[79] and establish domestic permitting regimes to govern the dumping of other substances.[80] Each party must require permits for the dumping of non-blacklisted substances by vessels or aircraft that fly its flag, were loaded within its territory, or otherwise fall under its jurisdiction (e.g., because they are engaging in dumping within waters under the party's jurisdiction).[81] The party must designate an appropriate national authority or authorities to issue permits and monitor permitted activities and their effects.[82]

The London Protocol is similar to the London Convention in that it prohibits the dumping of some substances altogether and allows the dumping of others with a permit. Importantly however, whereas the London Convention prohibits the dumping of only a small number of specifically identified blacklisted substances, the Protocol includes a much broader prohibition on dumping. The Protocol requires countries to prohibit the dumping of all substances, except for those that have been specifically listed in Annex 1.[83] The Annex currently

[76] International Maritime Organization, *Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter*, https://www.imo.org/en/OurWork/Environment/Pages/London-Convention-Protocol.aspx (last visited Mar. 28, 2024).
[77] *Id*.
[78] London Convention, *supra* note 23, Art. I.
[79] The blacklisted substances identified in Annex I to the London Convention are: (1) organohalogen compounds, (2) mercury and mercury compounds, (3) cadmium and cadmium compounds, (4) persistent plastics and other persistent synthetic materials, (5) crude oil and its wastes, refined petroleum products, petroleum, distillate residues, and mixtures containing those substances, (6) radiative wastes and other radioactive matter, (7) materials produced for biological and chemical warfare, and (8) industrial waste. *See id*., Annex I.
[80] *Id*., Art. IV.
[81] *Id*. Art. VI.
[82] *Id*.
[83] London Protocol, *supra* note 24, Art. 4.

only lists eight substances;[84] those eight substances are the only ones that can be dumped and dumping must be authorized via a permit issued by the relevant national authority.[85]

The London Protocol was, at the time it was adopted, intended to replace the London Convention. However, before that can happen, all of the parties to the London Convention must ratify the London Protocol. At the time of writing, there were 87 parties to the London Convention, 46 of which had not ratified the London Protocol.[86] In total, at the time of writing, there were 55 parties to the London Protocol (some were also parties to the London Convention, while others had only ratified the latter instrument).[87]

While only a relatively small number of countries are party to the London Convention and London Protocol, some have suggested that the instruments may have broader application. As noted above, countries that are party to UNCLOS have an obligation to "prevent, reduce and control pollution of the marine environment by dumping.[88]" UNCLOS directs parties "to establish global . . . rules, standards and recommended practices and procedures" with respect to dumping and to adopt national "laws and regulations" that are "no less effective in preventing, reducing and controlling . . . pollution than [those] global rules and standards.[89]" Some legal experts have argued the London Convention and London Protocol reflect the applicable global rules and standards.[90] Other scholars counter that, given the limited membership of the London Convention and London Protocol, they are not truly "global."[91] Regardless of which view is accepted, there is no doubt that the London Convention and London Protocol are important international instruments, with significant relevance to ocean CDR activities. Indeed, many ocean CDR activities are likely to qualify as "dumping" under the London Convention and London Protocol, and thus be subject to the requirements imposed by those instruments.

4.1 Regulating Ocean CDR as a Form of "Dumping" Under the London Convention and London Protocol

Both the London Convention and London Protocol define dumping broadly to include "any deliberate disposal at sea of wastes or other matter from vessels, aircraft, platforms, or other man-made structures at sea."[92] The

[84] The eight substances identified in Annex 1 to the London Protocol are: (1) dredged material, (2) sewage sludge, (3) fish waste, or material resulting from industrial fish processing operations, (4) vessels, platforms and other man-made structures, (5) inert, inorganic geological material, (6) organic material of natural origin, (7) bulky items primarily comprising iron, steel, concrete and similarly unharmful materials, and (8) carbon dioxide streams from carbon dioxide capture processes for sequestration. *See id*. Annex 1.
[85] *Id*. Art. 4 & Annex I.
[86] International Maritime Organization, *supra* note 31.
[87] *Id*.
[88] UNCLOS, *supra* note 22, Art. 210.
[89] *Id*.
[90] Hoon Hong & Joo Lee, *supra* note 33.
[91] David L. VanderZwaag & Anne Daniel, *International Law and Ocean Dumping: Steering a Precautionary Course Aboard the 1996 London Protocol, but Still an Unfinished Voyage, in* THE FUTURE OF OCEAN REGIME-BUILDING 515 (Aldo Chircop et al. eds, Brill, 2009).
[92] London Convention, *supra* note 23, Art. III; London Protocol, *supra* note 24, Art. 1.

