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THE INTERNATIONAL LEGAL FRAMEWORK OF OCEANIC SHIPPING OF CARBON DIOXIDE FOR PERMANENT STORAGE

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I. INTRODUCTION

The Intergovernmental Panel on Climate Change defines carbon dioxide capture and storage (CCS) as "a process in which a relatively pure stream of *carbon dioxide (CO_2)* from industrial and energy-related sources is separated (captured), conditioned, compressed, and transported to a storage location for long-term isolation from the *atmosphere*."[1] Therefore, CCS encompasses a

1. Intergovernmental Panel on Climate Change (IPCC), *Annex I: Glossary in* GLOBAL WARMING OF 1.5°C. AN IPCC SPECIAL REPORT ON THE IMPACTS OF GLOBAL

series of steps, at minimum: capturing carbon dioxide, its transportation to a storage site, and its injection into the subsurface for permanent storage.[2] As such, CCS does not refer to any single activity or technology.[3] This Article focuses on the transportation aspect of CCS and, more precisely, on the cross-border shipping of carbon dioxide for permanent storage (sequestration) abroad.[4] This Article presents a comprehensive review of the current international legal framework applicable to the transboundary transportation of carbon dioxide.

The issue of cross-border transportation of carbon dioxide for permanent storage is of academic and practical interest, especially when considering the current levels of greenhouse gases (GHGs) in the atmosphere[5] and the need for storing carbon

WARMING OF 1.5°C ABOVE PRE-INDUSTRIAL LEVELS AND RELATED GLOBAL GREENHOUSE GAS EMISSION PATHWAYS, IN THE CONTEXT OF STRENGTHENING THE GLOBAL RESPONSE TO THE THREAT OF CLIMATE CHANGE, SUSTAINABLE DEVELOPMENT, AND EFFORTS TO ERADICATE POVERTY (J. B. Robin Matthews ed., 2018), https://www.ipcc.ch/sr15/chapter/glossary [https://perma.cc/PER3-P7P7]. This IPCC Report refers to carbon dioxide capture and storage as a synonym for carbon capture and storage but distinguishes CCS from carbon dioxide capture and utilization (CCU). According to the IPCC, CCU is "a process in which CO_2 is captured and then used to produce a new product. If the CO_2 is stored in a product for a *climate*-relevant time horizon, this is referred to as carbon dioxide capture, utilisation and storage (CCUS). Only then, and only combined with CO_2 recently removed from the *atmosphere*, can CCUS lead to *carbon dioxide removal*. CCU is sometimes referred to as carbon dioxide capture and use." (emphasis in original).

2. Karl W. Bandilla, *Carbon Capture and Storage in* FUTURE ENERGY: IMPROVED, SUSTAINABLE AND CLEAN OPTIONS FOR OUR PLANET 669, 669–70 (Trevor M. Letcher ed., 2020).

3. The Royal Society, *Climate change Science and Solutions: Carbon Dioxide Capture and Storage* 3 (2021), https://royalsociety.org/-/media/policy/projects/climate-change-science-solutions/climate-science-solutions-ccs.pdf [https://perma.cc/X9XB-ST5P] (highlighting that most CCS systems are designed to capture from eighty-five percent to ninety-five percent of the carbon dioxide source point and higher capture targets significantly increases costs).

4. The issue of transboundary "migration" once the carbon dioxide is injected or stored is outside the scope of this Article.

5. Richard S. J. Tol, *Quantifying the Consensus on Anthropogenic Global Warming in the Literature: A Re-Analysis,* 73 ENERGY POL'Y 701, 701–05 (2014) (The scientific community overwhelmingly acknowledges the existence of climate change and that GHG emissions are a primary cause); Ove Hoegh-Guldberg et al., *The Human Imperative of Stabilizing Global Climate Change at 1.5°C*, 365 SCI. 1–11 (2019) (contending that multiple lines of evidence indicate that the next 0.5°C increase in temperature would bring more adverse impacts than the previous 0.5°C uptick).

dioxide outside Europe, in particular.[6] There is a vast literature discussing technical aspects of CCS[7] and the experience of sectors and specific countries with CCS.[8] Books and research exclusively

6. Because of the curtailing of natural gas from Russia, Europe increased its reliance on coal, despite the increasing costs of carbon dioxide emissions in the EU; to reduce these costs, carbon dioxide transported from Europe to be stored in the United States is of interest because Europe overall lacks vast storage capacity (except for a few countries such as Denmark and Iceland). Stephen Rassenfoss, *Europe Wants to Export Its CO_2 – The Question Is Who Wants It?*, J. PETROLEUM TECH. (Jan. 15, 2023), https://jpt.spe.org/europe-wants-to-export-its-co2-the-question-is-who-wants-it [https://perma.cc/SJ27-3RBF].

7. Reference books on these aspects include the following: R. E. HESTER & R.M HARRISON, CARBON CAPTURE: SEQUESTRATION AND STORAGE (2009) (published by the Royal Society of Chemistry, this book focuses on the chemical aspects of CCS); BASH O. DABBOUSSI ET AL., CARBON CAPTURE AND STORAGE: TECHNOLOGIES, POLICIES, ECONOMICS, AND IMPLEMENTATION STRATEGIES (2011) (addressing the technological aspects of CCS and related deployment drivers over a decade ago); GEOLOGICAL STORAGE OF CARBON DIOXIDE (CO_2): GEOSCIENCE, TECHNOLOGIES, ENVIRONMENTAL ASPECTS AND LEGAL FRAMEWORK (Jon Gluyas & Simon Mathias eds. 2013); MALTI GOEL ET AL., CARBON CAPTURE, STORAGE, AND UTILIZATION (2014) (mainly discussing the technological aspects involved in the context of decarbonization needs); SMIT BERENT ET AL., INTRODUCTION TO CARBON CAPTURE AND SEQUESTRATION (2014) (addressing engineering and chemistry aspects of the literature while considering some energy policy implications of CCS); CARBON, CAPTURE, STORAGE AND USE: TECHNICAL, ECONOMIC, ENVIRONMENTAL AND SOCIETAL PERSPECTIVES (Wilhelm Kuckshinrichs & Jürgen-Friedrich Hake eds., 2015) (discussing technical aspects of CCS in the EU and targeting different sectors, such as energy and transportation); YONGSEUNG YUN, RECENT ADVANCES IN CARBON CAPTURE AND STORAGE (2017) (This is a technical, engineering-oriented contribution); HOWARD J. HERZOG, CARBON CAPTURE (2018) (presenting the technological aspects of CCS in the larger context of decarbonization); BIOENERGY WITH CARBON CAPTURE AND STORAGE (Jose Carlos Magalhaes Pires & Ana Luisa da Cunha eds., 2019) (focusing on bioenergy, engineering and technology).

8. For specific authoritative book sources on such a topic, see, *e.g.*, NILS MARKUSSON ET AL., THE SOCIAL DYNAMICS OF CARBON CAPTURE AND STORAGE (2012) (analyzing public participation and related perception and representation of CCS projects); MICHAEL FAURE & ROY A. PARTAIN, CARBON CAPTURE AND STORAGE (2017) (centering on CCS's liability regimes and allocation of incentives for these regimes); BIOMASS ENERGY WITH CARBON CAPTURE AND STORAGE (BECCS) (Clair Gough et al. eds. 2018) (focusing on biomass energy and CCS and technical aspects pertinent to legal frameworks). More recently, *see, e.g.*, CARBON CAPTURE AND STORAGE: EMERGING LEGAL AND REGULATORY ISSUES (Ian Havercroft et al. eds., 2018) (discussing key regulatory aspects of CCS in several jurisdictions: Australia, China, the European Union, India, the United States, and the United Kingdom); CARBON CAPTURE AND STORAGE (Jose Carlos Magalhaes Pires et al. eds., 2019) (This is technology and engineering-oriented work which also considers the environmental feasibility of CCS projects); finally, CARBON CAPTURE AND STORAGE (CCS) IN INTERNATIONAL ENERGY POLICY AND LAW: PERSPECTIVES ON SUSTAINABLE DEVELOPMENT, CLIMATE CHANGE, AND ENERGY TRANSITION (Hirdan Katarina de M. Costa & Carolina Arlota eds., 2021) (discussing CCS in the context of international energy law and policies).

dedicated to the international legal framework of oceanic shipping of carbon dioxide for permanent storage are missing.[9]

Meanwhile, CCS is experiencing increasing momentum both internationally and supranationally. In 2021, Canada committed to spending CAD$319 million over seven years on CCUS.[10] In the Indo-Pacific region, ministers from Australia, Brunei Darussalam, Fiji, India, Indonesia, Japan, the Republic of Korea, Malaysia, New Zealand, Philippines, Singapore, Thailand, the United States, and Vietnam have specifically agreed to pursue provisions and initiatives supporting demand and supply for carbon capture, utilization, transport, and storage in the region.[11] The European Union, under the so-called Trans E-Regulation, is significantly investing in carbon dioxide transportation and storage as part of its energy infrastructure.[12] The European Union and United Kingdom are jointly advancing CCS with over €3 billion in funding for research,[13] along with many new facilities

9. The authors conducted a Google search on November 4, 2023 and found no books exclusively dedicated to the cross-border shipping of carbon dioxide. The Sabin Center for Climate Change Law's comprehensive database on CCS law, cdrlaw.org, currently has 484 academic works, legal provisions, and model law entries on CCS and transportation, but none exclusively address the applicable international legal framework for the oceanic shipping of carbon dioxide for sequestration. SABIN CENTER FOR CLIMATE CHANGE LAW, CARBON DIOXIDE REMOVAL DATABASE, https://cdrlaw.org [https://perma.cc/E377-LB7Q] (last visited Apr. 30, 2024).

10. *A Recovery Plan for Jobs, Growth and Resilience: Budget 2021*, GOV'T OF CANADA https://www.budget.canada.ca/2021/home-accueil-en.html [https://perma.cc/AA96-P654] (last visited Apr. 30, 2024).

11. Ministerial Statement for Pillar III of the Indo-Pacific Economic Framework for Prosperity, *Indo-Pacific Economic Framework for Prosperity (IPEF): Pillar III- Clean Economy* 2 (Sept. 9, 2022), https://id.usembassy.gov/ministerial-statements-for-the-four-ipef-pillars-trade-supply-chains-clean-economy-and-fair-economy [https://perma.cc/6YVX-967Q].

12. Commission Regulation 2022/869, 2022 O.J., amending commission regulation 715/2009, O.J, Commission Regulation 2019/942, 2019, O.J, Commission Regulation 2019/943, 2019, O.J and Directive 2009/73/EC, 2009, O.J., Commission Regulation 2019/944, and repealing Commission Regulation 347/2013, 2022, O.J.; whereas Articles 4(2)(f) and 3(c) establish additional investments for projects of mutual interest of the EU on cross-border transportation and storage of carbon dioxide.

13. *Carbon Capture, Storage and Utilisation,* EUR. COMM'N, (Dec. 1, 2022), https://energy.ec.europa.eu/topics/oil-gas-and-coal/carbon-capture-storage-and-utilisation_en [https://perma.cc/R7DZ-SU64].

being constructed,[14] with several NGOs actively supporting CCS.[15] Norway is particularly invested in CCS transportation and storage, with the first drilling in its Northern Lights project having been completed in November 2022 and predicting five million tons of annual storage capacity for carbon dioxide.[16] Late in 2022, Mission Innovation, a collaborative initiative of twenty-two countries and the European Union, launched the Green Shipping Corridors Hub, which aims to develop zero-emission shipping corridors.[17] Ultimately, this research is of practical interest, particularly after the pioneer cross-border shipping of carbon dioxide for permanent storage that occurred in March 2023.[18]

Academic and practical interest in the cross-border shipping of carbon dioxide for permanent storage is poised to increase. The contemporary law of the sea is based on the "freedom of the seas," which establishes oceans as a "global commons upon which

14. *See, e.g., E.U. Approves €1.1 Billion Danish CCS Scheme*, CARBON & CAPTURE J. (Jan. 13, 2023) (informing the approval of CCS financial support under the EU's State aid program); Zsuzsanna Szabo, *Norway's Horisont Selects Storage Site for Major Carbon Capture Scheme*, UPSTREAM ENERGY (Jan. 6, 2023); *E.U. Innovation Fund to Invest in Seven CCS and CCU Projects*, GLOBAL CCS INSTITUTE (Jul. 14, 2022) (informing that an Iceland onshore CCS project will store over 850 million tons of carbon dioxide); *Discussion on the Long-Term Deployment of CCS Technology in the CEE Region is Underway Again*, GLOBAL CCS INST. (Nov. 7, 2022) (There is a roadmap for Central and Eastern Europe–CEE that supports CCS deployment in the region). GLOBAL CCS INST., FACILITIES: CO_2RE DATABASE, https://co2re.co/FacilityData [https://perma.cc/92H2-Y4EZ] (CO_2RE is an extensive database containing projected CCS commercial plans expected for 2025, encompassing several countries such as Italy (2026), Belgium (2030), and the UK, which has numerous projects albeit no longer being part of the European Union).

15. Open Letter: NGOs Calls for E.U. Carbon and Capture and Storage Policy, CARBON AND CAPTURE J.(Dec. 20, 2022) (The letter, which had signatories from Denmark, Germany, Netherlands, Poland, and Romania, underscored the importance of CCS for the Paris Agreement targets).

16. *Carbon Storage Well Drilling Complete*, CCS NORWAY *Complete* (Nov. 11, 2022), (The Northern Lights initiative is part of the Norwegian Longship CCS project).

17. *Green Shipping Corridor Hub*, ZERO-EMISSION SHIPPING MISSION, http://mission-innovation.net/missions/shipping/green-shipping-corridors [https://perma.cc/2HTS-22BH].

18. Carolina Arlota, *Beyond Troubled Waters? Unprecedented cross-border transportation and injection of carbon dioxide (CO2) shows promise*, CLIMATE L. BLOG (March 23, 2023), https://blogs.law.columbia.edu/climatechange/2023/03/23/beyond-troubled-waters-unprecedented-cross-border-transportation-and-injection-of-carbon-dioxide-co2-for-offshore-storage-shows-promise [https://perma.cc/4Q99-78UL] (discussing the unprecedented cross-border transportation of carbon dioxide from Belgium for permanent storage in Denmark).

nations' freedom to travel and extract resources is unimpeded."[19] This freedom to travel, however, can be restricted when threatening the sea commons. Transportation of hazardous and toxic substances presents one such threat.

International agreements on what constitutes a hazardous or toxic substance are not unequivocal. Global definitions of "hazardous" and "toxic" substances may be interpreted differently across domestic regulations.[20] Adding to this complexity, international definitions of "hazardous" and "toxic" substances may depend on domestic regulations.[21] Similarly, there are often subtle distinctions between the movement of waste and dumping; while these two activities are not necessarily related, one may follow the other in practice.[22] Finally, the transboundary movement of carbon dioxide raises difficult

19. DAVID HUNTER ET AL., INTERNATIONAL ENVIRONMENTAL LAW AND POLICY 728-29 (2022) (noting that the law of the sea predates Roman times and citing the following famous passage of Hugo Grotius' MARE LIBERUM (1609): "[T]he sea is common to all because it is so limitless that it cannot become a possession of one, and because it is adapted for the use of all, whether we consider it from the point of view of navigation or of fisheries").

20. Definitions of "hazardous" and "toxic" can be convoluted domestically, being subject to multiple regulatory frameworks. In the United States, for instance, the definitions of "hazardous" and "waste" depend on the class of pollutant and different regulatory frameworks targeted. *See, e.g.*, the Hazardous Materials Transportation Act, 49 U.S.C.A. §§5101–5127; the Clean Air Act, 42 U.S.C.A. §§7401–7671 (defining hazardous at § 7412 (b)(2)); the Federal Hazardous Substance Act, 15 U.S.C.A. §§ 1261–1276 (defining "hazardous" in § 1261 (f)(1) (a – c)).

21. *See, e.g.,* the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal Mar. 22, 1989 (entered into force May 5, 1992), 1673 U.N.T.S. 57 [hereinafter Basel Convention]. Article 1 of the Basel Convention determines:

> Scope of the Convention: 1. The following wastes that are subject to transboundary movement shall be 'hazardous wastes' for the purposes of this Convention: (a) Wates that belong to any category contained in Annex I, unless they do not possess any of the characteristics contained in Annex III; and (b) Wastes that are not covered under paragraph (a) but are defined as, or are considered to be hazardous wastes by the domestic legislation of the Party of export, import or transit.

See also the Bamako Convention on the Ban of Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa, Jan. 30, 1991 (entered into force Apr. 22, 1998) 2101 U.N.T.S. 177 [hereinafter Bamako Convention]; Bamako Convention, art. 2, (1) (b) (In addition to the Convention's list, it considers as hazardous wastes those defined as such in domestic legislation of the State of export, import, or transit).

22. André Nollkaemper, *Transboundary Movement of Hazardous Waste for the Purpose of Dumping at Sea*, 22 MARINE POLLUTION BULL. 377, 377 (1991).

questions on how to classify carbon dioxide under international treaties that were drafted prior to the development of carbon capture and storage technologies.[23]

In such a complex setting, this Article narrows its scope of analysis to solely look at the international agreements that may affect the cross-border transportation of carbon dioxide for sequestration, i.e., permanent storage. It begins by examining the London Convention and Protocol, which is arguably the most important legal framework to understand the regulation of cross-border carbon dioxide transportation and storage. Next, this Article provides an analysis of the Basel and Bamako Conventions. These conventions, while relevant, will likely not impede the movement of carbon dioxide across borders.

Following the more in-depth analysis of the above international treaties, this Article then briefly outlines the potential implications of the following treaties and agreements on regulating transboundary carbon dioxide movement: UNCLOS (*United Nations Convention on the Law of the Sea*); the High Seas Treaty or BBNJ (*United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas Beyond National Jurisdiction*); MARPOL (*International Convention for the Prevention of Pollution from Ships*); OSPAR (*Convention for the Protection of the Marine Environment of the North-East Atlantic*); the HNS Convention (*International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea*); the OECD Wastes Decision; and specific US bilateral treaties involving the transportation of hazardous waste. While each of these treaties and agreements raises interesting considerations regarding the transport and storage of carbon dioxide, ultimately none pose significant barriers to the industry at this time. The Article concludes with reflections on how this patchwork international governance system may hinder the expansion of a nascent carbon capture, transportation, and storage industry.

23. Andy Raine, *Transboundary Transportation of CO_2 Associated with CCS Projects,* 2 CARBON & CLIMATE L. REV. 353, 356 (2008).

II. LONDON CONVENTION AND LONDON PROTOCOL

This section discusses the main provisions relevant to carbon dioxide for storage under the current complex system of the London Convention and the London Protocol. This legal framework only applies to carbon dioxide transport if the carbon dioxide is to be dumped offshore. Should the transported carbon dioxide be stored geologically on land, neither the Convention nor the Protocol would apply.

A. London Convention

The London Convention, or the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, recognizes that "the marine environment and the living organisms which it supports are of vital importance to humanity, and all people have an interest assuring that it is so managed that its quality and resources are not impaired."[24] The Convention requires States to take steps to prevent pollution of the marine environment due to the dumping of waste and other matter.[25]

The following table specifies each of the current eighty-seven parties to the London Convention.[26]

Table 1: Parties to the London Convention

Islamic Republic of *Afghanistan*	Rep. of *Cote d'Ivoire*	Republic of *Iceland*	New Zealand	Republic of *Haiti*
Antigua & Barbuda	Republic of *Croatia*	Islamic Republic of *Iran*	Federal Republic of *Nigeria*	Solomon Islands

24. United Nations Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, Dec. 29, 1972, 1046 U.N.T.S. 120. [hereinafter London Convention], pmbl.

25. *Id.* art. I.

26. INT'L MARITIME ORG. (IMO), STATUS OF IMO TREATIES: COMPREHENSIVE INFORMATION ON THE STATUS OF MULTILATERAL CONVENTIONS AND INSTRUMENTS IN RESPECT OF WHICH THE INTERNATIONAL MARITIME ORGANIZATIONS OR ITS SECRETARY-GENERAL PERFORMS DEPOSITARY OR OTHER FUNCTIONS 565 (2023), https://wwwcdn.imo.org/localresources/en/About/Conventions/StatusOfConventions/Status%202023.pdf [https://perma.cc/XB8E-LXH8].

Table 1: Parties to the London Convention

Republic of *Argentina*	Republic of *Cuba*	Republic of *Ireland*	Kingdom of *Norway*	Republic of *South Africa*
Common-wealth of *Australia*	Republic of *Cyprus*	Republic of *Italy*	Sultanate of *Omani*	Kingdom of *Spain*
Republic of *Azerbaijan*	Democratic People's Republic of *Korea*	Jamaica	Islamic Republic of *Pakistan*	Republic of *Suriname*
Barbados	Kingdom of *Denmark*	Japan	Republic of *Panama*	Kingdom of *Sweden*
Republic of *Belarus*	Dominican Republic	Hashemite Kingdom of *Jordan*	Independent State of *Papua New Guinea*	Swiss Confede-ration (*Switzerland*)
Kingdom of *Belgium*	Arabic Rep. of *Egypt*	Republic of *Kenya*	Republic of *Peru*	Syrian Arab Republic
Republic of *Benin*	Rep. of *Equatorial Guinea*	Republic of *Kiribati*	Republic of the *Philippines*	Kingdom of *Tonga*
Plurination-al State of *Bolivia*	Republic of *Finland*	Libya	Republic of *Poland*	Republic of *Tunisia*
Fed. Republic of *Brazil*	Republic of *France*	Grand Dutchy of *Luxem-bourg*	Republic of *Portugal*	Ukraine
Republic of *Bulgaria*	Gabonese Rep. (*Gabon)*	Republic of *Malta*	Russian Federation	United Arab Emirates
Republic of *Cabo Verde*	Fed. Rep. of *Germany*	United Mexican States (*Mexico)*	Saint Lucia	U. K. of Great Britain & Northern Ireland
Canada	Hellenic Republic (*Greece*)	Principal-ity of *Monaco*	Saint Vincent & the Grenadines	United Republic of *Tanzania*

Table 1: Parties to the London Convention

Republic of *Chile*	Republic of *Guatemala*	Monte-negro	Republic of *Serbia*	United States of America
People's Rep. of *China*	Republic of *Haiti*	Kingdom of *Morocco*	Republic of *Seychelles*	Republic of *Vanuatu*
Republic of the *Congo*	Republic of *Honduras*	Republic of *Nauru*	Republic of *Sierra Leone*	
Republic of *Costa Rica*	Hungary	Kingdom of the *Netherlands*	Republic of *Slovenia*	

The Convention defines dumping as "any deliberate disposal at sea of wastes or other matter from vessels, aircraft, platforms or other man-made structures at sea; and any deliberate disposal at sea of vessels, aircraft, platforms or other mandate structure at sea."[27] Under the Convention, the term "wastes or other matter" is defined to mean "material and substance of any kind, form or description."[28]

According to the London Convention, contracting parties "shall prohibit the dumping of any wastes or other matter in whatever form or condition" except as otherwise authorized under the Convention.[29] The London Convention requires parties to "adopt domestic laws to regulate the dumping of waste and other matters within offshore areas under their jurisdiction . . . and, outside of those areas, by vessels or aircraft that are registered, or were loaded, within their territory."[30]

27. London Convention, *supra* note 24, art. III, § 1(a). Article III, § 1(b), however, excludes from the scope of the London Convention the application of the MARPOL Convention, London Convention, *supra* note 24, art. III, § 1(b); the placement of matter for a purpose other than the mere disposal thereof and as long as not this placement is not contrary to the goals of the Convention; and the disposal of wastes or other matter directly arising from, or related to the exploration, exploitation and associated off-shore processing of sea-bed mineral resources. In practice, the London Convention regulates the intentional dumpling and incineration of wastes at sea from ships. *See* HUNTER ET AL., *supra* note 19, at 785.

28. London Convention, *supra* note 24, art. III, § 4.

29. London Convention, *supra* note 24, art. IV.

30. ROMANY M. WEBB ET AL., REMOVING CARBON DIOXIDE THROUGH ARTIFICIAL UPWELLING AND DOWNWELLING: LEGAL CHALLENGES AND OPPORTUNITIES 20 (2022); *see also* London Convention, *supra* note 24, arts. VI–VII.

Parties to the London Convention must prohibit the dumping of any substances listed in Annex I of the Convention.[31] These Annex I substances are often referred to as "blacklisted substances." To regulate the dumping of other non-blacklisted substances,[32] the Convention establishes a dual system for granting permits. Dumping of wastes and other matter listed in a second annex (Annex II) require a prior special permit, whereas the dumping of all other types of waste and matter that are not listed in either annex require a prior general permit.[33]

Carbon dioxide is not currently listed in Annexes I or II.[34] Therefore, its disposal at sea is not expressly prohibited, nor is it subjected to special permits;[35] only general permits would be required.[36] However, the "blacklisted" substances in Annex I

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31. London Convention, *supra* note 24, art. IV (1) provides as follows:
In accordance with the provisions of this Convention Contracting Parties shall prohibit the dumping of any wastes or other matter in whatever form or condition except as otherwise specified below: (a) the dumping of wastes or other matter listed in Annex I is prohibited; (b) the dumping of wastes or other matter listed in Annex II requires a prior special permit; (c) the dumping of all other wastes or matter requires a prior general permit.

32. London Convention, *supra* note 24, Annex I (11). The list of prohibited substances is as follows: organohalogen compounds; mercury and cadmium and their compounds; persistent plastics and other persistent synthetic materials; crude oil and its wastes, petroleum and refined petroleum products as well as distillate residues and any mixtures containing any of these; radioactive wastes and other radioactive matter; materials in any form produced for biological and chemical warfare. Except for radioactive wastes and related matters, Annex I, 8 determines that the Convention will not apply to these prohibited substances if they are rapidly rendered harmless by physical, chemical or biological process in the sea and provided they do not make edible marine organisms unpalatable or endanger human life of that of domestic animals.

33. London Convention, *supra* note 24, art. IV §§ 1(b), (c). In its relevant provisions to dumping, Annex II substances and materials includes the following: wastes containing significant amount of arsenic, beryllium, chromium, copper, lead, nickel, vanadium, zinc, and their compounds; organosilicon compounds, cyanides, fluorides, pesticides and their by-products not covered in Annex I; containers, scrap metal and other bulky wastes liable to sink to the sea bottom which may present a serious obstacle to fishing or navigation. Annex III details the criteria for issuance of dumping permits for general and special permits.

34. London Convention, *supra* note 24, arts. IV–V.

35. IEAGHG, THE STATUS AND CHALLENGES OF CO_2 SHIPPING INFRASTRUCTURES 56–57 (James Craig ed., 2020).

36. London Convention, *supra* note 24, art. IV §1(c); *see also* Mark A. de Figueiredo, *The Liability of Carbon Dioxide Storage*, (2007) (Ph.D. Dissertation, MIT), https://sequestration.mit.edu/pdf/Mark_de_Figueiredo_PhD_Dissertation.pdf [https://perma.cc/6G42-8LZX] (noting that the Parties of the London Convention have not decided if carbon dioxide could qualified as waste, but it is unlikely such a qualification is applicable).

include "industrial waste," defined as substances generated by manufacturing or processing operations under Annex I.[37] This definition could encompass carbon dioxide captured at manufacturing or other industrial facilities.[38]

The scientific working group of the London Convention, which plays an advisory role, was charged with examining whether carbon dioxide could be considered as "industrial waste" if it originated from a manufacturing or processing operation.[39] However, this question has not yet been answered[40] within the London Convention's framework.[41] If carbon dioxide were considered industrial waste, parties to the London Convention could not issue permits authorizing the dumping thereof.

There are a few potential arguments against including carbon capture for offshore storage in the list of prohibited substances in Annex I of the Convention. The key point is that the Convention aims only to control dumping "at sea" (in other words, in the water).[42] This would not cover carbon dioxide storage, since that would occur in geological formations below the sea column.[43] However, there is a contrary school of thought that interprets the term "dumping at sea" to include anything

37. London Convention, *supra* note 24, Annex I (11).

38. *Id.*; *see also* Mark A. de Figueiredo, *The International Law of Sub-Seabed Carbon Dioxide Storage: A Special Report to the MIT Carbon Sequestration Initiative*, 17–18 (Lab. for Energy and the Environment, 2005) (highlighting that the Convention does not mention carbon dioxide for storage and that a clarification would be relevant, despite concluding that carbon dioxide for storage would not be precluded by the London Convention).

39. IMO, Report of the Twenty-Second Meeting of the Scientific Group to the London Convention (1999).

40. IMO, Reports of the Consultative Meeting of the Parties of the London Convention: LC 21/13, LC 26/15, LC 27/16, LC 28/15, and LC 29/17 (1999), https://docs.imo.org/ [https://perma.cc/499B-NUMY] (registration required); *see also* Viktor Weber, *Are We Ready for the Ship Transport of CO_2 for CCS? Crude Solutions from International and European Law,* 30 REV. EUR. COMP. & INT. L. 387, 388 (2021).

41. Ian Havercroft & Ray Purdy, Carbon Capture and Storage—A Legal Perspective 3 U.N. Sustainable Development (2007), https://sustainabledevelopment.un.org/content/documents/3284havercroft_paper_legal.pdf [https://perma.cc/5WLC-X9NA].

42. London Convention, *supra* note 24, art. III § (1) (The text refers to disposal "at sea.").

43. *Id.*

that occurs at sea, regardless of whether it involves discharges into the water column or injection into the seabed.[44]

While these considerations on whether potential marine carbon dioxide export and storage would be regulated under the London Convention are important, the Convention's true role in these activities cannot be fully evaluated without examining the amendment meant to update and ultimately supersede the London Convention itself: the London Protocol.

B. London Protocol

In 1996, the London Protocol[45] was adopted with the aim of modernizing the London Convention.[46] If and when the London Protocol is ratified by all contracting parties, it will replace the Convention. In the meantime, countries that are party to both instruments are bound by the London Protocol, while the London Convention continues to bind those which have only ratified the Convention and not the Protocol.[47]

The table below details the current parties to the London Protocol and is followed by a map comparing the parties to the London Convention and those of the London Protocol.

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44. Romany Webb & Michael Gerrard, *Sequestering Carbon Dioxide Undersea in the Atlantic: Legal Problems and Solutions*, UCLA L. REV. 1, 16–17 (2018) (highlighting that carbon dioxide injection has been interpreted as to be implicitly included in the London Convention); Yvette Carr, *The International Legal Issues Relating to the Facilitation of Sub-Seabed CO_2 Sequestration Projects in Australia*, AUST. INT'L L. J. 137, 143–45 (2007) (underscoring that carbon dioxide storage would be considered prohibited under the London Convention); Ray Purdy & Richard Macrory, *Geologic Carbon Sequestration: Critical Legal Issues*, Tydall Centre for Climate Change Research 1, 20 (2003), https://www.researchgate.net/publication/268031244_Geological_Carbon_Sequestration_Critical_Legal_Issuues [https://perma.cc/48CR-EZ64] (noting the United Kingdom Government's position is that "their express policy of adhering to the more stringent requirements of the Protocol, and that the limitation of the London Convention in this area should not be taken as denying its application to sub-seabed CO_2 storage; rather it should be read in the light of the current standards set by the Protocol.").

45. 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, Nov. 7, 1996 36 I.L.M. 7 [hereinafter London Protocol].

46. IEA, CARBON CAPTURE AND STORAGE AND THE LONDON PROTOCOL: OPTIONS FOR ENABLING TRANSBOUNDARY CO_2 TRANSFER 9 (Justine Garret et al. eds., 2011).

47. Weber, *supra* note 40, at 388.

Table 2: Parties to the London Protocol [48]

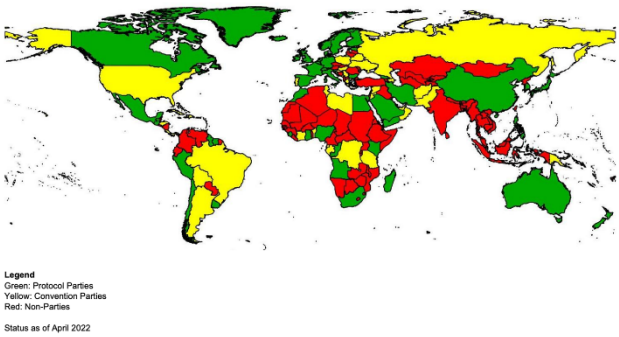
Republic of *Angola*	Kingdom of *Denmark*	Islamic Republic of *Iran*	New Zealand	Republic of *Suriname*
Antigua & Barbuda	Arabic Rep. of *Egypt*	Ireland	Federal Republic of *Nigeria*	Kingdom of *Sweden*
Common-wealth of *Australia*	Republic of *Estonia*	Republic of *Italy*	Kingdom of *Norway*	Swiss Confeder-ation (*Switzerland*)
Barbados	Republic of *Finland*	Japan	Republic of *Peru*	Kingdom of *Tonga*
Kingdom of *Belgium*	Republic of *France*	Republic of *Kenya*	Republic of the *Philippines*	Republic of *Trinidad & Tobago*
Republic of *Bulgaria*	Georgia	Grand Duchy of *Luxembourg*	Saint Kitts & Nevis	U. K. of Great Britain & Northern Ireland
Republic of *Cameroon*	Federal Republic of *Germany*	Republic of *Madagascar*	Kingdom of *Saudi Arabia*	Oriental Republic of *Uruguay*
Republic of *Chile*	Republic of *Ghana*	Republic of the *Marshall Islands*	Republic of *Sierra Leone*	Republic of *Vanuatu*
People's Republic of *China*	Republic of *Guatemala*	United Mexican States (*Mexico*)	Republic of *Slovenia*	Republic of *Yemen*
Republic of the *Congo*	Republic of *Guyana*	Kingdom of *Morocco*	Republic of *South Africa*	

48. IMO, *Status of IMO Treaties: Comprehensive Information on the Status of Multilateral Conventions and Instruments in respect of which the International Maritime Organizations or its Secretary-General performs depositary or other functions*, 567 (2023) https://wwwcdn.imo.org/localresources/en/About/Conventions/StatusOfConventions/Status%202023.pdf [https://perma.cc/WZM9-UXXT].

Table 2: Parties to the London Protocol [48]

Democratic People's Republic of *Korea*	Republic of *Iceland*	Kingdom of the *Netherlands*	Kingdom of *Spain*

Figure 1: Map of Parties to the London Convention and the London Protocol[49]



Under the London Protocol, all dumping is prohibited unless exceptions are provided for specific categories of waste or other matters listed in Annex 1 of the Protocol. The Protocol therefore reverses the assumption of the Convention, prohibiting all dumping unless a substance is specifically listed in the Protocol as an exception.[50] In other words, while the Convention organizes

49. IMO, *Map of the Parties to the London Convention/London Protocol* (Apr. 2022), https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/LC_LP/Map%20of%20Parties%202022.pdf [https://perma.cc/3RMJ-QZB5].

50. London Protocol, *supra* note 45, art. 1(4) defines dumping as: (1) any deliberate disposal into the sea of wastes or other matter from vessels, aircraft, platforms, or other man-made structures at sea; (2) any deliberate disposal into the sea of vessels, aircraft, platforms, or other man-made structures at sea; (3) any storage of wastes or other matter in the seabed and the subsoil thereof from vessels, aircraft, platforms, or other man-made structures at sea; and (4) any abandonment or toppling at site of platforms or other man-made structures at sea for the sole purpose of deliberate disposal. Article 4 establishes the following: (1) Contracting Parties shall prohibit the dumping of any

its primary annex around a "blacklist" of dangerous substances barred from dumping, the Protocol organizes its primary annex around a "whitelist" of permissible substances for dumping, banning all other substances from dumping entirely. Between this and the "precautionary approach" the Protocol adopts as a general obligation, the Protocol is ultimately more restrictive than the Convention.[51]

The Protocol maintained the Convention's definition of waste, but expanded its definition of "dumping" to include "any storage of wastes or other matter in the seabed and the subsoil thereof from vessels, aircraft, platforms or other man-made structures at sea."[52] The Protocol defines "waste or other matter" as "material and substance of any kind, form or description," which would encompass carbon dioxide.[53] Therefore, the sub-seabed storage of carbon dioxide falls within the original scope of the Protocol.

The London Protocol's importance for the transboundary transportation of carbon dioxide for storage cannot be emphasized enough. In short, the Protocol is the only international legal framework that specifically regulates offshore CCS.[54] Importantly, the London Protocol only regulates offshore, sub-seabed carbon storage and related export of carbon dioxide; it does not regulate the carbon capture process itself, nor does it regulate onshore carbon storage.

While the London Protocol currently regulates the export of carbon dioxide for offshore, sub-seabed storage, the way in which it does so has shifted over time. As such, the remainder of this Section is divided into three subsections. The first outlines how the London Protocol came to regulate sub-seabed storage of

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wastes or other matter with the exception of those listed in Annex 1; (2) The dumping of wastes or other matter listed in Annex 1 shall require a permit. Contracting Parties shall adopt administrative or legislative measures to ensure that issuance of permits and permit conditions comply with provisions of Annex 2. Particular attention shall be paid to opportunities to avoid dumping in favor of environmentally preferable alternatives, *id.* art. 4.

51. London Protocol, *supra* note 45, art. 3 (1).

52. London Protocol, *supra* note 45, art. 1 (4); *see also* IEAGHG, *supra* note 35, at 58.

53. London Protocol, *supra* note 45, art. 1 (8).

54. Swati Gola & Kyriaki Noussia, *From CO_2 Sources to Sinks: Regulatory Challenges for Trans-Boundary Trade Shipment and Storage*, 179 RESOURCES, CONSERVATION & RECYCLING 1, 3 (2022).

carbon dioxide, and the second explains how the Protocol has more recently come to regulate the cross-border transportation of carbon dioxide. Since the formal adoption of carbon dioxide transportation regulations has been particularly slow, the third and final subsection details the resolution that aims to operationalize carbon dioxide transport for interested parties.