definition excludes the "placement of matter for a purpose other than mere disposal thereof, provided that such placement is not contrary to the aims of" the London Convention or London Protocol.[93] Many ocean CDR activities involve the placement of matter in the ocean and that placement is arguably not done for the purposes of disposal. While the term "disposal" is not defined in the London Convention or London Protocol, it is typically used to refer to the act of getting rid of something that is no longer useful.[94] In ocean CDR, materials are not added to the ocean to get rid of them, but rather to stimulate biological or chemical processes that enhance uptake and storage of carbon dioxide in the ocean.[95] Thus, whether an ocean CDR activity qualifies as a form of "dumping" that is regulated under the London Convention and London Protocol, or is viewed as a "placement" that is exempt therefrom, will primarily depend on whether it is contrary to the aims of the two instruments.

In 2008, the parties adopted a resolution that clarifies when one specific ocean CDR technique–ocean fertilization–will be considered contrary to the aims of the London Convention and London Protocol, and thus qualify as dumping.[96] The resolution drew a distinction between ocean fertilization activities conducted for the purposes of legitimate scientific research and non-research activities. With respect to the latter, the parties concluded that:

> [G]iven the present 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 qualify for any exemption from the definition of dumping.[97]

Interestingly, and contrary to the suggestion in this statement, classifying non-research projects as "dumping" does not necessarily mean that they will "not be allowed." Previous analysis has found that parties to the London Convention could issue dumping permits for ocean fertilization activities because those activities do not involve the discharge of any "blacklisted" substance identified in Annex I of the Convention.[98] However, because of the broader prohibition on dumping in the London Protocol, parties to that instrument likely could not permit ocean fertilization activities (i.e., because the materials discharged in ocean fertilization are not listed in Annex I to the Protocol).

Regardless, it is clear that when the parties adopted the 2008 resolution they were concerned about the potential adverse impacts of ocean fertilization, and felt it should be restricted. The resolution expressly states that "knowledge on the effectiveness and potential environmental impacts of ocean fertilization is currently

[93] London Convention, *supra* note 23, Art. II; London Protocol, *supra* note 24, Art. 1.
[94] Webb et al., supra note 57, at 58.
[95] *Id*.
[96] Resolution LC-LP.1(2008) on the Regulation of Ocean Fertilization (adopted 31 October 2008), Art. 1 [hereinafter "2008 Resolution"].
[97] *Id.* cl. 8.
[98] Korey Silverman-Roati et al., Removing Carbon Dioxide Through Ocean Fertilization: Legal Challenges and Opportunities 14 (2022), https://scholarship.law.columbia.edu/faculty_scholarship/3637/

insufficient to justify activities other than legitimate scientific research."[99] At the same time, however, the parties recognized the need "to provide for legitimate scientific research."[100]

In the 2008 resolution, the parties agreed that "legitimate scientific research . . . should be regarded as placement of matter for a purpose other than mere disposal," and pledged to evaluate research proposals on a case-by-case basis "to ensure protection of the marine environment consistent with the [aims of the] Convention and Protocol."[101] In 2010, the parties adopted an assessment framework, which provides further guidance on evaluating ocean fertilization research projects.[102] The framework provides for a two-stage review, comprising an "initial assessment" to determine whether a project "has proper scientific attributes to qualify as "legitimate scientific research," followed by an "environmental assessment" to determine whether the project is contrary to the aims of the London Convention and Protocol.[103]