1. Sub-seabed Carbon Dioxide Storage Under the London Protocol

When the Protocol was first adopted in 1996, carbon dioxide was not included in Annex 1, meaning no exceptions for dumping of carbon dioxide were provided. Under the Protocol's initial language, sub-seabed storage of carbon dioxide qualified as the dumping of a waste, prohibiting all countries who were party to the Protocol from issuing permits for such an activity.[55]

However, the Protocol provides criteria and guidelines for assessing the addition of new wastes into Annex 1. These guidelines are listed in Annex 2.[56] In 2006, the parties to the London Protocol utilized the Annex 2 guidelines to develop and adopt the Risk Assessment and Management Framework for CO_2 Sequestration in Sub-Seabed Geological Structures (CS-SSGS).[57] This framework was developed to ensure compatibility with Annex 2 of the Protocol, providing generic guidance to the contracting parties of both the London Convention and Protocol.[58] The new framework analyzed the risks to the marine environment from CCS with the goal of making a determination of whether carbon dioxide should be included in Annex 1's list of permitted substances for dumping. The framework concluded that there were knowledge gaps regarding the expected composition of carbon dioxide injection streams, as well as

55. *See, e.g.,* IEA, *supra* note 46, at 10.

56. IMO, Risk Assessment and Management Framework for CO_2 Sequestration in Sub-Seabed Geological Structures (CS-SSGS): LC/SG-CO2 1/7, Annex 3, IMO (2006), https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/CO2SEQUESTRATIONRAMF2006.doc [https://perma.cc/2RC8-8P22] (This Risk Assessment and Management Framework was adopted at the joint session of the 28th Consultative Meeting of Contracting Parties under the London Convention and the 1st Meeting of Contracting Parties under the London Protocol, 30 October to 3 November 2006, *id.* at 1, n.1).

57. *Id.*

58. *Id.* at 2.

uncertainty regarding the stream's behavior and interactions with other substances that may be present in the injection stream once it is in the geological and marine environment.[59]

Despite these identified knowledge gaps, in 2006 the parties of the London Protocol amended Annex 1 to include carbon dioxide streams from carbon capture processes for storage, placing it among the specific permitted substances for dumping[60] provided that (1) the carbon dioxide streams for storage are disposed into a sub-seabed geological formation; (2) the streams consist overwhelmingly of carbon dioxide; and (3) no wastes or other matter are added for the purpose of disposing of those wastes or other matter.[61] This amendment entered into force in 2007[62] since the London Protocol establishes that an amendment to its annexes automatically enters into force 100 days after the meeting of the parties for those who did not timely object.[63]

Once the amendment was approved, licensing arrangements and mandatory impact assessments for carbon dioxide streams needed to be developed, as the treaty requires these for all listed Annex 1 substances.[64] To this end, parties to the London Protocol adopted Specific Guidelines for the Assessment of Carbon Dioxide Streams for Disposal into Sub-Seabed Geological Formations in 2007.[65] These guidelines established assessments and considerations for issuing a permit for carbon dioxide seabed

59. *Id.* at 13.

60. London Protocol, *supra* note 45, Annex 1, paragraph 1.8 now reads as follows: "Carbon dioxide streams from carbon dioxide processes for sequestration."

61. London Protocol, *supra* note 45, Annex 1 ("Wastes and Other Matter that may be considered for Dumping: Paragraph 4: Carbon dioxide streams referred to in paragraph 1.8 may only be considered for dumping, if: (1) disposal is into a sub-seabed geological formation; (2) they consist overwhelmingly of carbon dioxide. They may contain incidental associated substances derived from the source material and the capture and sequestration processes used; and (3) no wastes or other matter are added for the purpose of disposing of those wastes or other matter.")**.**

62. IEA, *supra* note 46, at 10.

63. London Protocol, *supra* note 45, art. 22, paragraph 4 (detailing the time frame for such an objection).

64. Tim Dixon & Andrew Birchenough, *Exporting CO_2 for Offshore Storage – The London Protocol's Export Amendment,* GHGT-15, 3 (2021).

65. IMO, Specific Guidelines for the Assessment of Carbon Dioxide for Disposal into Sub-Seabed Geological Formations (adopted in the Second Meeting of the Parties to the London Protocol and Convention (Nov. 2007), https://www.gc.noaa.gov/documents/gcil_imo_co2wag.pdf [https://perma.cc/AN3D-62D3].

storage, including stream characterization, site selection and characterization, environmental impact and risk assessments, monitoring, mitigation and remediations plans, and risk management.[66] These guidelines also have implications for the transport of carbon dioxide, which are further discussed in the next Section.

2. Export of Carbon Dioxide Under the London Protocol

Ultimately, a dumping regime is not effective if parties are able to circumvent it by exporting the material to be dumped to a nonparty State.[67] As such, the Article 6 export prohibition in the London Protocol is intended to stop parties from exporting their waste to nonparties as a backdoor route for dumping.[68] Article 6 states that "Contracting Parties shall not allow the export of wastes or other matter to other countries for dumping or incineration at sea."[69]

While the Protocol broadly defines "wastes and other matter," it does not define "export."[70] Still, neither the export of carbon dioxide for onshore storage nor its transport for use on EOR is prohibited because neither activity is considered dumping under the London Protocol.[71] However, export of carbon dioxide

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66. *Id.* These guidelines are quite broad. The complete specifications of the carbon dioxide stream, for instance, are the following:

> Chapter 4: Chemical and Physical Properties. 4.1. Proper characterization of the carbon dioxide stream is essential. If the carbon dioxide stream is so poorly characterized that proper assessment cannot be made of the risks of potential impacts on human health and the environment, that carbon dioxide stream shall not be dumped. 4.2. Specific characterization of the carbon dioxide stream, including any incidental associated substances, shall take into account the chemical and physical characteristics and the potential for interaction among stream components. Such interactions could potentially affect the reactivity of the stream with the geological formation. This analysis should include as appropriate: 1. origin, amount, form and composition; 2. properties: physical and chemical; and 3. toxicity, persistence, potential for bio-accumulation.

Id. ch. 4.

67. Weber, *supra* note 40, at 389.

68. IEAGHG, EXPORTING CO_2 FOR OFFSHORE STORAGE – THE LONDON PROTOCOL'S EXPORT AMENDMENT AND ASSOCIATED GUIDELINES AND GUIDANCE 2 (2021).

69. London Protocol, *supra* note 45, art. 6; *see also* IEA, *supra* note 46, at 11.

70. London Protocol, *supra* note 45, art. 1 (8) ("wastes and other matter" means "material and substance of any kind, form or description.").

71. London Protocol, *supra* note 45, art. 1 (4) (3). IEAGHG, *supra* note 35, tbl.2.

for permanent geological storage below another country's seabed was originally prohibited under Article 6.[72]

Over time, parties identified the need to establish provisions for carbon dioxide export when a party does not have suitable storage but may still benefit from CCS to reduce emissions.[73] As a result, in 2009, Norway made a formal proposal for an amendment to Article 6 that authorized the export of carbon dioxide for geological storage.[74] To date, the amendment has been adopted by all parties.[75] However, the amendment has yet to enter into force because it has not been ratified by two-thirds of the London Protocol's parties.[76] The London Protocol currently has fifty-three parties; thirty-six are needed to approve an amendment to its main text.[77] China was the only party that voted against the amendment, raising the concern that it could potentially weaken the Protocol's protections by opening the

72. London Protocol, *supra* note 45, art. 6 (before the 2009 Amendment): "Export of Wastes or Other Matters: 'Contracting Parties shall not allow the export of wastes or other matter to other countries for dumping or incineration at sea.'"

73. IEAGHG, *supra* note 68.

74. The 2009 amendment to Article 6 reads as follows:

> Add '1' before: Contracting Parties shall not allow the export of wastes or other matter to other countries for dumping or incineration at sea. 2 Notwithstanding paragraph 1, the export of carbon dioxide streams for disposal in accordance with Annex 1 may occur, provided that an agreement or arrangement has been entered into by the countries concerned. Such an agreement or arrangement shall include: (2.1) confirmation and allocation of permitting responsibilities between the exporting and receiving countries, consistent with the provisions of this Protocol and other applicable international law; and (2.2) in the case of export to non-Contracting Parties, provisions at a minimum equivalent to those contained in this Protocol, including those relating to the issuance of permits and permit conditions for complying with the provisions of Annex 2, to ensure that the agreement or arrangement does not derogate from the obligations of Contracting Parties under this Protocol to protect and preserve the marine environment. A Contracting Party entering into such an agreement or arrangement shall notify it to the Organization.

IMO, *CO_2 Export Amendment: Resolution LP.3(4)* (Oct. 30, 2009), https://wwwcdn.imo.org/localresources/en/KnowledgeCentre/IndexofIMOResolutions/LCLPDocuments/LP.3(4).pdf [https://perma.cc/7AWV-DYC2].

75. Raphael J. Heffron et al., *Reducing Legal Risk for CO_2 Transport for Carbon Capture and Storage in the EU*, 6 INT. ENERGY L. REV. 192, 194–95 (2018) (highlighting Norway's interest in the amendment).

76. IEAGHG, *supra* note 68, at 3.

77. IMO, *supra* note 74, Annex; London Protocol, *supra* note 45, art. 21 (requiring approval of two third of the contracting parties of the Protocol for an amendment to its main text to be valid).

door for exports of other wastes while also highlighting that the technical and legal issues regarding carbon dioxide export were unclear when the amendment was first proposed.[78]

Following the 2009 amendment, parties set out to revise the Carbon Dioxide Specific Guidelines to include transboundary activities, specifically the export (and related migration) of carbon dioxide for storage purposes.[79] In 2012, the parties agreed on the new Specific Guidelines for the Assessment of Carbon Dioxide for Disposal into Sub-Seabed Geological Formations,[80] which clarified how to approach permitting.[81]

More specific issues regulating permit issuance and the liability of both contracting and non-contracting parties were streamlined in the following year, when the parties agreed on Guidance on the Implementation of Article 6.2 on the Export of Carbon Dioxide Streams for Disposal in Sub-Seabed Geological Formations for the Purpose of Sequestration.[82] Together, these

78. Raphael J. Heffron et al., *Three Layers of Energy Law for Examining CO_2 Transport for Carbon-Capture and Storage,* J. ENERGY L. & BUS. 1, 7 (2017).

79. Tim Dixon & Andrew Birchenough, *Exporting CO_2 for Offshore Storage – The London Protocol's Export Amendment,* GHGT-15, 3 (2021) (noting that the guidelines were split and now disposal has its own exclusive guideline).

80. IMO, Specific Guidelines for the Assessment of Carbon Dioxide for Disposal into Sub-Seabed Geological Formations, LP 7 and LC 34/15, Annex 8 (2012), https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/2012%20SPECIFIC%20GUIDELINES%20FOR%20THE%20ASSESSMENT%20OF%20CARBON%20DIOXIDE.pdf [https://perma.cc/G3ZB-AW3H].

81. *Id.* Like the 2007 guidelines, the 2012 guidelines are also quite general, albeit emphatic in the need for parties to reduce their dumping and disposal. *Id.*, 1.5 (For the reduction of dumping and disposal); and exemplifying the generic requirements, *Id.* ch. 4 ("4.1 Proper characterization of the carbon dioxide stream is essential. If the carbon dioxide stream is so poorly characterized that proper assessment cannot be made of the risks of potential impacts on human health and the environment, that carbon dioxide stream shall not be dumped. 4.2 Specific characterization of the carbon dioxide stream, including any incidental associated substances, shall take into account the chemical and physical characteristics and the potential for interaction among stream components. Such interactions could potentially affect the reactivity of the stream with the geological formation. This analysis should include as appropriate: 1. origin, amount, form and composition; 2. properties: physical and chemical; and 3. toxicity, persistence, potential for bio-accumulation.").

82. IMO, Guidance on the Implementation of Article 6.2 on the Export of Carbon Dioxide Streams for Disposal in Sub-Seabed Geological Formations for the Purpose of Sequestration, LC 35/15 Annex 6 (2013), https://www.umweltbundesamt.de/sites/default/files/medien/381/dokumente/london_protocol_-_lc_35-15_-_report_of_the_thirty-fifth_consultative_meeting_and_the_eight_meeting_of_the_contracting_parties.pdf [https://perma.cc/L8QN-82KD].

guidelines supplement the previously-established Annex 2 provisions for issuing permits and verification of the carbon dioxide stream, highlighting the entities that may be best situated to verify the purity of the streams.[83]

3. The 2019 Resolution on Article 6

Progress on the ratification of the 2009 amendment to Article 6 has been slow because not all State parties see CCS as an immediate priority.[84] Although several parties to the London Protocol have stated their interest in CCS,[85] only ten have formally accepted the amendment: Belgium, Denmark, Estonia, Finland, the Islamic Republic of Iran, the Netherlands, Norway, Republic of Korea, Sweden, and the United Kingdom.[86]

In light of the slow pace of ratification of the 2009 amendment to Article 6—and the need for two-thirds of the parties to ratify the amendment for it to become effective[87]—Norway and the Netherlands proposed a resolution on the provisional application of the 2009 amendment to Article 6 of the London Protocol. The resolution aims to authorize the export of

83. *Id.* In the relevant part – namely, Chapter 3, paragraph 6.3.3 – the guidelines determine that: "Characterization of the Chemical and Physical Properties of the CO_2 Stream: It is most likely that the exporting country will be best able to characterize the composition, properties and quantity of the CO_2 stream. The exporting country would then share that characterization with the importing country in order that any agreement or arrangement can reflect expected quality, adherence to Action Lists and any special precautions or mitigations needed for the secure import and storage of the CO_2 stream. The agreement or arrangement should reflect the actual results of the application of the Action Lists and should be applied prior to export. The country accepting the carbon dioxide stream should reassure itself of the quality of that characterization, including by undertaking its own characterization if necessary. Because the content of the CO_2 waste stream may change over time, the establishment of an ongoing monitoring information system could be useful to include in the agreement or arrangement."

84. IEA, *supra* note 46, at 12 (noting that to reach the two-thirds requirement stipulated under Article 21 of the London Protocol for an amendment to become effective is not trivial).

85. Ian Havercroft & Chritopher Consoli, *Development and Opportunities – A review of National Responses to CCS under the London Protocol*, GLOBAL CCS INSTITUTE 2 (2022).

86. IMO, Status of IMO Treaties 581 (2023), https://wwwcdn.imo.org/localresources/en/About/Conventions/StatusOfConventions/Status%202023.pdf [https://perma.cc/9C2J-2S6P].

87. London Protocol, *supra* note 45, art. 21 establishes the two-thirds requirement for amendments to the Protocol's text entering into force.

carbon dioxide for geologic storage offshore,[88] creating an interim solution that enables two or more countries to apply the 2009 export amendment before it enters into force. In doing so, the resolution allows countries to consent to cross-border transport of carbon dioxide for geological storage without breaching international commitments.[89] The structure of the resolution was based on the Vienna Convention, which authorizes parties of a treaty to agree to the provisional application of treaty terms that have not yet entered into force.[90]

The resolution was adopted at the 2019 Conference of the Parties.[91] Its final language emphasized the need for parties to

88. IEAGHG, *supra* note 68, at 6 (explaining that Norway's motivation was the Northern Lights Project).

89. *Id.*

90. Vienna Convention on the Law of Treaties, May 23, 1969, 1115 U.N.T.S. 331 [hereinafter Vienna Convention], art. 25, (Determining that a treaty, or parts of it, may be applied provisionally while its entry into force is pending if: (a) the treaty itself so provides; or (b) the negotiating States have in some other manner so agreed). Article 25 (b) was the trigger for the proposed resolution, as the 2009 amendment to Article 6 did not provide for the provisional application of the London Protocol itself. Because there is no guidance in the Vienna Convention regarding the minimum votes for approval of this provisional resolution, it is ultimately up to the Conference of the Parties of the London Protocol to make these determinations. London Protocol, *supra* note 45, arts. 18(7), 18(8). The London Protocol specifically authorizes the consideration of resolutions in the meetings of the Protocol's contracting parties, or in their special meetings, if any. These special meetings determine that parties will establish rules and procedures for the adoption of resolutions. Unfortunately, our analysis of all the resolutions available online in the IMO website for registered users did not show any documentation specifying the quorum for adoption of these resolutions. IMO, Meeting Documents: Assembly Resolutions (Sessions 20 to 23), https://docs.imo.org [https://perma.cc/499B-NUMY]; *see also* IEA, *supra* note 46, at 16 (also outlining six different solutions for applying the 2009 amendment in the absence of the two-thirds approval by the London Protocol's parties and underscoring that any party that does not vote will not be bound by the resolution, *id.* at 17).

91. This resolution was adopted on October 11, 2019. IMO, *Resolution LP.5(14) on the Provisional Application of the 2009 Amendment to Article 6 of the London Protocol of 2019* (2020), http://www.imo.org/en/OurWork/Environment/LCLP/Pages/default.aspx [https://perma.cc/MWH2-9Z29] (available as Annex 2 in the report of the meeting LC41). The resolution appears to have been adopted in a consensus, as its text does not refer to objections set forward by any of the Protocol's parties. *See also* The 41st Consultative Meeting of the Parties to the London Convention and the 14th Meeting of the Parties to the London Protocol: Meeting Summaries (October 7–11, 2019), https://www.imo.org/en/MediaCentre/MeetingSummaries/Pages/LC-41-LP-14-.aspx [https://perma.cc/9CGN-BP7Z].

reduce their GHG emissions,[92] contextualizing CCS as an option in a portfolio of actions targeting these reductions.[93] The resolution enables the provisional application of the 2009 Amendment to Article 6 for countries that specifically conclude bilateral agreements and consent to be bound by the 2009 amendment. These agreements are defined as legally binding between States, meaning they must take place within instruments such as memorandum of agreement or a treaty; non-binding arrangements between States would include instruments such as a memorandum of understanding (MoU).[94] Parties to the

92. IMO, *Resolution LP.5(14) on the Provisional Application of the 2009 Amendment to Article 6 of the London Protocol of 2019* (2020), available in Annex 2 in the report of the meeting LC41, at http://www.imo.org/en/OurWork/Environment/LCLP/Pages/default.aspx (available under "IMODOCs" and "Public Account" and the LC41 meeting), pmbl. ("*Reiterating* the serious concern regarding the implications for the marine environment of climate change and ocean acidification, as a result of elevated levels of carbon dioxide in the atmosphere; . . . *Reiterating* that resolution LP.1(1) recognizes that carbon dioxide capture and sequestration should not be considered as a substitute to other measures to reduce carbon dioxide emissions, but considered such sequestration as one of a portfolio of options to reduce levels of atmospheric carbon dioxide and as an important interim solution . . . ; *Stressing* that the disposal of carbon dioxide streams into sub-seabed geological formations does not remove the obligation under the London Protocol to reduce the need for such disposal and the commitments under UNFCCC to reduce greenhouse gas emissions, taking into account the recent special reports of IPCC; *Emphasizing* the need to further develop low carbon forms of energy; *Noting* that not all States have suitable sub-seabed geological formations for the sequestration of carbon dioxide streams."

93. The resolution enables the provisional application of the 2009 export amendment to the London Protocol while urging contracting parties of the London Protocol to accept its 2009 amendments. IMO, *Resolution LP.5(14), supra* note 92. This Resolution determines the following:

> Decides to allow for the provisional application of the 2009 amendment pending its entry into force by those Contracting Parties which have deposited a declaration on provisional application of the 2009 amendment; (2) Invites Contracting Parties to deposit with the Depositary a declaration on provisional application of the 2009 amendment of the London Protocol pending its entry into force; (3) Further recalls the obligation to notify the Depositary of agreements or arrangements mentioned in article 6, paragraph 2 of the London Protocol (as amended by resolution LP.3(4)); (4) affirms that the export of carbon dioxide under the provisional application of article 6 of the London Protocol (as amended by resolution LP.3(4)), and in compliance with the requirements of paragraph 2 of the article (as amended by resolution LP.3(4)) will not be in breach of article 6 as in force at the time of the export; and (5) Urges Contracting Parties to consider accepting the amendment to article 6 of the London Protocol adopted through resolution LP.3(4).

94. IMO, *supra* note 82, at Annex 6, art. 3 (2).

London Protocol must also provide the Secretary-General of the International Maritime Organization (IMO) with a declaration on the provisional application of the 2009 amendment, and commit to notifying the IMO of any agreements and arrangements regarding permitting and liability for the export of carbon dioxide for sub-seabed geologic storage.[95] As long as parties to the London Protocol fully comply with the terms of the 2019 resolution and its related guidance, parties are considered compliant to the London Protocol.[96]

Importantly, the interim resolution also covers export to non-contracting parties. As long as minimum provisions equivalent to those of the London Protocol are met, including issuance of permits and protection and preservation of the marine environment, the amendment enables the export of carbon dioxide for geologic offshore storage.[97] This is particularly relevant when considering any carbon dioxide exports into the United States, which is a member of the London Convention but has not ratified the London Protocol.[98] In this case, the provisional application of the 2009 amendment may authorize the export of carbon dioxide for offshore storage within US waters. By entering a legally binding bilateral agreement with another country that is bound by both the Protocol and its 2009 amendment, the United States would effectively be bound by the terms of Protocol for the operations associated with that agreement.

The following table summarizes the application of the London Protocol to the import and export of carbon dioxide, as it relates to both contracting and non-contracting parties.

95. IMO, *supra* note 82, at Annex 6, art. 3.

96. *See generally*, IMO, *supra* note 82.

97. IMO, *supra* note 74.

98. United States EPA, *Ocean Dumping: International Treaties*, https://www.epa.gov/ocean-dumping/ocean-dumping-international-treaties#US%20LC%20Contracting%20Party [https://perma.cc/8AUD-K74X] (underscoring that the United States is a party to the London Convention and has signed, but never ratified, the London Protocol).

Table 3: Cross-border maritime transportation of carbon dioxide for offshore storage under the London Protocol after the 2009 Amendment and the 2019 Resolution for its provisional application[99]

London Protocol Status	*Importer: Contracting Party*	*Importer: Non-contracting Party*
Exporter: Contracting Party	Both exporter and importer must present a declaration of the provisional application of the 2009 amendment with the IMO and establish an agreement consistent with the London Protocol and international law.	The contracting party (exporter) is responsible for compliance with the London Protocol and must establish an agreement with the non-contracting party that, at a minimum, provides the same protection of the Protocol.
Exporter: Non-Contracting Party	The contracting party (importer) must establish agreement with the non-contracting party and notify IMO.	The London Protocol is not applicable. However, this scenario may be subject to UNCLOS (discussed in Part 5 of this Article).[100]

Ultimately, most experts contend that the 2019 resolution has removed the last significant barrier to CCS while still maintaining the marine protections under the London Protocol

99. This CCS table summarizes our previous discussion regarding the application of the London Protocol to its parties and nonparties, according to IMO, *supra* note 82, Annex 6. Importantly, the guidance focuses on the export from a contracting party to a non-contracting party of the London Protocol, *id.* at 3.6.3, Annex 6. *See also* IEA, LEGAL AND REGULATORY FRAMEWORKS FOR CCUS: AN IEA CCUS HANDBOOK 74–75 (2022) (providing a different table focusing on storage and utilization of captured carbon dioxide).

100. This Article examines UNCLOS in Part V.

and related guidance of its parties.[101] Though some view the resolution as imperfect,[102] it is generally regarded as an effective solution.[103]

The following table summarizes the three major modifications to the London Protocol as it relates to carbon dioxide transport and storage.

Table 4: Instrumental modifications of the London Protocol regarding CCS

Instrumental modification to the London Protocol	***Content and status of the modification of the London Protocol***
2006 Amendment to Annex 1	Enables sub-seabed carbon dioxide storage. Status: effective since February 2007.
2009 Amendment to Article 6	Allows cross-border transportation of carbon dioxide for storage. Status: pending approval. The amendment has yet to enter into force, as Article 21 of the London Protocol requires two-thirds approval.
2019 Resolution of the Conference of the Parties	Authorizes the interim application of the 2009 amendment to Article 6 provided interested parties enter into specific bilateral or multilateral agreements, followed by registration and

101. *See e.g.,* Tim Dixon & Andrew Birchenough, *Exporting CO_2 for Offshore Storage – The London Protocol's Export Amendment,* GHGT-15, 7 (2021). The EU Parliament and EU Council also agree with this interpretation. *See* EU Parliament and EU Council, 2009/31/EC of the European Parliament and of the Council on the geological storage of carbon dioxide and amending Council Directive 85/337/EEC, European Parliament and Council Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC, 2008/1/EC and Regulation (EC) No. 1013/2006 (Apr. 23, 2009), stating: "*Whereas* (12-13): At the international level, legal barriers to the geological storage of CO_2 in geological formations under the seabed have been removed through the adoption of related risk management frameworks under the 1996 London Protocol to the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (1996 London Protocol)."

102. Weber, *supra* note 40, at 392 (criticizing the solution as not the most fitting but acknowledging its effectiveness).

103. Hisham Al Baroudi et al., *A Review of Large-Scale CO_2 Shipping and Marine Emissions Management for Carbon, Capture, Utilisation and Storage*, 287 APPLIED ENERGY 1, 14 (2021) (highlighting that the provisional application of the London Protocol under the 2019 resolution enabled the cross-border transportation of carbon dioxide for storage).

> notification to the IMO. Status: effective since October 2019.

A number of countries that are strategically positioned for sub-seabed carbon dioxide storage have yet to enter into specific agreements for provisional application of the export amendment under the 2019 resolution. To date, Belgium, Denmark, Republic of Korea, the Netherlands, Norway, Sweden, and the United Kingdom have deposited declarations on their intent to utilize the provisional application of the 2009 amendment with the IMO.[104]

In late 2022, Denmark and Belgium entered into an agreement authorizing cross-border transportation of carbon dioxide for offshore storage.[105] These two countries are the first to pursue cross-border transport of carbon dioxide, effectively injecting it into offshore geologic formations early in 2023.[106] This unprecedented agreement and the subsequent injection are particularly relevant for international law purposes, as it sets the standard for the level of detail that parties to the London Protocol need to provide the IMO in the future. Belgium and Denmark were the first States to have concluded such a bilateral agreement.[107] France followed suit, signing a similar agreement with Denmark; and, more recently, bilateral agreements signed between Norway, France, Belgium, Denmark, the Netherlands

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104. 45th Consultative Meeting of Contracting Parties to the London Convention and the 18th Meeting of Contracting Parties to the London Protocol (LC 45/LP 18), https://www.imo.org/en/MediaCentre/MeetingSummaries/Pages/LC-45-LP-18.aspx [https://perma.cc/R5GH-N25K] ("Following the adoption of a resolution to allow provisional application of the amendment to article 6 (resolution LP.5(14), 2019), Seven Governments had deposited declarations of provisional application of the 2009 amendment (Belgium, Denmark, Kingdom of the Netherlands, Norway, Republic of Korea, Sweden and United Kingdom).").

105. Naida Hakirevic Prevljack, *Danish-Belgium CCS Agreement Paves Way for Creating 'Actual Market' for Maritime Transport of CO_2*, MARKET OUTLOOKS (Oct. 3, 2022).

106. Global CCS Institute, *Denmark's Project Greensand Begins Groundbreaking Cross-border CO_2 Injection,* LATEST NEWS (Mar. 8, 2023) (The carbon dioxide came from a chemical facility in Belgium and was injected in Denmark's North Sea, as part of the Greensand Project).

107. INFO. EXCH. GRP. (IEG), THE EU LEGAL FRAMEWORK FOR CROSSBORDER CO2 TRANSPORT AND STORAGE IN THE CONTEXT OF THE REQUIREMENTS OF THE LONDON PROTOCOL 26 (2022), https://climate.ec.europa.eu/document/download/dfbbc90c-071e-4088-ada2-7af467084b30_en?filename=EU-London_Protocol_Analysis_paper_final0930.pdf [https://perma.cc/NUV3-V5RN].

and Sweden enable carbon dioxide sequestration in Norway.[108] Germany is facing pressure to sign similar agreements with Norway and Denmark to enable export of carbon dioxide captured in Germany for offshore storage in Norway and Denmark.[109]

Recently, the European Commission concluded that there is significant alignment between the requirements of the London Protocol and the current legal framework in the European Economic Area (EEA)[110] regarding the capture, cross-border transportation, and safe geological storage of carbon dioxide between EU Member States and EEA countries.[111] It contends that Directive 2009/31 and Directive 2003/87, which are binding for all member States, "can act as a relevant 'arrangement' between the parties in the meaning of Article 6 (2) of the London Protocol."[112] Likewise, the EEA treaty and the incorporation of these two directives in the EEA legal regime are also arrangements with EEA partners for the London Protocol's purposes.[113]

The Commission states that member States that are party to the London Protocol may conduct additional bilateral arrangements with other member States and EEA partners exclusively on issues that are not covered by the EU directives.

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108. Paul Messad, *France Strikes CO2 Storage Deal with Denmark*, EURACTIV FRANCE (Mar. 5, 2024), https://www.euractiv.com/section/energy-environment/news/france-strikes-co2-storage-deal-with-denmark [https://perma.cc/AAD3-RQV5] (noting the relevance of France and Denmark's bilateral agreement); Nicolai Mykleby-Skaara, *Four North Sea Countries and Sweden Sign Agreement on CO2 Transport and Storage*, AKER CARBON CAPTURE (Apr. 15, 2024), https://akercarboncapture.com/2024/04/four-north-sea-countries-and-sweden-sign-agreements-on-co2-transport-and-storage [https://perma.cc/CV94-JC8H].

109. Vera Eckert, *Wintershall Dea Urges Germany to Clear CO_2, Exports for Storage*, REUTERS (Jan. 16, 2023), https://www.reuters.com/business/energy/wintershall-dea-urges-germany-clear-co2-exports-storage-2023-01-16 [https://perma.cc/9T3X-LN3S].

110. The European Parliament, *The European Economic Area, Switzerland and the North* (Apr. 2024), https://www.europarl.europa.eu/factsheets/en/sheet/169/the-european-economic-area-eea-switzerland-and-the-north [https://perma.cc/8SJU-NS3G]. The European Economic Area (EEA) was established in 1994 to extend the EU's provisions on its internal market to the European Free Trade Area (EFTA) countries. Norway, Iceland, and Liechtenstein are parties to the EEA. Switzerland is a member of EFTA but is not part of the EEA. The EU and EEA EFTA partners (Norway and Iceland) are also connected by several "northern policies."

111. IEG, *supra* note 107, at 6.

112. *Id.*

113. *Id.* at 26.

This means that these bilateral agreements would be strictly limited to residual issues not already addressed by EU law.[114] Ultimately, the Commission's interpretation would authorize EEA member States to circumvent the provisional requirements of having a specific bilateral agreement because in practice the European Union and the EEA would already provide the general framework for CCS. Of course, this is merely the EU Commission's interpretation, and it suggests a legal interpretative gymnastic that does not advance international law. Contracting parties under the London Protocol have an obligation to obey the provisions of the treaty and a failure to do so would mean breaching international law.[115] It is noteworthy that in their recent cross-border shipping of carbon dioxide for storage, Belgium and Denmark actually signed an agreement establishing the details for this complex shipping operation as specified under the 2019 provisional application to Article 6 of the London Protocol.[116]

Finally, the International Energy Agency (IEA), in its 2021 Technical Report, highlighted the need for international cooperation to ensure that further agreements are created, emphasizing that the London Protocol is no longer a significant hurdle for the export and storage of carbon dioxide.[117] The ratification of the 2009 amendment would be the optimal solution, as it would negate the need for countries to arrange specific agreements. As the number of parties to the London

114. *Id.* The Commission contends that the EU member States that are parties to the London Protocol should notify the IMO that elements of EU Law (specifically, Directives 2009/31 and 2003/87) are part of the relevant arrangements for exchanges between EU member States jointly with any additional bilateral arrangements concluded among member States on matters not regulated under these directives. Similarly, a notification to IMO must occur regarding the EEA treaty as part of the pertinent arrangement between EU member State parties to the London Protocol and EEA countries.

115. Lena W. Østgaard & Ingvild Ombudstvetdt, *Regulatory frameworks for cross-border transportation and offshore storage of CO_2 in Europe*, 16 (Dec. 7, 2023), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4624764&dgcid=ejournal_htmlemail_international%3Aenvironmental%3Alaw%3Aejournal_abstractlink [https://perma.cc/SU73-A9KF].

116. Arlota, *supra* note 18.

117. IEAGHG, *supra* note 68, at 5 (underscoring the need for cooperation exchange of info etc); *id.* at 7 (noting that IEAGHG was the only agency present supporting the amendments); *id.* at 9 (affirming the provisional application removed the last significant barrier).

Protocol may increase, particularly in Africa and Asia, newcomers may be more willing to ratify the amendment upon ascending to the Protocol.[118] For the moment, it remains to be seen how both parties and nonparties will navigate the current system under the interim application of the 2009 amendment.

III. BASEL CONVENTION

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal aims to establish a global regime for controlling the international trade of hazardous wastes. The Convention does not create a general prohibition on the cross-border transportation of hazardous waste.[119] Rather, following the concept of prior informed consent (PIC), the Convention requires that, before an export occurs, authorities of the exporting State shall notify the authorities of the prospective importing States as well as any State the hazardous material will pass through in transit. The exporting State is required to share detailed information on the intended movement with all involved States, and the export may only proceed if and when all involved parties provide their written consent.[120]

Parties to the Basel Convention cannot trade Basel-covered waste with nonparties in the absence of a predetermined agreement between countries.[121] In addition, these predetermined agreements cannot be "less environmentally sound" than the Convention itself.[122] There are currently 191 parties to the Basel Convention, with the notable exception of the United States, which signed the Convention in 1990 but never ratified it. [123]

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118. The use of "ascending" here is strictly technical under international law and is not to imply that merely parties to the London Convention would be increasing their protection upon ratification of the London Protocol. In other words, "ascending" is a technical term referring to any party ratifying a treaty.

119. Raine, *supra* note 23, at 357.

120. Basel Convention, *supra* note 21, arts. 6–7.

121. United States Environmental Protection Agency, International Agreements on Transboundary Shipments of Hazardous Waste (Nov. 1, 2022).

122. Basel Convention, *supra* note 21, art. 11.

123. Parties to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, Status of Ratification (2022),

The Basel Convention's PIC procedure establishes strict requirements for the transboundary movement of hazardous and other wastes.[124] The PIC process has four stages: (1) notification; (2) consent and issuance of a movement document; (3) transboundary movement of the waste(s) from an area under the jurisdiction of one State to (or through) an area under the jurisdiction of another State, or through an area under the jurisdiction of no State; and (4) confirmation of disposal.[125] Each of these stages may be expensive and time-consuming.[126] The Convention also requires that only an authorized person or authorized transport and disposal personnel perform these operations, and that wastes subject to a transboundary movement be packaged, labelled, and transported in accordance with international practices.[127] As currently designed, these procedures would not pose a significant hurdle for the cross-border transportation of carbon dioxide for storage purposes.

The Basel Convention does not apply to hazardous materials that do not qualify as waste.[128] The Convention defines waste as "substances or objects which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law."[129] This definition would encompass carbon dioxide that is captured at point sources (or removed from the

https://www.basel.int/Countries/StatusofRatifications/PartiesSignatories/tabid/4499/Default.aspx [https://perma.cc/8GNP-GKYW]. A table naming each of these 191 parties can be found in the Appendix of this chapter.

124. "Other wastes," which are also called "wastes subject to special consideration," under Annex II, are not pertinent to our analysis because they refer to household wastes, residues from the incineration of household wastes and several plastic wastes. Basel Convention, *supra* note 21, Annex II ("other wastes"). *See also* our discussion *supra* and references thereafter.

125. Basel Convention, *supra* note 21, Art. 6 and 7; and Annex V, which details the information to be provided on notification and in the movement document. *See also* Jonathan Krueger, *Prior Informed Consent and the Basel Convention: The Hazards of What Isn't Known*, 7 THE J. OF ENV'T & DEV. 115–37 (1998).

126. PREVENT & STEP, PRACTICAL EXPERIENCES WITH THE BASEL CONVENTION, DISCUSSION PAPER 1, 4–12 (2021), https://www.step-initiative.org/files/_documents/publications/PREVENT-StEP_Practical_Experiences_Basel%20Convention_discussion-paper%202022.pdf [https://perma.cc/4L6F-28E4] (outlining the lack of cost-effective procedures implementing the Basel Convention, particularly in low and middle income countries).

127. Basel Convention, *supra* note 21, art. 4(b).

128. Basel Convention, *supra* note 21, art. 1 combined with Annexes I, II, III, and VIII, as detailed below.

129. Basel Convention, *supra* note 21, art. 2.

atmosphere) and intended to be permanently sequestered in subsurface geologic rock formations (i.e., the carbon dioxide would be "intended to be disposed of" in the rock formations). However, carbon dioxide that is used in EOR or for some other purpose would not qualify as "waste" because it is not "disposed of."[130]

The Basel Convention is organized into multiple annexes. The provisions of the most important annexes for this analysis are listed in the table below:

Table 5: Annexes of the Basel Convention[131]

Basel Convention Annex	***Convention Language***	***Description***
Annex I	Article 1 (a): The following wastes that are subject to transboundary movement shall be '**hazardous wastes**' for the purposes of this Convention: (a) Wastes that belong to any category contained in **Annex I** [. . .]	*Categories of wastes to be controlled.* Divided into a list of "waste streams" and a list of "wastes having as constituents." Relevant **waste streams** include: waste oils/water, hydrocarbons/ water mixture (Y9); waste tarry residues arising from refining, distillation (Y11); wastes of explosive nature not subject to other legislation (Y15). Relevant **wastes having as constituents** include: arsenic and compounds (Y24); cadmium and compounds) (Y26); mercury and compounds (Y29).