While the 2008 resolution and 2010 assessment framework are expressed to apply only to ocean fertilization, the parties to the London Convention and Protocol recently agreed that they should also be applied to other ocean CDR techniques. In 2023, the parties issued a Statement on Marine Geoengineering in which they concluded that ocean CDR techniques such as OAE and seaweed cultivation and sinking have "the potential for deleterious effects that are widespread, long-lasting, or severe".[104] As such, the parties determined that use of the techniques, other than in connection with "legitimate scientific research, should be deferred."[105] The statement went on to state: "The governing bodies are of the view that the requirements set out in the [2010] Assessment Framework for Scientific Research Involving Ocean Fertilization . . . form the appropriate basis for the assessment of proposed research and development project" involving OAE, seaweed cultivation and sinking, and certain other marine geoengineering activities.[106]

It is important to note that the 2008 resolution, 2010 assessment framework, and 2023 statement are not legally binding. Some scholars have, however, argued that the instruments must be consulted when interpreting the provisions of the London Convention and London Protocol.[107] There is no doubt that the instruments are highly influential and, as such, countries that fail to comply with them could face pushback from the international community.

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[99] 2008 Resolution, *supra* note 96, Preamble.
[100] *Id*. cl. 3.
[101] *Id*. cl. 3-4.
[102] Resolution LC-LP.2(2010) on the Assessment Framework for Scientific Research Involving Ocean Fertilization (adopted 14 October 2010) [hereinafter "2010 Resolution"].
[103] *Id*. Annex I & 6.
[104] International Maritime Organization, *45th Consultative Meeting of Contracting Parties to the London Convention and 18th Meeting of Contracting Parties to the London Protocol, LC 45/LP18*, https://www.imo.org/en/MediaCentre/MeetingSummaries/Pages/LC-45-LP-18.aspx (last visited Feb. 20, 2024).
[105] *Id*.
[106] *Id*.
[107] Alexander Proelss, *Law of the Sea and Geoengineering, in* LAW OF THE SEA: NORMATIVE CONTEXT AND INTERACTIONS WITH OTHER LEGAL REGIMES (Nele Matz-Lück et al. eds., Routledge, 2023).

4.2 London Protocol Amendment on Marine Geoengineering

In 2013, the parties to the London Protocol agreed to an amendment, aimed at regulating so-called "marine geoengineering" activities.[108] The amendment has not yet entered into force but, if and when it does, it will insert a new provision into the London Protocol as follows:

> Contracting Parties shall not allow the placement of matter into the sea from vessels, aircraft, platforms or other man-made structures at sea for marine geoengineering activities listed in annex 4 [to the London Protocol], unless the listing provides that the activity . . . may be authorized under a permit.[109]

The term "marine geoengineering" is defined broadly to include any "deliberate intervention in the marine environment to manipulate natural processes, including to counteract 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."[110] This definition could encompass a wide range of ocean CDR techniques but, to date, only ocean fertilization has been listed under the 2013 amendment. Consistent with the approach adopted in the 2008 resolution, the 2013 amendment provides that only ocean fertilization projects involving "legitimate scientific research" may be permitted, and sets out a process for reviewing projects that mirrors the requirements of the 2010 assessment framework (described above).[111] Each country that is a party to the London Protocol must designate a national authority to review and issue permits for proposed projects under the country's jurisdiction (eg, projects that are conducted using vessels that fly the country's flag or were loaded in its territory and projects that occur within the country's territorial sea or EEZ).

Since only ocean fertilization is currently listed under the 2013 amendment, the amendment is not directly applicable to other ocean CDR activities. There is, however, a growing push to expand the list of activities covered by the amendment. A Working Group established under the Group of Experts on the Scientific Aspects of Marine Environmental Protection ("GESAMP") recently identified the following seven marine geoengineering techniques as potential candidates for listing:

1. fertilization for fish stock enhancement
2. macroalgae cultivation for sequestration including artificial upwelling
3. microbubbles / reflective particles / materials;
4. marine cloud brightening
5. alkalinization of the ocean by adding alkaline material directly to the ocean or by electrochemistry;

[108] Resolution LP .4(8), Amendment to the 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 to Regulate Marine Geoengineering (adopted 18 October 2013, not in force) [hereinafter "2013 Amendment"].
[109] *Id*. Annex 1, Art. 1.
[110] *Id*.
[111] *Id*.