130. Raine, *supra* note 23, at 358.

131. The authors developed Table 5 to summarize the potential application of the Basel Convention (if any) to the transportation of carbon dioxide for storage. Table 5 is based on the text of the Basel Convention as summarized by the authors. Basel Convention, *supra* note 21, art. 1 combined with Annexes I –IV.

Table 5: Annexes of the Basel Convention[131]

Basel Convention Annex	***Convention Language***	***Description***
Annex II	Article 1 (b): Wastes that belong to any category contained in **Annex II** that are subject to transboundary movement shall be '**other wastes**' for the purposes of this Convention.	*Categories of wastes requiring special consideration.* Establishes the scope of "other wastes," specifically household waste and incinerator ash.
Annex III	Article 1(a): [. . .] unless they do not possess any of the characteristics contained in **Annex III**.	*Hazardous characteristics.* Outlines criteria to determine whether or not a waste is hazardous, including: explosive (H1); flammable liquids (H3); oxidizing (H5.1); poisonous (acute) (H6.1); corrosives (H8); liberation of toxic gases in contact with air or water (H10); toxic (delayed or chronic) (H11); ecotoxic (H12); capable, by any means, after disposal, of yielding another material which possesses any of the characteristics listed in the complete list (H13).
Annex IV	Article 2: For the purposes of this Convention [. . .] 4. '**Disposal**' means any operation specified in **Annex IV** to this Convention.	*Disposal operations.* Presents a specific and exhaustive list of ways to dispose of waste, including deep injections, release of materials into deep water, and permanent storage.

The Basel Convention distinguishes between two types of waste: "hazardous waste" as defined in Annexes I and III and "other waste" as defined in Annex II.[132] To qualify as a hazardous waste, a substance must either (1) be classified as one of the categories listed in Annex I of the Convention *and* possess at least one of the hazardous characteristics listed in Annex III or (2) be defined or considered to be hazardous under domestic legislation of the party of export, import, or transit.[133]

Establishing whether the Basel Convention applies to potential carbon dioxide transportation and storage first requires determining whether carbon dioxide could qualify as either "hazardous" or "other" waste as defined by the Convention. Since the "other waste" category established by Annex II in Article 1 (b) applies primarily to domestic wastes, carbon dioxide does not qualify as "other waste" under the Basel Convention,[134] nor is it eligible for consideration as a "waste presumed hazardous."[135] Additionally, the Authors' review of the parties' communication to the Basel Convention's Secretariat does not show any instances of domestic legislation that defines carbon dioxide storage shipments as "hazardous."[136]

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132. Basel Convention, *supra* note 21, art. 1 ("Scope of the Convention: (2). Wastes that belong to any category contained in Annex II that are subject to transboundary movement shall be 'other wastes' for the purposes of this Convention.").

133. *Id.* art. 1, which also determines:

> Scope of the Convention: (1). The following wastes that are subject to transboundary movement shall be 'hazardous wastes' for the purposes of this Convention: (a) Wastes that belong to any category contained in Annex I, unless they do not possess any of the characteristics contained in Annex III; and (b) Wastes that are not covered under paragraph (a) but are defined as, or are considered to be hazardous wastes by the domestic legislation of the Party of export, import or transit.

134. "Other wastes," which are also called "wastes subject to special consideration," under Annex II, are not pertinent to our analysis because they refer to household wastes, residues from the incineration of household wastes and several plastic wastes. Basel Convention, *supra* note 21, Annex II ("other wastes").

135. Basel Convention, *supra* note 21, Annex VIII, A (This provision does not appear to be relevant for carbon dioxide streams as Annex VIII, A regulates metal and metal bearing wastes; wastes containing principally inorganic constituents, which may contain metals and organic materials; wastes containing principally organic constituents, which may contain metals and inorganic materials (includes waste from the production or processing of petroleum coke and bitumen, waste tarry residues arising from refining, distillation and any pyrolytic treatment of organic materials, among others)).

136. *See infra* note 150 and accompanying text.

The remaining question, therefore, is whether carbon dioxide could qualify as "hazardous" waste within the Convention's existing categorizations in Annexes I and III. With no minimum concentrations or thresholds established in the Basel Convention's classification system for hazardous waste,[137] the precise determinations about what constitutes waste are notoriously convoluted in practice.[138] Annex I does not specify tests for waste streams or define purity levels nor does it mention percentages of substances.[139] Likewise, Annex III does not detail percentages nor does it outline tests to determine whether a substance possesses a hazardous quality, with the only exception being a test for inflammability.[140] However, Annex III does acknowledge that certain types of waste are not yet fully documented, welcoming national legislation to develop tests for controlled waste to decide whether the materials of Annex I present any of the hazardous characteristics listed in Annex III.[141]

This lack of clarity has generated legal controversy about whether carbon dioxide for cross-border storage should be considered a "hazardous waste" under the Basel Convention. Some scholars contend that carbon dioxide is not specifically mentioned in the Convention as hazardous waste, and therefore the Convention does not apply.[142] Practically speaking, an official classification of carbon dioxide as hazardous waste could lead to tensions between States that decide to prohibit carbon dioxide transportation and States that allow it, posing a potential obstacle to the uniform development of CCS.[143] Likewise, should carbon dioxide be officially included within the scope of the Convention,

137. Ray Evans, *Basel Convention: Why National Sovereignty is Important*, Proceedings of the Fourth Conference of the Samuel Griffith Society, 4 THE SAMUEL GRIFFITH SOC. 1, 11 (1994).

138. Ishtiaque Ahmed, *The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal: A Legal Misfit in Global Ship Recycling Jurisprudence*, 29 WASH. INT'L L. J. 411, 427 (2020).

139. Basel Convention, *supra* note 21, Annex I.

140. *Id.* Annex III.

141. *Id.* Annexes I, III.

142. *CO_2 Transport for Storage*, THE UNIVERSITY COLLEGE LONDON (UCL) CARBON CAPTURE LEGAL PROGRAMME, https://www.ucl.ac.uk/cclp/ccstransport-int-waste-basel.php [https://perma.cc/MP8V-DTZM] (last visited Apr. 30, 2024); Gola & Noussia, *supra* note 54, at 3 (affirming that carbon dioxide is not prohibited nor controlled in the Basel Convention.).

143. THE UCL CARBON CAPTURE LEGAL PROGRAMME, *supra* note 142.

there would be discrepancies in how importing parties manage hazardous waste in an "environmentally sound manner" under the Convention.[144]

On the other hand, arguments that favor the inclusion of carbon dioxide for cross-border storage within the Basel Convention interpret the characteristics listed in the annexes of the Convention more literally, contending that some of the hazardous characteristics listed in Annex I (waste tarry residues arising from refinery, explosiveness) and Annex III (explosiveness, corrosiveness, oxidizing, delayed or chronic toxicity, and ecotoxicity) could be applicable to carbon dioxide in a specific set of physical and chemical circumstances.[145] This line of reasoning is further supported under Annex IV of the Convention, which targets disposal activities relating to the "injection and storage" of waste.[146]

However, such a literal interpretation of Annex III would mean that the presence of a single molecule of listed materials would characterize the waste as hazardous.[147] This has been previously discussed in the context of copper and steel, which cannot be entirely pure due to having lead and zinc as compounds.[148] Therefore, applying a literal interpretation of the Basel Convention to the transboundary movement of steel would have made a significant part of world trade virtually impossible.[149] The Basel Convention was amended in 1998 when an additional annex (Annex VIII) was added to authorize, among other inclusions, the cross-border transportation of steel and copper

144. Basel Convention, *supra* note 21, art. 2(8) ("Environmental sound management of hazardous wastes means taking all practical steps to ensure that hazardous wastes or other wastes are managed in a manner which will protect human health and the environment against the adverse effects which may result from such wastes.").

145. Raine, *supra* note 23, at 358.

146. Basel Convention, *supra* note 21, Annex IV (d) (3) (deep injections); *id.* Annex IV (d) (4) (release sea/ocean, including sea-bed injections).

147. Evans, *supra* note 137, at 11 (highlighting that in superfund collection and enforcement actions in the United States, EPA has interpreted the absence of minimum concentrations to mean that no such limitations were intended; therefore, the presence of a single molecule would characterize the material as within the scope of the legal protection).

148. Evans, *supra* note 137, at 11–12.

149. *Id.* at 12.

scraps unless they presented "hazardous characteristics."[150] Therefore, this demonstrates that literal interpretation was not favored by the contracting parties of the Convention at that time, because steel and copper scraps were ultimately permitted.

With this in mind, parties should not favor such a literal interpretation regarding the presence of impurities in a carbon dioxide stream. A literal interpretation is ultimately contrary to the intent of the Convention, and, as such, against international law.[151] It would also be unreasonable, as no stream of carbon dioxide can be completely pure.[152]

The Intergovernmental Panel on Climate Change (IPCC) has long opposed a literal interpretation of the Basel Convention, with its Special Report on Carbon Dioxide Capture and Storage concluding that

> there is no indication that carbon dioxide will be defined as a hazardous waste under the [Basel] Convention except in relation to the presence of impurities such as some heavy metals and some organic compounds that may be entrained during the capture of carbon dioxide. Adoption of schemes where emissions of SO_2 and NO_x would be included with the carbon dioxide may require such a review.[153]

Under this IPCC interpretation, the Basel Convention could be differentially applied to carbon dioxide depending on the purity standards of the carbon dioxide stream itself. This interpretation, while rarely cited in the literature,[154] offers one practical way to evaluate whether carbon dioxide would be classified as

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150. Basel Convention, *supra* note 21, Annex VIII (B) (listing steel scrap and copper scrap as non-hazardous waste, "unless they contain Annex I material to an extent causing them to exhibit and Annex III characteristic.").

151. Vienna Convention on the Law of Treaties art. 31 (1), May 23, 1969, 1115 U.N.T.S. 331 [hereinafter Vienna Convention] (requiring parties to interpret treaties in good faith and considering its purpose as well as ordinary meaning of its words).

152. *See e.g.*, Hisham Al Baroudi et al., *Techno-economic Analyses of CO_2 Liquefaction: Impact of Product Pressure and Impurities*, 103 INT'L. J. OF REFRIGERATION 301, 309 (2019).

153. IPCC, IPCC SPECIAL REPORT ON CARBON DIOXIDE CAPTURE AND STORAGE PREPARED BY WORKING GROUP III OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 189 (Bert Metz et al. eds., 2005).

154. Of all the articles of our literature review, only two addressed the IPCC position. UCL CARBON CAPTURE LEGAL PROGRAMME, *supra* note 142, acknowledges the position of the IPCC, but highlights that carbon dioxide is neither a regulated substance nor CCS is a regulated activity under the Basel Convention. In a similar vein, see Raine, *supra* note 23, at 357–58.

"hazardous" under the Convention. The specific composition of transported carbon dioxide will vary depending on the carbon dioxide capture methodology and the source of the stream.[155] Previous purity guidelines applicable for pipelines are not advisable,[156] as purity levels in ships are likely to be more stringent due to differences in temperature and pressure.[157]

Currently, there are two sets of guidelines for the purity of the carbon dioxide for storage in Europe: the Northern Lights Concentration and the European Union Recommendations. The table below summarizes the percentages of each impurity as recommended by both sets of guidelines.

Table 6: European Guidance on Shipping Carbon Dioxide Transportation[158]

Component	*Northern Lights Concentration (ppm mol)*	*European Union Recommendations*
Carbon Dioxide (CO_2)	Not defined	>99.7% by volume
Acetaldehyde	≤20	Not defined
Amine	≤10	Not defined
Ammonia (NH_3)	≤10	Not defined
Argon (Ar)	Not defined	<0.3% by volume
Cadmium (Cd) / Titanium (Ti)	≤0.03 (sum)	Not defined
Carbon Monoxide (CO)	≤100	<2000ppm
Hydrogen (H_2)	≤50	<0.3% by volume
Hydrogen sulfide (H_2S)	≤9	<200ppm

155. ZERO EMISSIONS PLATFORM, NETWORK TECHNOLOGY GUIDANCE FOR CO_2 TRANSPORT BY SHIP: GUIDANCE NOTE 20 (2022).

156. DYNAMIS, Towards Hydrogen and Electricity Production with Carbon Dioxide Capture and Storage, DYNAMIS Consortium 2006-2009 (Einar Jordanger ed., 2009), https://cordis.europa.eu/docs/results/19/19672/122320071-6_en.pdf [https://perma.cc/HJ6N-DABV] (providing a renowned guideline for pipelines).

157. *See generally* IEAGHG, *supra* note 35, at 10.

158. ZERO EMISSIONS PLATFORM, *supra* note 155.

Formaldehyde	≤20	Not defined
Mercury (Hg)	≤0.03	Not defined
Methane	Not defined	<0.3% by volume
Nitric oxide/Nitrogen dioxide (NOx)	≤10	Not defined
Oxygen (O_2)	≤10	Not specified
Sulfur oxides (SOx)	≤10	Not defined
Water (H_2O)	≤30	<50ppm

Many of the components listed above are common in carbon dioxide streams captured at point sources. The guidelines above consider certain impurities to be some combination of highly toxic (ammonia, cadmium), toxic (carbon monoxide, mercury, nitric oxide), corrosive (ammonia, hydrogen sulfide, mercury, oxygen in the presence of water), flammable (hydrogen sulfide), and fatal (hydrogen sulfide) as each of these hazardous characteristics are defined by Annex III of the Basel Convention.[159]

As such, the above analysis may be relevant for establishing the hazardous characteristics of carbon dioxide stream under Annex III of the Basel Convention. If these guidelines were to be formally incorporated through an amendment, the presence of any of these components beyond recommended levels would trigger the need to comply with the requirements for export, transit, and import of hazardous wastes established in the Convention.[160]

For the moment, however, this scenario seems farfetched. There are no such proposals for an amendment of this kind. In addition, as the London Protocol's Section above demonstrates, international law is heading in the opposite direction, creating an

159. *Id.* at 36–38; *see also* Basel Convention, *supra* note 21, Annex III.

160. Basel Convention, *supra* note 21, art. 1 (a) combined with Annexes I and III (defining hazardous waste); whereas the procedure of prior informed consent is detailed in Articles 6 and 7.

enabling legal environment for the permanent storage of carbon dioxide. With the pressing needs posed by climate change, efforts to pave the way for carbon dioxide storage are only expected to gain momentum. Nonetheless, the discussion of purity levels is relevant for the effectiveness of international law, and parties to the Basel Convention should consider clarifying that carbon dioxide is not within its scope.

In short, our literature review found that most authorities do not consider the Basel Convention to be a significant obstacle to cross-border transportation of carbon dioxide for storage. A recent report by the IEA, which was silent on the Basel Convention, concluded that "although there has been a proliferation of public international law which can result in overlap or conflicting frameworks, there do not appear to be any showstoppers that would prevent the international development of CCUS."[161]

Though it seems unlikely to occur, one possibility for restricting carbon dioxide transportation under the Basel Convention may arise from the passage of domestic laws that establish carbon dioxide as hazardous waste by the parties to the Basel Convention.[162] So long as the party properly communicated this to the Secretariat, the classification of carbon dioxide as hazardous waste would apply to all of the parties to the Basel Convention.[163] As noted earlier, according to the Authors' review of the seventy-nine parties that submitted their information to the Secretariat in 2021, this has not yet occurred.[164]

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161. IEAGHG, *supra* note 35, at 12, 51–54.

162. Basel Convention, *supra* note 21, art. 1 § 1(b), determining that hazardous waste can be defined also in accordance with the domestic legislation of the party of export, import, or transit. Article 3 details the procedures for these inclusions to be effective.

163. Basel Convention, *supra* note 21, arts. 3 § 1; 13 § 2(b).

164. Our review of the answers of the parties to question 2 of the questionnaires sent by the Secretariat does not indicate that carbon dioxide has been included as a hazardous substance under their national legislation. Most of the answers do not list additional requirements for handling hazardous materials than those of the Basel Convention, according to answers to question 2 (b) (iv). The exceptions are as follows: Belarus required nontariff measures; Madagascar, Mexico, Thailand, Turkmenistan, and Pakistan required additional documentation under their national law, with Pakistan also requiring pictures and previous environmental assessments of the disposal facilities; Germany, Norway, Sweden, and the UK mentioned EU Waste Shipment Regulation (EC

However, the Authors' analysis did reveal that several parties have mentioned the EU Regulation on Waste Shipment (RWS) in their submission to the Basel Secretariat.[165] The regulation applies to the shipment of waste between EU member States, specifically (1) waste transported within the European Union or transiting through third countries; (2) waste imported into the European Union from third countries; (3) waste exported from the European Union to third countries; and (4) waste transiting through the European Union on the way to or from third countries.[166] In 2009, the EU directive on CCS[167] amended Article 1(3) of the RWS to exclude the shipment of carbon dioxide for the exclusive purpose of geological storage from these regulations.[168]

Although the EU CCS Directive[169] aims at preventing adverse effects regarding the security of the transport network and mandates that member States cooperate to jointly implement EU legislative requirements regarding cross-border transportation of carbon dioxide for CCS,[170] it does not apply to carbon dioxide

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Reg. 1013/2006). The information currently available on the Basel Convention's website is limited to the 2021 legislative year. Basel Convention, National Reports on Nation Definitions of Waste (2021), http://www.basel.int/Countries/NationalReporting/NationalReports/BC2021Reports/tabid/9379/Default.aspx [https://perma.cc/EM7A-SE5M].

165. *See* discussion *supra* note 164.

166. Regulation (EC) N. 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste (2021), art. 1 (2).

167. Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide and amending Council Directive 85/337/EEC, European Parliament and Council Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC, 2008/1/EC and Regulation (EC) N. 1013/2006. (Directive 2009/31, as its name conveys, focuses on storage; Article 24 contains limited provisions on transportation aspects, effectively ceding much of the regulatory scheme to member States).

168. EUROPEAN COMMISSION, STUDY SUPPORTING THE EVALUATION OF REGULATION (EC) NO. 1013/2006 ON SHIPMENTS OF WASTE (WASTE SHIPMENT REGULATION) 107 (Keir McAndrew et al. eds., 2019).

169. IEAGHG, *supra* note 68, at 9 (noting that the EU CCS Directive requirements are aligned with those of the OSPAR Convention and the London Protocol). Interestingly, the London Protocol and OSPAR Convention are aligned, but the Convention on the Protection of the Marine Environment of the Baltic Sea Area (Helsinki Convention, 1992) does not authorize sub-seabed storage and has legal superiority over the EU CCS Directive: Therese Nehler & Mathias Fridahi, *Regulatory Preconditions for the Deployment of Bioenergy with Carbon Capture and Storage in Europe*, 4 FRONTIERS IN CLIMATE: PERSPECTIVES 1, 5 (2022).

170. Directive 2009/31/EC, *supra* note 167, art. 24.

emissions generated from shipping.[171] The European Commission (or EU member States, for instance), may consider clarifying how the RWS may apply to the Basel Convention as it relates to transboundary carbon dioxide movement and storage.

It is noteworthy that the "Ban Amendment" to the Basel Convention entered into force on December 5, 2019. The amendment prohibits hazardous waste exports from member States of the Organization for Economic Co-operation and Development (OECD), the European Union, and Liechtenstein to developing countries.[172] Moreover, hazardous wastes can be transported only if (1) the State of origin demonstrates that it does not have the technical capacity, storage sites, or adequate facilities to dispose of the waste in its own territory; (2) the wastes are required as raw material for recycling or recovery industries by the importing State; or (3) the transboundary movement is in accordance with other criteria established by the parties of the Convention.[173]

Importantly, the Basel Convention outlines international cooperation and technical standards that parties shall obey for the purpose of legally transporting hazardous waste.[174] To date,

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171. *See* CARBON NEUTRAL CITIES ALLIANCE, NOTE 7: BARRIERS TO TRANSPORT AND STORAGE OF CO_2 WITHIN THE EUROPEAN UNION 4 (2020).

171. UNITED NATIONS ENVIRONMENTAL PROGRAMME, BASEL CONVENTION ON THE CONTROL OF TRANSBOUNDARY MOVEMENTS OF HAZARDOUS WASTES AND THEIR DISPOSAL: TEXTS AND ANNEXES, https://www.basel.int/Portals/4/Basel%20Convention/docs/text/BaselConventionText-e.pdf [https://perma.cc/95RC-4JQW]. (The "Ban Amendment" prohibits parties that are included in the new Annex VII (parties and other States that are members of the OECD, EC, Liechtenstein) of all transboundary movements to States not included in Annex VII of hazardous wastes covered by the Convention that are intended for final disposal, and of all transboundary movements to States not included in Annex VII of hazardous wastes covered by paragraph 1 (a) of Article 1 of the Convention that are destined for reuse, recycling or recovery operations. In the so-called Ban Amendment, parties listed in Annex VII (members of OECD, EU, Liechtenstein) immediately prohibit all transboundary movements of hazardous wastes that are destined for final disposal operations from OECD to non-OECD States). The Ban Amendment is binding for parties to the Basel Convention that have expressed their consent to be bound by it); *see also* Press Release, *Entry into force of amendment to UN treaty boosts efforts to prevent waste dumping*, UNEP BASEL CONVENTION (Sep. 13, 2019), https://www.basel.int/Default.aspx?tabid=8120#:~:text=The%20Ban%20Amendment%20prohibits%20the,the%20recent%20ratification%20by%20Croatia [https://perma.cc/TC9L-E2AZ].

173. Basel Convention, *supra* note 21, art. 4 § 9.

174. *Id.* art. 10.

however, there are no uniform international standards regulating the transport of carbon dioxide for storage, which is indicative of a legislative gap that international treaties should close by harmonizing international legal standards for the transport of carbon dioxide for permanent storage.[175]

There is an expert review working group with a broad mandate to consider potential amendments to Annexes I, III, IV, and VIII of the Convention. Currently, carbon dioxide does not appear to be listed as part of these amendments.[176] As States individually or jointly apply their own interpretation of the Convention,[177] any further interpretation of the Convention related to the elements applicable to carbon dioxide transportation and storage is left to the International Court of Justice or arbitral tribunals under the dispute settlement procedure established in the Convention.[178] Only parties to the Convention have standing to challenge the interpretation of the Convention, and they can only do so after negotiating with the party or parties that have allegedly breached the Convention.[179] In the meantime, customary international law establishes that all States remain obliged to interpret the Basel Convention in good faith, both in accordance with the ordinary meaning to be given to the terms of the treaty in their context and in consideration with the treaty's object and purpose.[180]

IV. BAMAKO CONVENTION

The Bamako Convention is a regional convention applicable to Organization of African Unity (OAU) countries, commonly referred to as the African Union.[181] The Convention reflects the

175. UCL CARBON CAPTURE LEGAL PROGRAMME, *supra* note 142.

176. *See Expert Working Group*, BASEL CONVENTION, http://www.basel.int/TheConvention/Amendments/Proposedamendments/tabid/7906; *see also Annexes I, III, IV and Related Aspects of Annexes VIII and IX*, BASEL CONVENTION, www.basel.int/Implementation/LegalMatters/LegalClarity/ReviewofAnnexes/AnnexesI,III,IVandrelatedaspectsofAnnexes/tabid/6269/Default.aspx#footnote-1 [https://perma.cc/92NV-EXGL].

177. Raine, *supra* note 23, at 356.

178. Basel Convention, *supra* note 21, art. 20 § 1.

179. *See id.*

180. Vienna Convention on the Law of Treaties art. 31 § 1, May 23, 1969, 1115 U.N.T.S. 331 (entered into force Jan. 27, 1980), [hereinafter Vienna Convention].

181. Bamako Convention, *supra* note 21, art. 23.

concerns of these countries that the Basel Convention was insufficiently stringent,[182] particularly with regard to authorizing the export of wastes to nonparties under a bilateral or multilateral agreement.[183] The Bamako Convention prohibits the import of waste into Africa from non-contracting parties, deeming such imports illegal and criminal.[184]

The Bamako Convention requires parties to adopt appropriate legal, administrative, and other measures within their jurisdictional area to prohibit the import of hazardous waste into Africa from non-contracting parties. The Convention also prohibits all dumping of waste at sea,[185] which gives it a broader scope than the Basel Convention.[186] The Bamako Convention also has more stringent criteria than the Basel Convention.[187] For example, its definition of hazardous waste also covers substances that are radioactive or have been banned, cancelled, refused registration by government regulatory action, or voluntarily withdrawn from registration in the country of manufacture for human and environmental reasons.[188]

Considering the Bamako Convention's broader definition of "hazardous waste,"[189] scholars have noted that carbon dioxide could be interpreted as a hazardous waste that possesses any of the characteristics contained in Annex II of the Bamako Convention, including explosive, poisonous, corrosive, toxic, or ecotoxic.[190] Mirroring the Basel Convention, the Bamako

182. HUNTER ET AL., *supra* note 19, at 961.
183. Basel Convention, *supra* note 21, art. 11 § 1.
184. Bamako Convention, *supra* note 21, art. 4 § 1.
185. *Id.* art. 4 § 2.
186. HUNTER ET AL., *supra* note 19, at 962.
187. *Id.*
188. The Bamako Convention, *supra* note 21, art. 2.
189. *Id.* art. 2, which reads as follows:

> The following substances shall be 'hazardous wastes' for the purposes of this convention: 1. (a) Wastes that belong to any category contained in Annex I of this Convention [wastes that are defined as hazardous]; (b) Wastes that are not covered under paragraph (a) above but are defined as, or are considered to be, hazardous wastes by the domestic legislation of the State of export, import or transit; (c) Wastes which possess any of the characteristics contained in Annex II of this Convention [list of hazardous characteristics] . . . 3. Wastes which derive from the normal operations of a ship, the discharge of which is covered by another international instrument, shall not fall within the scope of this convention.

190. Raine, *supra* note 23, at 359–60.

Convention also does not adopt specific tests to determine whether waste is hazardous.

Considering that the Bamako Convention's prohibition on importing waste into Africa from non-contracting parties—and the fact that only member States of the OAU may become parties[191]—the Convention could effectively prohibit imports of carbon dioxide from outside Africa.[192] It remains to be seen whether importing carbon dioxide for storage would actually be interpreted as falling within the scope of the Bamako Convention, which would trigger the prohibition of carbon dioxide imports into OAU countries. Because Africa might be a promising location for carbon dioxide sequestration,[193] a clarification (or eventual amendment, if needed) about the current status of carbon dioxide for permanent storage would be helpful to dissipate doubts.

V. UNCLOS (UNITED NATIONS CONVENTION ON THE LAW OF THE SEA)

The United Nations Convention on the Law of the Sea (UNCLOS),[194] has been referred to as a constitution for the oceans.[195] Among other provisions, UNCLOS establishes a

191. The Bamako Convention, *supra* note 21, art. 22–23.

192. Raine, *supra* note 23, at 360.

193. Hèléne Pilorgé et al., *Global Mapping of CDR Opportunities*, *in* CDR PRIMER § 3-4 (J. Wilcox et al eds., 2021), https://cdrprimer.org/read/chapter-3#sec-3-4 [https://perma.cc/U6CE-BBUB] (displaying data on East Africa's carbon dioxide overall promising sequestration capacity); *id.* ("To maintain a supercritical state, which reduces the risks of leakage, CO_2 needs to be sequestered at pressures greater than 73.8 bars, corresponding to geostatic pressures occurring deeper than 800 meters. In order to ensure safe injection and trapping of CO_2, the threshold of 1,000 meters is preferred. Combining [the two datasets analyzed by the authors] might help . . . This combined information provides a rough guide to areas that can be explored for future CO_2 sequestration projects.").

194. UN Convention on the Law of Sea, Dec. 10, 1982, 1833 U.N.T.S. 397 (entered into force Nov. 16, 1994) [hereinafter UNCLOS]. This convention has currently 157 parties. The United States has neither signed nor ratified the UNCLOS, according to the United Nations Treaty Collection website; *see Chapter XXI: Law of the Sea*, UN: TREATIES, https://treaties.un.org/pages/ViewDetailsIII.aspx?src=TREATY&mtdsg_no=XXI-6&chapter=21&Temp=mtdsg3&clang=_en [https://perma.cc/JHA4-CG8T] (last visited Jan. 20, 2023).

195. Tommy T.B. Koh, President, Third United Nations Convention on the Law of the Sea, Remarks at the Third United Nations Convention on the Law of the Sea: A

jurisdictional regime for the world's oceans by dividing marine areas into "zones" based on the distance from each State's coast.[196]

The framework for defining such marine zones works as follows. A State may claim an area up to twelve nautical miles (nm) from its coast as its "territorial sea," all of which is subject to the State's sovereignty.[197] Sovereignty in international law does not have an unequivocal definition,[198] but manifests itself as a State's self-determination.[199] Beyond 12 nm and up to 24 nm from its coast, a State may claim a "contiguous zone," where the coastal State may exercise the limited control necessary to prevent or punish infringement of its customs, fiscal, immigration, or sanitary laws and related regulations in its territory or territorial sea.[200] Beyond the territorial sea, a State may claim an area up to 200 nm from its coast as its "exclusive economic zone" (EEZ), where the State has sovereign rights to explore, exploit, conserve and manage living and non-living natural resources.[201] States also retain jurisdiction over marine scientific research and the protection and preservation of the marine environment in its EEZ.[202] Finally, the area beyond 200 nm from any State's coastline

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Constitution for the Oceans, (Dec. 11, 1982), https://www.un.org/depts/los/convention_agreements/texts/koh_english.pdf [https://perma.cc/GA5B-HZRN] ("We worked not only to promote our individual national interests but also in pursuit of our common dream of writing a constitution for the oceans.").

196. UNCLOS, *supra* note 194, arts. 3, 33, 34.

197. *Id.* arts. 3, 21–61 (for the different categorizations).

198. *See* Ronald A. Brand, *External Sovereignty and International Law*, 18 FORDHAM INT'L L.J. 1685, 1686 (1995) ("[E]arlier concepts of subjects joining to receive the benefits of peace and security provided by the sovereign. [For the author]It diverges from most contemporary commentary by avoiding what has become traditional second- tier social contract analysis. In place of a social contract of states, this redefinition of sovereignty recognizes that international law in the twentieth century has developed direct links between the individual and international law. The trend toward democracy as an international law norm further supports discarding notions of a two-tiered social contract relationship between the individual and international law.").

199. Celia L. Taylor, *A Modest Proposal: Statehood and Sovereignty in a Global Age*, 18 U. PA. INT'L. ECON. J. 745, 750 (2014).

200. S. REP. NO. 110-9, at 4 (2007), https://www.foreign.senate.gov/imo/media/doc/executive_report_110-09.pdf [https://perma.cc/UE5R-EP9U].

201. UNCLOS, *supra* note 194, arts. 55-58.

202. *Id.* art. 55, specifically.

is typically referred to as the "high seas" and is open to the use of all States exclusively for peaceful purposes.[203] The high seas are not subject to the exclusive jurisdiction of any State.[204]

UNCLOS establishes rules for measuring the distances from a State's coast to define these zones and determines the protocol for dealing with overlapping territorial seas, exclusive economic zones, and continental shelves.[205] In practice, the extension of

203. *Id.* arts. 86-89.

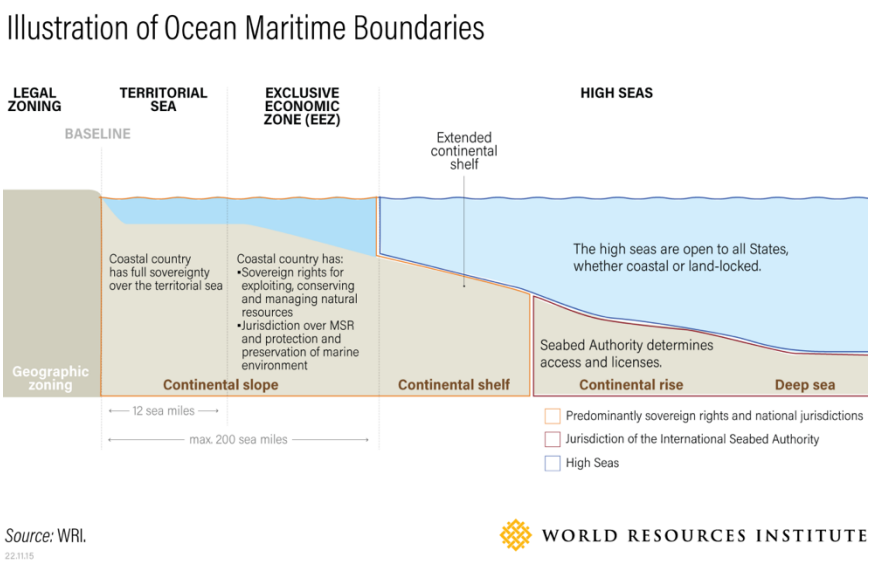
204. *Id.* arts. 56-57, 86-88, 140; S. REP. NO. 110-9, at 4 (2007).

205. UNCLOS, *supra* note 194, art. 76 defines continental shelf as follows:

> (1) The continental shelf of a coastal State comprises the seabed and subsoil of the submarine areas that extend beyond its territorial sea throughout the natural prolongation of its land territory to the outer edge of the continental margin, or to a distance of 200 nautical miles from the baselines from which the breadth of the territorial sea is measured where the outer edge of the continental margin does not extend up to that distance. (2) The continental shelf of a coastal State shall not extend beyond the limits provided for in paragraphs 4 to 6. (3) The continental margin comprises the submerged prolongation of the land mass of the coastal State, and consists of the seabed and subsoil of the shelf, the slope and the rise. It does not include the deep ocean floor with its oceanic ridges or the subsoil thereof. (4) (a) For the purposes of this Convention, the coastal State shall establish the outer edge of the continental margin wherever the margin extends beyond 200 nautical miles from the baselines from which the breadth of the territorial sea is measured, by either: (i) a line delineated in accordance with paragraph 7 by reference to the outermost fixed points at each of which the thickness of sedimentary rocks is at least 1 per cent of the shortest distance from such point to the foot of the continental slope; or (ii) a line delineated in accordance with paragraph 7 by reference to fixed points not more than 60 nautical miles from the foot of the continental slope; (b) In the absence of evidence to the contrary, the foot of the continental slope shall be determined as the point of maximum change in the gradient at its base. (5). The fixed points comprising the line of the outer limits of the continental shelf on the seabed, drawn in accordance with paragraph 4 (a)(i) and (ii), either shall not exceed 350 nautical miles from the baselines from which the breadth of the territorial sea is measured or shall not exceed 100 nautical miles from the 2,500 meters isobath, which is a line connecting the depth of 2,500 meters. (6) Notwithstanding the provisions of paragraph 5, on submarine ridges, the outer limit of the continental shelf shall not exceed 350 nautical miles from the baselines from which the breadth of the territorial sea is measured. This paragraph does not apply to submarine elevations that are natural components of the continental margin, such as its plateaux, rises, caps, banks and spurs. (7) The coastal State shall delineate the outer limits of its continental shelf, where that shelf extends beyond 200 nautical miles from the baselines from which the breadth of the territorial sea is measured, by straight lines not

these zones is measured in nautical miles from the "baseline" defined under UNCLOS, which provides that the baseline begins at the low-water line along the coast.[206] Despite the United States not being a party to UNCLOS,[207] the country recognizes many of its provisions (including those defining the maritime zones) as forming part of international customary law.[208]

Figure 2: Illustration of the Ocean Maritime Boundaries[209]



exceeding 60 nautical miles in length, connecting fixed points, defined by coordinates of latitude and longitude . . .

UNCLOS, *supra* note 194, art. 77 provides that the coastal State will have sovereignty over its continental shelf's natural resources.

206. UNCLOS, *supra* note 194, art. 5 (The low-water is defined according to the State's own chart); *see also* U.S. Senate, Convention of the Law of the Sea, S. EXEC. REP. 110-9, 3–4.

207. *Status of the United Nations Convention on the Law of Sea*, United Nations Treaty Collection (2023), https://treaties.un.org/pages/ViewDetailsIII.aspx?src=TREATY&mtdsg_no=XXI-6&chapter=21&Temp=mtdsg3&clang=_en [https://perma.cc/RR8B-FEXJ] (UNCLOS currently has 169 parties; the United States never has signed let alone ratified it).

208. WEBB ET AL., *supra* note 30, at 9.

209. Katie Lebling et al., *Carbon Removal from the Ocean Explained*, WORLD RESOURCES INSTITUTE (Nov. 15, 2022), https://www.wri.org/insights/ocean-based-carbon-dioxide-removal [https://perma.cc/3WW9-EGZH] (source for the figure).

In addition to defining each of these zones, UNCLOS defines the "area" as encompassing "the seabed and ocean floor and subsoil thereof, beyond the limits of national jurisdiction."[210] This national jurisdiction is recognized under international law as a corollary of sovereignty. As such, the seabed underlying the high seas is open to all countries.[211] Ultimately, a State's domestic laws apply to activities on the high seas if these activities are performed by either individuals subject to that State's jurisdiction (e.g., because the individual is a national of the country) or by using vessels registered or flagged to the State.[212]

Since UNCLOS is a framework convention, it establishes a set of general norms to guide States. As a result, additional specific agreements are often required to make its general provisions concrete.[213] For example, UNCLOS broadly commands States to "prevent, reduce and control pollution of the marine environment by dumping."[214] UNCLOS also establishes that States shall notify other affected States in case of imminent danger or damage to the marine environment, and also mandates that States cooperate in developing contingency plans responding to these emergencies.[215] Carbon dioxide transportation alone is unlikely to be prohibited under this general provision. However, arguably the transboundary movement of carbon dioxide for storage in ships would trigger the application of UNCLOS, as it could be characterized as a transfer of "hazards" from one area to another.[216]

UNCLOS does not formally define the term "hazard," leaving the term open to interpretation.[217] Although it is theoretically possible to interpret carbon dioxide as a "hazardous substance" under the guiding principles of UNCLOS—that is, to

210. UNCLOS, *supra* note 194, art. 1, 1 (1).

211. *Id.* arts. 140–41.