6. mineralization of carbon dioxide in rocks under the seabed; and
7. extraction of carbon dioxide from seawater.[112]

The parties to the London Protocol subsequently agreed to prioritize evaluation of four of the techniques.[113] Two of the prioritized techniques – (1) "macroalgae cultivation and other biomass sequestration including artificial upwelling" and (2) "enhancing ocean alkalinity" – involve ocean CDR.[114] The other two are solar radiation management techniques (i.e., the techniques that seek to reduce climate change by reflecting solar radiation into outer space) and thus are not discussed in this article.

In 2022, the parties to the London Protocol established a working group (known as the Legal Intersessional Correspondence Group on Marine Geoengineering) to consider, among other things, whether the four priority techniques are eligible for listing under the 2013 amendment. In a draft report issued in June 2023, the group concluded that activities involving the sinking of macroalgae and other forms of biomass, including biomass grown on land, are eligible for listing under the 2013 amendment.[115] The Group reached the same conclusion with respect to OAE activities that involve adding alkaline materials (e.g., ground alkaline rock or alkaline solution produced through electrochemical processes) to the ocean.[116] Notably, however, the group took a different view of OAE approaches involving "controlled alkalinisation in reactors with discharge of a [carbon dioxide]-equilibrated solution to the marine environment."[117] According to the group, while the equilibrated solution would be placed in the ocean, that placement would arguably not be for the purposes of marine geoengineering, at least where the drawdown of carbon dioxide only occurs within the reactor and there is no additional drawdown after the solution is added to the ocean. In that situation, adding the solution to the ocean would be an act of disposal, done to get rid of the solution, not to manipulate natural processes to counteract climate change. Given this, the group concluded that OAE approaches involving "controlled alkalinisation in reactors" may not be eligible for listing under the 2013 amendment.[118]

The practical effect of listing additional activities under the 2013 amendment is somewhat uncertain. The 2013 amendment has not yet entered into force and thus is not, strictly speaking, legally binding. However, under

[112] 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, LC/SG 44/16 (29 April 2021).
[113] International Maritime Organization, *Marine geoengineering techniques for climate change mitigation - LP/LC evaluates potential for marine environment effects,* https://www.imo.org/en/MediaCentre/PressBriefings/pages/Marine-geoengineering.aspx (last visited Feb. 20, 2024).
[114] *Id*.
[115] Progress Report from the Legal Intersessional Correspondence Group on Marine Geoengineering, LC 45/5/1 (30 June 2023), annex, 10-12 [hereinafter "2023 Progress Report"].
[116] *Id*. Annex, 1-6.
[117] *Id*. Annex, 7-9. A committee established under the London Convention / Protocol to study marine geoengineering described this approach to AOE as follows: "Alkaline material is added to seawater in chemical reactors. The alkaline seawater is then brought into contact with a CO_2-rich atmosphere (ideally concentrated CO_2 from point sources, but could theoretically be surrounding air or ship emissions). A CO_2- equilibrated (in terms of OAE-induced CO_2 uptake) solution is discharged to the ocean not leading to larger pH-changes." *See* Progress Report from the Correspondence Group on Marine Geoengineering, LC 45/5 (30 June 2023), Annex, 17.
[118] 2023 Progress Report, *supra* note 115, at Annex, 7-9.

the Vienna Convention on the Law of Treaties, countries are required to refrain from acts that would defeat the object and purpose of a treaty that they have consented to but that has not yet entered into force.[119] Relying on this, in June 2023, the Legal Intersessional Correspondence Group on Marine Geoengineering issued a draft statement indicating that London Protocol "parties . . . who accepted the 2013 amendment [shall][should] refrain from acts which would defeat the object and purpose of the amendment pending its entry into force."[120] The statement goes on to state that London Protocol parties "who have not yet accepted the amendment" and parties to the London Convention "are strongly encouraged to refrain from such acts."[121] The square brackets above reflect the fact that members of the committee could not agree on whether to use the word "shall" or "should" in the statement. This disagreement further highlights the uncertainty and confusion regarding the effect of the 2013 amendment.