212. WEBB ET AL., *supra* note 30, at 8.

213. HUNTER ET AL., *supra* note 19, at 730.

214. UNCLOS, *supra* note 194, art. 210.

215. *Id.* arts. 198–99.

216. *Id.* art. 195 ("Duty not to transfer damage or hazards or transform one type of pollution into another: In taking measures to prevent, reduce and control pollution of the marine environment, States shall act so as not to transfer, directly or indirectly, damage or hazards from one area to another or transform one type of pollution into another.").

See also Raine, *supra* note 23, at 361.

217. Raine, *supra* note 23, at 361.

prevent, reduce, and control marine pollution[218]—this interpretation is considered unlikely by experts.[219] As a framework convention, UNCLOS' general scope leaves the elaboration of more precise rules and specifics to other treaties and other agreements.[220]

The general rules set forth by UNCLOS are also typically complemented by more recent and issue-specific treaties.[221] Once ratified, parties are bound to the most stringent applicable law.[222] In practice, treaties like the London Convention and Protocol are therefore more consequential than UNCLOS in regulating transboundary carbon dioxide transport. Because UNCLOS broadly calls for the adoption of more elaborate international rules on dumping,[223] the London Convention—and, if fully

218. UNCLOS, *supra* note 194, art. 194 ("Measures to prevent, reduce and control pollution of the marine environment: (1) States shall take, individually or jointly as appropriate, all measures consistent with this Convention that are necessary to prevent, reduce and control pollution of the marine environment from any source, using for this purpose the best practicable means at their disposal and in accordance with their capabilities, and they shall endeavour to harmonize their policies in this connection. (2) States shall take all measures necessary to ensure that activities under their jurisdiction or control are so conducted as not to cause damage by pollution to other States and their environment, and that pollution arising from incidents or activities under their jurisdiction or control does not spread beyond the areas where they exercise sovereign rights in accordance with this Convention. (3) The measures taken pursuant to this Part shall deal with all sources of pollution of the marine environment. These measures shall include, *inter alia*, those designed to minimize to the fullest possible extent: (a) the release of toxic, harmful or noxious substances, especially those which are persistent, from land-based sources, from or through the atmosphere or by dumping; (b) pollution from vessels, in particular measures for preventing accidents and dealing with emergencies, ensuring the safety of operations at sea, preventing intentional and unintentional discharges, and regulating the design, construction, equipment, operation and manning of vessels; (c) pollution from installations and devices used in exploration or exploitation of the natural resources of the seabed and subsoil, in particular measures for preventing accidents and dealing with emergencies, ensuring the safety of operations at sea, and regulating the design, construction, equipment, operation and manning of such installations or devices; (d) pollution from other installations and devices operating in the marine environment, in particular measures for preventing accidents and dealing with emergencies, ensuring the safety of operations at sea, and regulating the design, construction, equipment, operation and manning of such installations or devices.").

219. Raine, *supra* note 23, at 361.

220. Ian Havercroft & Ray Purdy, *Carbon Capture and Storage: Developments under European Union and International Law*, 4 J. EUR. ENV'T PLAN. L. 353, 353–54 (2007).

221. *Id.*

222. Raine, *supra* note 23, at 361.

223. UNCLOS, *supra* note 194, art. 210 (6).

adopted, the Protocol—would ultimately determine what constitutes dumping under UNCLOS.[224]

In the context of carbon dioxide transportation, UNCLOS may also apply to pollution unrelated to dumping. More specifically, under-regulated sources of marine pollution such as ocean noise or heat pollution could, in theory,[225] trigger the application of UNCLOS under its mandate to prevent and reduce pollution.[226] This is the case, as the UNCLOS definition of "pollution of the marine environment" is quite broad, meaning

> the introduction by man, directly or indirectly, of substances or energy into the marine environment, including estuaries, which results or is likely to result in such deleterious effects as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of sea water and reduction of amenities.[227]

Whereas underwater noise emissions from ships are not currently regulated,[228] there is an understanding that they deserve further environmental analysis[229] since ocean-going traffic is the most significant source of acoustic pollution.[230] Even though an analysis of noise pollution is based on a purely theoretical

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224. David Langlet, *Exporting CO_2 for Sub-Seabed Storage: The Non-effective Amendment to the London Dumping Protocol and Its Implications*, 30 INT. J. MARINE COASTAL L. 395, 401 (2015). *See also, Offshore CO_2 Storage: International Marine Legislation, U.N Convention on the Law of the Sea (UNCLOS, 1982)*, UCL CARBON CAPTURE LEGAL PROGRAMME, https://www.ucl.ac.uk/cclp/ccsunclos.php [https://perma.cc/JE4J-3DDE].

225. Karen Scott, *International Regulation of Undersea Noise*, 53 ICQL 287, 293 (2004) (contending that Article 194 combined with Article 1(4) of UNCLOS includes noise and heat as introducing energy, and thus, pollution).

226. UNCLOS, *supra* note 194, art. 211.

227. *Id.* art. 1(4).

228. Jukka-Pekka Jalkanen et al., *Underwater Noise Emissions from Ships During 2014–2020*, 311 ENV'T POLLUTION 2 (2022).

229. Scott, *supra* note 225, at 294.

230. IMO, *Guidelines for the Reduction of Underwater Noise from Commercial Shipping to Address Adverse Impacts on Marine Life,* IMO MEPC1/Circular 833 (Apr. 7, 2014), https://cetsound.noaa.gov/Assets/cetsound/documents/MEPC.1-Circ%20883%20Noise%20Guidelines%20April%202014.pdf [https://perma.cc/6S4G-MX94] (Article 6 notes that "the International Organization for Standardization (ISO) has developed the (ISO/PAS) 17208-1 – Acoustics – Quantities and procedures for description and measurement of underwater sound from ships – Part 1: General requirements for measurements in deep water. This measurement standard is for deep water which implies that the water depth should be larger than 150 m or 1.5 times overall ship length (engineering method), whichever is greater.").

perspective bearing extremely limited practice, this Article briefly addresses it for the purpose of completeness. Although it remains difficult to estimate the volume of carbon dioxide shipping and the impact it would have on shipping traffic, should ocean noise or heat pollution trigger protection under UNCLOS,[231] States will be encouraged to issue best practices.[232] Still, the UNCLOS system does not specifically implicate the shipping of carbon dioxide for storage; at best, these new provisions may require States to set and improve current standards for all shipping traffic.

VI. THE "HIGH SEAS" TREATY, OR BBNJ TREATY (UNITED NATIONS CONVENTION ON THE LAW OF THE SEA ON THE CONSERVATION AND SUSTAINABLE USE OF MARINE BIOLOGICAL DIVERSITY OF AREAS BEYOND NATIONAL JURISDICTION)

A new agreement under UNCLOS on the Conservation and Sustainable Use of Marine Biological Diversity of Areas Beyond National Jurisdiction[233] was recently reached by delegates of the Intergovernmental Conference on Marine Biodiversity of Areas Beyond National Jurisdiction. It is commonly referred to either by its acronym, "BBNJ," or simply as the "High Seas Treaty."[234]

As this Article previously discussed, UNCLOS gives countries jurisdiction over the waters that extend within 200 nautical miles from their shores. Beyond this area is the "high seas." Waters of the high seas make up about two-thirds of the global ocean, or almost half of Earth's surface.[235]

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231. Scott, *supra* note 225, at 293.

232. UNCLOS, *supra* note 194, art. 208.

233. U. N. Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas Beyond National Jurisdiction [hereinafter The High Seas Treaty] Mar. 5, 2023, https://www.un.org/bbnj/?_gl=1*1jsveb1*_ga*MjA1MjY2ODI1OC4xNjYyOTA4MDc3*_ga_TK9BQL5X7Z*MTY3ODQ3NjkzMC4xLjAuMTY3ODQ3NjkzMC4wLjAuMA) [https://perma.cc/44GK-NQJC].

234. *UN Delegates reach historic agreement on protecting marine biodiversity in international waters,* UN DELEGATE (Mar. 5, 2023), https://www.un.org/en/delegate/un-delegates-reach-historic-agreement-marine-biodiversity [https://perma.cc/CK5Z-ACPA].

235. Nicola Jones, *UN Forges Historic Deal to Protect Ocean Life: What Researchers Think*, NATURE (Mar. 7, 2023), https://www.nature.com/articles/d41586-023-00684-z [https://perma.cc/8V9Z-PMNY].

UNCLOS regulates certain activities in the high seas, including shipping and seabed mining.[236] The high seas, nonetheless, have long been deemed the "wild west" of the ocean, with few specific provisions on the protection of biodiversity.[237] This new treaty builds on the UNCLOS system,[238] covering access and use of marine genetic resources in both the high seas and exclusive economic zone (EEZ) area as defined by UNCLOS,[239] among other provisions.

A preliminary analysis of the available text of the High Seas Treaty shows that it should not specifically impact cross-border transportation of carbon dioxide for offshore storage overseas. There are, however, two main provisions that are noteworthy for the purposes of this Article.

First, the High Seas Treaty provides for cumulative impact and environmental impact assessments that may be potentially relevant for the cross-border transportation and overseas storage of carbon dioxide.[240] As science and technology continue to advance, the scope and extent of currently unrecognized cumulative impacts and future risks may be clarified. These may be further clarified as countries begin to engage in carbon dioxide shipping and storage activities, since higher volumes of shipped carbon dioxide also increase the chances that damage may occur. Second, the treaty's innovative concept of designating area based management tools (AMBTs), such as marine

236. See discussion *supra* Part IV.

237. See discussion *supra* Part IV.

238. The High Seas Treaty, *supra* note 233, arts. 1–4 (defining the supplementary relationship of the new treaty to UNCLOS).

239. The High Seas Treaty, *supra* note 233, arts. 1 (4); UNCLOS, *supra* note 194, art. 1 (1) (defining the Area as "the seabed and ocean floor and subsoil thereof, beyond the limits of national jurisdiction," as discussed above).

240. The High Seas Treaty, *supra* note 233, art. 1 (6) ("'Cumulative impacts' means the combined and incremental impacts resulting from different activities, including known past and present and reasonably foreseeable activities, or from the repetition of similar activities over time, and the consequences of climate change, ocean acidification and related impacts. 'Environmental impact assessment' means a process to identify and evaluate the potential impacts of an activity to inform decision-making."). Environmental impact assessments are further detailed in Articles 21–38.

protected areas (MPAs), in the high seas may trigger limitations on shipping traffic.[241]

In conclusion, it is still too early to assess the effects of the High Seas Treaty on cross-border carbon dioxide transportation for storage overseas, as this treaty has not yet entered into force. More research is recommended on this topic as countries move towards ratification, as well as once the treaty's newly created scientific body charged with researching the changing conditions of begins its work.

VII. MARPOL (INTERNATIONAL CONVENTION FOR THE PREVENTION OF POLLUTION FROM SHIPS)

The International Convention for the Prevention of Pollution from Ships (MARPOL),[242] addresses operational pollution from ships, including unintentional releases of pollution.[243] Annex I of MARPOL establishes rules for oil pollution, whereas Annex VI's Regulations for the Prevention of Air Pollution from Ships establishes specific Emission Control Areas for both sulfur oxides (SO_x) and nitrogen oxides (NO_x).[244]

In principle, carbon dioxide transportation for storage should not face additional requirements beyond what any ordinary ship faces under MARPOL's Annex VI. However, further research needs to be done to determine whether ships

241. The High Seas Treaty, *supra* note 233, art. 1 (9) ("'Marine protected area' means a geographically defined marine area that is designated and managed to achieve specific long-term biodiversity conservation objectives and may allow, where appropriate, sustainable use provided it is consistent with the conservation objectives."). This provision should also be read in combination with Articles 14–18.

242. U.N. Convention for the Prevention of Pollution from Ships, Nov. 2, 1973, 12 I.L.M 319 [hereinafter MARPOL].

243. The definition of discharge in MARPOL's Article 2 excludes any dumping regulated under the London Convention. MARPOL, *supra* note 242, art. 2; *see also* HUNTER ET AL., *supra* note 19, at 786. (Noting that MARPOL's focuses on operational discharges, excepting from its coverage the intentional dumping of waste. The latter is the regulated under the London Convention).

244. MARPOL, *supra* note 242, at Annex VI; *see also* IMO, *Special Areas under MARPOL*, INT'L MAR. ORG. https://www.imo.org/en/OurWork/Environment/Pages/Special-Areas-Marpol.aspx [https://perma.cc/6C64-KXZ4]. (Sulfur oxide areas have more stringent controls on sulfur emissions; likewise, nitrogen oxide areas have higher stringency requirements and apply to Tier III NOx emission standards).

transporting carbon dioxide would use or carry substances that would trigger additional requirements under MARPOL.

MARPOL's Annex VI requirements are implemented in United States' domestic law under the Act to Prevent Pollution from Ships (APPS),[245] which subjects U.S-.flagged vessels to inspection regarding compliance with Annex VI's requirements. Non-US flagged vessels are subject to examination under the Port State Control when operating in US waters.[246] Under MARPOL's regime,[247] a port State or a coastal State at an offshore terminal may carry out intensive inspections of all ships, but the State's jurisdiction is restricted to the vessel's location at the time of enforcement.[248]

VIII. OSPAR (CONVENTION FOR THE PROTECTION OF THE MARINE ENVIRONMENT OF THE NORTH-EAST ATLANTIC)

The Convention for the Protection of the Marine Environment of the North-East Atlantic,[249] or OSPAR, is a regional convention that applies to States located in the North-East Atlantic region, and focuses on regulating offshore dumping.[250] According to the OSPAR Convention, dumping refers to "(i) any deliberate disposal in the maritime area of

245. *MARPOL Annex VI and the Act To Prevent Pollution From Ships (APPS)*, U.S. ENV'T PROT. AGENCY (Aug. 29, 2023), https://www.epa.gov/enforcement/marpol-annex-vi-and-act-prevent-pollution-ships-apps [https://perma.cc/9NTA-JHSG] ("Annex VI of the MARPOL treaty is the main international treaty addressing air pollution prevention requirements from ships. It was implemented in the United States through the Act to Prevent Pollution from Ships, 33 U.S.C. §§ 1901-1905 (APPS). Annex VI requirements comprise both engine-based and fuel-based standards, and apply to U.S. flagged ships wherever located and to non-U.S. flagged ships operating in U.S. waters.").

246. The United States Coastal Guard or EPA may bring enforcement action for a violation. *See* 33 U.S.C. app. §§ 1903–1907.

247. MARPOL, *supra* note 242, art. 5.

248. HUNTER ET AL., *supra* note 19, at 796–97. (Noting that when a port state takes an enforcement measure, such as an inspection, to determine where if the vessel has committed a discharge violation on the high seas, the port state will investigate a violation of another state's law (not its own) and it does not have jurisdiction to prescribe).

249. Convention for the Protection of the Marine Environment of the North-East Atlantic, [abbreviated parties to agreement], Sep. 22, 1992, 2454 U.N.T.S. 67 [hereinafter OSPAR Convention].

250. Contracting States are Belgium, Denmark, the European Union, Finland, France, Germany, Iceland, Ireland, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom of Great Britain and Northern Ireland. OSPAR COMMISSION, https://www.ospar.org [https://perma.cc/K6MW-PN6D] (last visited May 4, 2024).

wastes or other matter (1) from vessels or aircraft; (2) from offshore installations; (ii) any deliberate disposal in the maritime area of (1) vessels or aircraft; (2) offshore installations and offshore pipelines."[251] In 2007, parties to the OSPAR Convention amended it to expressly authorize carbon dioxide streams from carbon dioxide capture processes for storage to be disposed into a sub-soil geological formations.[252] Despite the amendments' focus on storage, experts[253] have interpreted them to mean that transportation is incidentally included as part of the process of storage.[254] Since the amendment came into force, the status of CCS for offshore storage sub-soil geological formation has not been questioned under international law;[255] there are no relevant controversies about the authorization of CCS under the amended

251. OSPAR Convention, *supra* note 249, art. 1, (f). This Convention further excludes from this definition MARPOL's application as well as placement of matter for a purpose other than the mere disposal thereof, provided that, if the placement is for a purpose other than that for which the matter was originally designed or constructed, it is in accordance with the relevant provisions of the Convention; and the leaving wholly or partly in place of a disused offshore installation or disused offshore pipeline, provided that any such operation takes place in accordance with any relevant provision of the Convention and international law.

252. OSPAR Convention, *supra* note 249, Amendment to Annex II on the Prevention and Elimination of Pollution by Dumping or Incineration, art. 3 ("The dumping of all waste is prohibited, except for wastes and matters listed in paragraph 2 and 3 of this Article . . . (2) (f): Carbon dioxide streams from carbon dioxide capture processes for storage, provided: i. disposal is into a sub-soil geological formation; ii. the streams consist overwhelmingly of carbon dioxide. They may contain incidental associated substances derived from the source material and the capture, transport and storage processes used; iii. no wastes or other matter are added for the purpose of disposing of those wastes or other matter; iv. they are intended to be retained in these formations permanently and will not lead to significant adverse consequences for the marine environment, human health and other legitimate uses of the maritime area.").

253. Weber, *supra* note 40, at 388; *see also* IEAGHG, *supra* note 35, at 60.

254. OSPAR Convention, *supra* note 249, Amendment to Annex II on the Prevention and Elimination of Pollution by Dumping or Incineration (see amendment of the text in the previous footnote).

255. *See* EU Parliament and EU Council, 2009/31/EC of the European Parliament and of the Council on the geological storage of carbon dioxide and amending Council Directive 85/337/EEC, European Parliament and Council Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC, 2008/1/EC and Regulation (EC) No. 1013/2006 (Apr. 23, 2009) ("*Whereas* (12 and 14): At the international level, legal barriers to the geological storage of CO_2 in geological formations under the seabed have been removed through the adoption of related risk management frameworks under the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention)." (emphasis in original)).

legal regime.[256] Exports of carbon dioxide for permanent storage face uncertainties under other European regional conventions.[257] Analysis of these conventions is outside the scope of analysis of this Article as they are unlikely to be relevant for the cross-border shipping of carbon dioxide from Europe to the United States.

IX. HNS CONVENTION (INTERNATIONAL CONVENTION ON LIABILITY AND COMPENSATION FOR DAMAGE IN CONNECTION WITH THE CARRIAGE OF HAZARDOUS AND NOXIOUS SUBSTANCES BY SEA)

The International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea (HNS Convention) will establish an international liability framework in the event of accidents at sea that involve hazardous and noxious substances. Beyond pollution damage from accidental spills, the HNS Convention also covers the risks of fire and explosion, including loss of life or personal injury as well as loss or damage of property.[258]

Although the HNS Convention does not regulate the legality of the transport of carbon dioxide per se, it may impose costs on CCS and carbon dioxide shipping as a result of the Convention's mandatory contributing fund from shipowners.[259] Because shipowners of particularly high tonnage have to contribute to the fund, it is likely that the HNS Convention will increase costs for carbon dioxide carriers once it enters into force.[260]

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256. Weber, *supra* note 40, at 388; *see also* Østgaard & Ombudstvetdt, *supra* note 115, at 11.