5. FUTURE DIRECTIONS FOR INTERNATIONAL GOVERNANCE OF OCEAN CDR

As the foregoing discussion shows, while the global climate change regime has generally been supportive of CDR, other international treaty regimes could significantly restrict the use of ocean-based CDR techniques. The restrictions imposed under agreements such as the London Convention and London Protocol stem from a concern, within the international community, that ocean CDR activities present unknown but potentially significant risks to marine ecosystems. That is a legitimate concern that must be taken seriously. Further research is urgently needed to fill existing gaps in knowledge and answer key questions about both the potential adverse effects, and the potential climate and other benefits, of different ocean CDR techniques. Many of those questions can only be answered through in-ocean research and, in some cases, relatively large scale and/or long duration in-ocean field trials may be required. That creates a challenge for governance, necessitating the development of a regime that facilitates potentially large-scale experimentation with often unknown impacts, while still safeguarding marine ecosystems.

The parties to the London Convention and London Protocol have recognized the importance of enabling further research into ocean CDR, but have said that only "legitimate scientific research" should be allowed. Determining what counts as legitimate scientific research and what does not is proving very challenging, however. At a meeting of the parties to the London Convention and London Protocol in October 2023, Iceland announced that it had allowed a private company–Running Tide–"to undertake scientific research on carbon removal . . . by floating 50,000 tonnes of buoys made from forestry material, with macroalgea cultivation, that would eventually sink into the deep sea."[122] Iceland noted that its Ministry of the Environment, Energy, and

[119] Vienna Convention on the Law of Treaties, 1155 UNTS 331 (1969), Art. 18(b).
[120] 2023 Progress Report, *supra* note 115, annex, 5.
[121] *Id*.
[122] Report of the Forty-Fifth Consultative Meeting and the Eighteenth Meeting of Contracting Parties, LC 45/17 (30 October 2023), para 5.15.2.

Climate had concluded that the project did not require a dumping permit "since the purpose of the [project] was not to dispose of material but to place it in the ocean for the purpose of research."[123] In response, a representative of GESAMP opined that "the scale of the activity . . . was well above what would normally be considered research scale," and suggested that further assessment was needed.[124] This is especially notable given that the 2010 assessment framework does not establish any size limit for research projects.

The 2010 assessment framework does provide some guidance for determining whether a project involves legitimate scientific research. Among other things, the assessment framework states that research projects "should be designed to answer questions that will add to the body of scientific knowledge," "economic interests should not influence the design, conduct, and/or outcomes of" the project, and "[t]here should not be any financial and/or economic gain arising directly from the [project] or its outcomes."[125] How should these criteria be applied to, for example, a privately funded research project that is designed to verify the amount and duration of carbon storage associated with a particular ocean CDR technique so as to enable its commercialization? The criteria would seem to exclude any project with a commercial aim, since the "outcomes" of such a project may lead to "financial and/or economic gain." But that could cut off an important source of funding for research and delay scientific progress in a field that could play an important role in mitigating climate change.

The parties to the London Convention and London Protocol have recently suggested that the potential for ocean CDR to help mitigate climate change should not factor into their assessment of whether and when to allow research. A report of the October 2023 meeting of the parties noted that discussions under the London Convention and London Protocol "were focusing solely on risks" associated with ocean CDR and not its potential climate or other benefits.[126] Some parties indicated that they "could not support the consideration of benefits as the aim of the [London Protocol] was marine environmental protection."[127] Some also opined that efforts to address climate change "should be focused on reducing the causes of climate change rather than mitigating the impact."[128]

These statements arguably reflect a misunderstanding of ocean CDR and how it might be used to advance climate and other environmental goals. The IPCC has made clear that, while CDR cannot substitute for GHG emissions reductions, it is an essential component of the global climate change response. Like emissions reductions, CDR addresses the cause of climate change, namely the increasing accumulation of GHGs in the Earth's atmosphere, and both will be needed to achieve the goals set in the Paris Agreement. Moreover, by helping to mitigate climate change, CDR could also help to advance the marine environmental protection goals

[123] *Id*.
[124] *Id.*
[125] 2010 Assessment Framework, *supra* note 102, annex I, cl. 2.2.
[126] Report of the Forty-Fifth Consultative Meeting and the Eighteenth Meeting of Contracting Parties, LC 45/17 (30 October 2023), para 5.11.
[127] *Id*. para 5.12.
[128] *Id*. para 5.10.

of the London Convention and London Protocol. The marine environment is currently threatened by climate change, which is leading to higher water temperatures and more frequent and severe marine heat waves, as well as increased ocean acidification and deoxygenation, with serious adverse consequences for marine life.[129]

All of this suggests that a new approach to ocean CDR governance is needed. An approach that more effectively accounts for both the potential benefits of ocean CDR and its potential harms would help to promote greater coherence between the global ocean governance regime and the global climate change regime and simultaneously advance the goals of those two regimes. One way to operationalize this would be by adopting a balancing approach similar to what has been discussed in the context of UNCLOS (see section 3.2 above). The new BBNJ Treaty, adopted under UNCLOS, might provide an avenue for that.

5.1 Applying the BBNJ Treaty to Ocean CDR Activities

The BBNJ Treaty was adopted in June 2023 after nearly a decade under negotiation. In June 2015, the United Nations General Assembly adopted Resolution 69/292, calling for the development "of an international legally binding agreement under [UNCLOS] on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction."[130] A preparatory committee was established to "make substantive recommendations to the General Assembly on the elements of the" new agreement[131] and met four times between 2016 and 2017.[132] After receiving the committee's report, the General Assembly adopted Resolution 77/249, "conven[ing] an international conference, under the auspices of the United Nations, to consider the recommendations of the Preparatory Committee on the elements and to elaborate the text of" the new agreement "with a view to developing the instrument as soon as possible."[133] The conference held six negotiating sessions from 2017 to 2023, before finally reaching agreement on the text of the new agreement in June 2023.[134]

The aim of the new BBNJ treaty is to "ensure the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction," meaning the High Seas and The Area.[135] The BBNJ Treaty recognizes that "climate change impacts . . . such as warming and ocean deoxygenation, as well as ocean acidification," pose a threat to marine ecosystems and calls for an "approach that builds ecosystem resilience .

[129] European Environment Agency, *How Climate Change Impacts Marine Life,* https://www.eea.europa.eu/publications/how-climate-change-impacts#:~:text=Globally%2C%20oceans%20are%20changing.,to%20adapt%20to%20the%20changes. (last visited Mar. 28, 2024)
[130] United Nations G.A. Resolution 69/292, Art. 1 (June 19, 2015).
[131] *Id*. Art. 1(a).
[132] United Nations, *Background*, Intergovernmental Conference on Marine Biodiversity of Areas Beyond National Jurisdiction, https://www.un.org/bbnj/content/background (last visited Mar. 26, 2024).
[133] United Nations G.A. Resolution 72/249, Art. 1 (Dec. 24, 2017).
[134] Nguyen Thanh Trung, *The BBNJ Agreement: Links between the New and Existing Laws on Protecting Marine Biodiversity*, CIL Dialogues: An International Law Blog (Apr. 17, 2023), https://cil.nus.edu.sg/blogs/the-bbnj-agreement-links-between-the-new-and-existing-laws-on-protecting-marine-biodiversity/
[135] BBNJ Treaty, *supra* note 40, Art. 1 & 2.

. . to adverse effects of climate change and ocean acidification, and also maintains and restores ecosystem integrity, including the carbon cycling services that underpin the ocean's role in climate."[136]

One way in which the BBNJ Treaty seeks to achieve these goals is through the use of area-based management tools. The BBNJ Treaty defines an area-based management tool as "a tool, including a marine protected area, for a geographically defined area through which one or several sectors or activities are managed with the aim of achieving particular conservation and sustainable use objective."[137] In the future, area-based management tools may be used to control where activities, like ocean CDR, take place and direct them away from high biodiversity areas, areas subject to competing uses, or other unsuitable locations.[138] Area-based management tools could also be used to control the manner in which ocean CDR activities take place, for example, by requiring a staged approach to research that involves constant reassessment of projects based on new scientific findings.

The BBNJ Treaty sets out a robust process for establishing area-based management tools that should, if implemented effectively, promote a balanced approach to ocean CDR governance. Parties to the BBNJ Treaty may develop proposals for area-based management tools, which may then be accepted (or rejected) by the full Conference of the Parties.[139] Proposals must be based on the "best available science" and developed with input from "relevant stakeholders," including "civil society, the scientific community, the private sector, Indigenous Peoples and local communities."[140] The Secretariat of the BBNJ Treaty must facilitate "[c]onsultations on proposals," which must be "inclusive, transparent and open to all relevant stakeholders."[141] The Secretariat must, among other things, notify and invite submissions from bodies of other relevant legal instruments and frameworks.[142] Further, if a proposal is accepted, the parties must "make arrangements for regular consultations to enhance cooperation and coordination with and among relevant legal instruments and frameworks."[143] This should promote greater engagement across, and coherence between, treaty regimes. That could, in turn, help to avoid the type of one-sided assessments that have occurred under treaties such as the London Convention and Protocol (i.e., where the parties have focused solely on the risks posed by ocean CDR activities and ignored their potential benefits because they are the subject of a different treaty regime). Moreover, the requirements for consultation with the scientific community and other stakeholders should ensure that countries hear a range of viewpoints, and thus can undertake a balanced assessment that accounts for both the benefits and risks of ocean CDR activities.

[136] *Id.* Preamble & Art. 5.
[137] *Id*. Art. 1(1).
[138] Wil Burns & Romany M. Webb, R, *The Biodiversity Beyond National Jurisdiction treaty and its implications for marine-based carbon dioxide removal*, ILLUMINEM, blog post, Aug. 23, 2023, https://illuminem.com/illuminemvoices/the-biodiversity-beyond-national-jurisdiction-treaty-and-its-implications-for-marinebased-carbon-dioxide-removal (last visited Feb. 5, 2024).
[139] BBNJ Treaty, *supra* note 40, Art. 19(1).
[140] *Id*. Art. 19(2)-(3).
[141] *Id*. Art. 21(1)-(2).
[142] *Id*. Art. 21(2)(b).
[143] *Id*. Art. 22(3).

This type of balanced assessment is also supported by other parts of the BBNJ Treaty. Most notable are the provisions in Part IV of the BBNJ Treaty requiring assessment of the environmental and other impacts of ocean-based activities. Under the BBNJ Treaty, where a country determines that an activity under its jurisdiction or control "may have more than a minor or transitory effect on the marine environment or the effects of the activity are unknown or poorly understood," the country must "conduct a screening of the activity" to determine if it "may cause substantial pollution of or significant and harmful changes to the marine environment."[144] If there are "reasonable grounds for believing that the activity" may have such effects, an environmental impact assessment must be conducted.[145] The assessment must identify the activity's various environmental impacts, along with "associated impacts, such as economic, social, cultural, and human health impacts."[146] Similar to the process for developing area based management tools, environmental impact assessment must be conducted in a "transparent and inclusive" manner, and provide "opportunities for participation" by "Indigenous Peoples and local communities with relevant traditional knowledge, relevant global, regional, subregional and sectoral bodies, civil society, the scientific community, and the public."[147]

Given the limited state of knowledge about ocean CDR, projects will often have unknown or poorly understood effects, and thus require screening.[148] In some cases, that screening may reveal that a project will cause pollution of the marine environment or have other harmful effects on it, necessitating a full environmental impact assessment. In conducting that assessment, countries can and should evaluate not only the risks posed by the project, but also its potential benefits. Here, again, the robust consultation requirements in the BBNJ Treaty should ensure that countries hear from stakeholders on both sides and can undertake a balanced assessment of projects.

As the foregoing discussion suggests, the BBNJ Treaty has great potential to improve international governance of ocean CDR, but whether that potential is realized will ultimately depend on countries' willingness and ability to implement it effectively. The treaty was opened for signature in September 2023 and, at the time of writing, had been signed by eighty-eight countries and the European Union.[149] Only two countries—Chile and Palau—had ratified the treaty, however. For the treaty to enter into force, it must be ratified by at least sixty countries, which could take several years. In the meantime, ocean CDR development will face continued governance challenges, which countries will need to address through existing treaty regimes.

[144] *Id*. Art. 30(1).
[145] *Id*.
[146] *Id*. Art. 31.
[147] *Id*. Art. 32.
[148] Burns & Webb, *supra* note 138.
[149] UN, *Status of Treaties: Agreement under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas beyond National Jurisdiction*, https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXI-10&chapter=21&clang=_en (last visited Mar. 28, 2024).