257. European regional conventions on the topic include the Bucharest Convention (from 1992 and applying to six countries located in the Back Sea); and the Barcelona Convention (from 1976 and applying in the Mediterranean Sea area). As of January of 2024, experts contend that carbon dioxide for storage is not prohibited under both conventions. See Østgaard & Ombudstvetdt, *supra* note 115, at 11–14.

258. International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea 1996 and its Protocol of 2010 (adopted May 3, 1996, and Apr. 29, 2010, respectively, and not yet entered into force), 35 I.L.M. 1415 [hereinafter HNS Convention].

259. HNS Convention, *supra* note 258, art. 9 (determining the tonnage and the contribution for the HNS fund, which will have separate funds for carriers of oil than carriers of gas, for instance).

260. Weber, *supra* note 40, at 392.

Even though the HNS Convention has not yet entered into force, the Convention has already been superseded by its Protocol. The Protocol was based on both the Civil Liability and the Fund Conventions,[261] which cover the pollution damage caused by spills of persistent oil from tankers.[262] The HNS Convention, following the original oil pollution compensation regime, will create a two-tiered system for compensation to be paid in the event of accidents at sea involving hazardous and noxious substances.[263] The first tier of compensation will be covered by compulsory insurance taken out by shipowners, who can then use that insurance to limit their liability. In cases where the insurance does not cover an incident or is insufficient to satisfy the claim, a second tier of compensation will be paid from a fund comprising contributions from the receivers of hazardous or noxious substances (HNS).[264]

The main features of the HNS Convention include a system of strict liability for the shipowner. Apart from a few exceptions, a shipowner's liability cannot be excluded.[265] The liability of the

261. International Convention on Civil Liability for Oil Pollution Damage and the Fund Conventions, Nov. 27, 1992, 1956 U.N.T.S. 255.

262. *International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea*, IMO, https://www.imo.org/en/About/Conventions/Pages/International-Convention-on-Liability-and-Compensation-for-Damage-in-Connection-with-the-Carriage-of-Hazardous-and-Noxious-.aspx [https://perma.cc/KH5H-8HZW].

263. *Id.*

264. IMO, *supra* note 262 (noting that contributions will be calculated according to the amount HNS received by each party in the previous calendar year. For additional details, see Weber, *supra* note 40, at 393).

265. HNS Convention, *supra* note 258, arts. 7 (1), 7(5), 7(6). Article 7 determines the following:

> Art. 7 (1) Except as provided in paragraphs 2 and 3, the owner at the time of an incident shall be liable for damage caused by any hazardous and noxious substances in connection with their carriage by sea on board the ship, provided that if an incident consists of a series of occurrences having the same origin the liability shall attach to the owner at the time of the first of such occurrences. (2) No liability shall attach to the owner if the owner proves that: (a) the damage resulted from an act of war, hostilities, civil war, insurrection or a natural phenomenon of an exceptional, inevitable and irresistible character; or (b) the damage was wholly caused by an act or omission done with the intent to cause damage by a third party; or (c) the damage was wholly caused by the negligence or other wrongful act of any Government or other authority responsible for the maintenance of lights or other navigational aids in the exercise of that function; or (d) the failure of

shipowner, however, can be limited depending on the size of the ship and whether it carries cargo in bulk or packaged form.[266]

The HNS Convention does not expressly mention carbon dioxide.[267] However, the HNS Convention will apply to ships carrying both liquefied bulk carbon dioxide of a high purity as well as carbon dioxide of reclaimed quality, as per the Convention's reference to the International Code of the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk.[268] Therefore, once the HNS Convention enters into force, its regulations will apply to carbon dioxide carriers.[269] For ships carrying carbon dioxide,[270] the HNS Convention will replace the Convention on Limitation of Liability for Maritime Claims.[271]

> the shipper or any other person to furnish information concerning the hazardous and noxious nature of the substances shipped either (i) has caused the damage, wholly or partly; or (ii) has led the owner not to obtain insurance in accordance with article 12; provided that neither the owner nor its servants or agents knew or ought reasonably to have known of the hazardous and noxious nature of the substances shipped. (3) If the owner proves that the damage resulted wholly or partly either from an act or omission done with intent to cause damage by the person who suffered the damage or from the negligence of that person, the owner may be exonerated wholly or partially from liability to such person.

266. HNS Convention, *supra* note 258, arts. 9, 14.

267. HNS Convention, *supra* note 258, art. 1(5)(a)(v) reads as follows:

> Hazardous and noxious substances (HNS) means: (a) any substances, materials and articles carried on board a ship as cargo, referred to in (i) to (vii) below: (v) liquefied gases as listed in chapter 19 of the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk, as amended, and the products for which preliminary suitable conditions for the carriage have been prescribed by the Administration and port administrations involved in accordance with paragraph 1.1.6 of the Code.

268. *The International Code of the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGC)*, INT'L MARITIME ORG., https://www.imorules.com/GUID-7B95E771-BBFD-447B-84AD-D6370DA61DE5.html [https://perma.cc/VT49-9NJE] (Carbon dioxide of reclaimed quality is not specifically defined, but it is generally understood as a stream which contains impurities. It may contain water or sulfur dioxide, among other impurities. These impurities may increase acid corrosion-related risks.) (last visited Apr. 30, 2024).

269. Weber, *supra* note 40, at 392.

270. HNS Convention, *supra* note 258, art. 42; LLMC Convention, *infra* note 271, art. 18 (1) (b).

271. Convention on Limitation of Liability for Maritime Claims, Nov. 16, 1976 (entered into force on Dec. 1, 1986), Protocol of 1996, May 1996 (entered into force May 13, 2004) 1456 U.N.T.S. 221 [hereinafter LLMC Convention].

It is noteworthy that the HNS Convention only applies when the cargo is onboard.[272] Therefore, while carbon dioxide is waiting in storage tanks or after it has been discharged, liability under the Convention would not be triggered.[273]

X. OECD (ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT) COUNCIL WASTES DECISION

OECD member States, including the United States, are parties to the OECD Council's decision regulating the transboundary movements of waste for recovery purposes.[274] This decision established a notice and consent system for the transboundary movements of wastes destined for recovery operations among OECD member States.[275]

The OECD Wastes Decision qualifies as a multilateral agreement under the Basel Convention,[276] thus allowing OECD member States who are parties to the Basel Convention to trade wastes covered by the OECD decision with OECD members that have not ratified the Basel Convention—for example, the United States.[277] The decision aims to facilitate the trade of waste for recovery, reducing the likelihood that waste is abandoned or handled illegally.[278] The decision defines disposal and recovery as the activities listed in its annexes,[279] which automatically triggers

272. HNS Convention, *supra* note 258, arts. 1(9); 4(1).

273. Weber, *supra* note 40, at 392.

274. OECD Legal Instruments, *Decision of the Council on the Control of Transboundary Movements of Wastes Destined for Recovery Operations*, Mar. 29, 1992 (amended Dec. 31, 2020) [hereinafter OECD Wastes Decision], https://legalinstruments.oecd.org/en/instruments/OECD-LEGAL-0266 [https://perma.cc/R2VC-4G77].

275. *Id.* chs. II. A.– B.

276. Basel Convention, *supra* note 21, art. 11.

277. HUNTER ET AL., *supra* note 19, at 961.

278. United States Environmental Protection Agency, International Agreements on Transboundary Shipments of Hazardous Waste, Nov. 1, 2022, (noting that the OECD decision is implemented in US law under Title 40 of the Code of Federal Regulations, section 262.81).

279. OECD Wastes Decision, *supra* note 274, Chapter II, A (3) defines disposal as any activity listed in Appendix 5.A; Chapter II, A (4) defines recovery as any of the activities of Appendix 5.B. Appendix 5.A, in the relevant part potentially applicable to CCS, refers to: (D3) Deep injection, meaning the injection of pumpable discards into wells, salt domes or naturally occurring repositories, etc.; (D7) Release into seas/oceans including sea-bed insertion; (D15) Storage pending any of the operations in Appendix

the application of the Basel Convention and its amendments unless an OECD member objects.[280]

The notice and consent system established by the OECD Wastes Decision is called the Control System. The Control System has two types of control procedures.[281] The Green Control Procedure applies to wastes that present low risk for human health and the environment and are not subject to any other controls than those normally applied in commercial transactions. The Amber Control Procedure applies to wastes that present sufficient risk to justify closer control.[282] As with the Basel Convention, the OECD Wastes Decision does not prohibit the cross-border transportation of hazardous waste, but instead sets specific requirements for its transport.[283] Accordingly, in the

5.A. Appendix 5.B, in the relevant part potentially considered for CCUS, determines (R1) the use as a fuel (other than in direct incineration) or other means to generate energy; (R7) recovery of components used for pollution abatement; and (R9) used oil re-refining or other reuses of previously used oil.

280. OECD Wastes Decision, *supra* note 274, pmbl. ("Noting that Member countries agreed at the Working Group on Waste Management Policy (WGWMP) meeting in Vienna in October 1998 to further harmonisation of procedures and requirements of OECD Decision C(92)39/FINAL with those of the Basel Convention."); *see also* OECD, *The OECD Control System for Waste Recovery*, OECD https://www.oecd.org/env/waste/theoecdcontrolsystemforwasterecovery.htm [https://perma.cc/HG6E-867S].

281. OECD Wastes Decision, *supra* note 274, Chapter II, B.2.

282. *Legal Instruments: Appendices 3 and 4 to the OECD Council Decision: The Green and Amber Lists of Wastes*, OECD (updated on Dec. 31, 2020), https://legalinstruments.oecd.org/en/instruments/OECD-LEGAL-0266 [https://perma.cc/R2VC-4G77].

283. OECD Wastes Decision, *supra* note 274, ch. I ("Decides that Member countries shall control transboundary movements of wastes destined for recovery operations within the OECD area in accordance with the provisions set out in Chapter II of this Decision and in the appendices to it; II. Instructs the Environment Policy Committee in co-operation with other relevant OECD bodies, in particular the Trade Committee, to ensure that the provisions of this Control System remain compatible with the needs of Member countries to recover wastes in an environmentally sound and economically efficient manner; III. Recommends Member countries to use for the Notification Document and Movement Document the forms contained in Appendix 8 to this Decision; IV. Instructs the Environment Policy Committee to amend the forms for the Notification Document and Movement Document as necessary; V. Instructs the Environment Policy Committee to review the procedure for amending the waste lists under Chapter II. B, (3) at the latest seven (7) years after the adoption of the present Decision; VI. Requests Member countries to provide the information that is necessary for the implementation of this Decision and is listed in Appendix 7 to this Decision; VII. Requests the Secretary General to transmit this Decision to the United Nations Environment Programme and the Secretariat of the Basel Convention.").

unlikely event that carbon dioxide becomes considered hazardous waste under the Basel Convention, it should follow a similar classification under the OECD Wastes Decision. Because the decision could also pose a challenge to the cross-border transportation of carbon dioxide, this would present an additional reason for the parties of the Basel Convention to clarify the scope of its application regarding the cross-border transportation of carbon dioxide for storage.

XI. BILATERAL AGREEMENTS BETWEEN THE UNITED STATES AND OTHER COUNTRIES

The United States has entered into separate bilateral agreements for importing and/or exporting hazardous wastes with Canada,[284] Mexico,[285] Costa Rica,[286] Malaysia,[287] and the Philippines.[288] These agreements implement the OECD Control

284. The Agreement Concerning the Transboundary Movement of Hazardous Waste, Can-U.S, (Oct. 28, 1986; amended on Nov. 4, 1992), https://www.epa.gov/sites/default/files/2015-12/documents/canada86and92.pdf [https://perma.cc/9YVN-Q6ZX] (Article 1 defines hazardous waste for the United States as per the country's legislation; likewise, Canada's definition of hazardous waste are determined according to Canadian laws; Article 2 authorizes export, import or transit hazardous waste for recycling or disposal).

285. The Agreement Regarding the Transboundary Shipments of Hazardous Wastes and Hazardous Substances, Mex.-U.S., (Nov. 12, 1986), https://19january2021snapshot.epa.gov/hwgenerators/agreement-between-mexico-and-united-states-regarding-transboundary-shipments-hazardous_.html [https://perma.cc/TDD3-ZKYE] (determining the movement of hazardous waste from Mexico the United States for recycling or disposal; and from the United States to Mexico exclusively for recycling).

286. The Agreement Concerning the Transboundary Movement of Hazardous Wastes from Malaysia to the United States, Malay.-U.S., (March 10, 1995), https://www.epa.gov/hwgenerators/agreement-between-government-america-and-government-malaysia-concerning-transboundary [https://perma.cc/3WTC-4L5G] (The Preamble specifically refers to Article 4(5) and Article 11 of the Basel Convention authorizing parties of the Convention to enter into bilateral agreements with non-parties, provided they are not less stringent than the requirements of the Basel Convention.).

287. The Agreement on the Transboundary Movement of Hazardous Waste, Costa Rica-U.S., (Sep. 30, 1997), https://www.epa.gov/hwgenerators/agreement-transboundary-movement-hazardous-waste-costa-rica-united-states-1997 [https://perma.cc/F3C8-U2LM] (The Preamble refers to Article 11 of the Basel Convention.).

288. The Agreement Concerning the Transboundary Movement of Hazardous Wastes from the Philippines to the United States, Phil.-U.S., (Sep. 20, 2001),

System[289] outlined in the previous Section. At the time of writing, the review of each of these agreements according to documents available online did not indicate that transportation and overseas storage of carbon dioxide is specifically regulated or precluded under these agreements.[290]

XII. CONCLUSION

As the previous Sections demonstrated, there is no single international treaty that explicitly addresses the cross-border transportation of carbon dioxide for storage. Currently, the London Convention and Protocol system offer the strongest regulation potential, with the latter being the only treaty expressly allowing for offshore storage of carbon dioxide. The Basel Convention is unlikely to apply to the cross-border transportation of carbon dioxide for storage, so long as purity levels of the carbon dioxide stream are high, and no prohibited co-components are added. This tends to be the case in practice, since low purity streams or the presence of toxic co-components would likely jeopardize shipping and pipeline infrastructure altogether. Finally, as our review has shown, other international conventions present a general obligation of nonpollution but are not indicative of the legal prohibition of cross-border transportation of carbon dioxide for storage.

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https://www.epa.gov/hwgenerators/agreement-between-government-united-states-america-and-government-republic-philippines [https://perma.cc/C6SX-L3DV] (The Preamble mentions Article 4 (5) and Article 11 of the Basel Convention.).

289. OECD, *Decision of the Council on the Control of Transboundary Movements of Wastes Destined for Recovery Operation* (updated on Dec. 31, 2020), at https://legalinstruments.oecd.org/en/instruments/OECD-LEGAL-0266 [https://perma.cc/R2VC-4G77].

290. The review conducted used the documents available at the US Environmental Protection Agency website: United States Environmental Protection Agency, *International Agreements on Transboundary Shipments of "Hazardous Waste": Bilateral Agreements between the United States and Other Countries* (Jan. 3, 2023), https://www.epa.gov/hwgenerators/international-agreements-transboundary-shipments-hazardous-waste [https://perma.cc/9EJP-BN9L]. (It is noteworthy that hazardous waste is defined according to domestic legislation. In the United States, the EPA specifically excluded carbon dioxide for storage as hazardous waste, and this exclusion encompasses transportation. *See* EPA, Hazardous Waste Management System: Conditional Exclusion for Carbon Dioxide (CO_2), 79 FR 350 (published Jan. 3, 2014, and effective since Mar. 4, 2014.)).

The current pending-ratification status of the 2009 Amendment to Article 6 of the London Protocol, as discussed, still requires countries to enter into bilateral agreements to authorize the export of carbon dioxide for permanent offshore storage. Moreover, none of the international legal frameworks discussed contain provisions regulating onshore storage; they only cover offshore storage. None of them prohibit onshore storage. The provisional application of the 2009 Amendment to Article 6 of the London Protocol coupled with the absence of an international legal framework for cross-border transportation for onshore storage is unlikely to be optimal if the international law community continues to consider CCS as having an important role as a part of a mitigation portfolio of activities needed to reduce GHG emissions, particularly for hard-to-abate sectors.

Overall, there is general agreement regarding the role of international treaties in transboundary offshore carbon dioxide storage. The provisional application of the 2009 export amendment to Article 6 of the London Protocol removed the last significant international legal barrier to the export of carbon dioxide for offshore storage.[291] In a recent report, the IEA encouraged countries to develop and publicly share bilateral agreements for cross-border transport of carbon dioxide under the provisional application of that amendment.[292]

Despite a general understanding that no international treaty poses significant barriers to CCS, actors still face a patchwork of international treaties that each have some level of uncertainty regarding the exact scope of their application. Such a legal patchwork is not ideal to facilitate the transportation of carbon dioxide in order to achieve the climate change mitigation benefits of CCS and promote effective environmental protection. Instead, it is likely to increase transaction costs for all involved parties, which may present a potential deterrence to attracting new actors. The higher the uncertainties of the applicable law, the higher the incentives for actors to litigate.[293] Unsurprisingly,

291. IEAGHG, *supra* note 68, at 9.

292. IEA, *supra* note 99, at 18.

293. ROBERT COOTER & THOMAS ULEN, LAW AND ECONOMICS 406–08 (2016) (contending that legal uncertainty is likely to foster litigation, increasing transaction costs).

key players in the industry have emphasized the need for a unified legal regime[294] and market.[295]

The cross-border transportation of carbon dioxide for permanent storage may be consequential to enable carbon dioxide storage for countries that would not otherwise have this possibility; without it, more carbon dioxide remains in the atmosphere and continues to pollute. This harmful scenario of high levels of carbon dioxide in the atmosphere provides an additional reason for parties to ratify the 2009 amendment to Article 6 of the London Protocol as soon as possible.

In the meantime, the interim application of the 2009 amendment to Article 6 of the London Protocol has already enabled the cross-border transportation of carbon dioxide for permanent offshore storage. While the current legal patchwork of international treaties is not exactly the most encouraging for the cross-border transportation of carbon dioxide for storage, it ultimately does not present significant legal hurdles.

294. IEA, *supra* note 99, at 72–75 (underscoring the multiple international legal scenarios involved in the cross-border transportation of carbon dioxide).

295. Lucy Hine, *EU Policy seeing as blocking Scale Up of Cross-border Liquified CO_2 Exports by Ship*, TRADEWINDS (Oct. 24, 2022) https://www.tradewindsnews.com/opinion/eu-policy-seen-as-blocking-scale-up-of-cross-border-liquefied-co2-exports-by-ship/2-1-1338366 [https://perma.cc/CTS3-W9JB] (highlighting the following remarks by Jasper Heikens, chief commercial officer for EcoLog at the CCUS 2022: Time to Deliver conference in London: "Shipping by its very nature is cross-border. We now have policy in the way preventing free movement of carbon dioxide.").

APPENDIX

Table 7: Parties to the Basel Convention[296]

Afghanistan	Cyprus	Kazakhstan	Panama	Türkiye
Albania	Czechia	Kenya	Papua New Guinea	Turkmen-istan
Algeria	Republic of Korea (*Democratic People's*)	Kiribati	Paraguay	Tuvalu
Andorra	Democratic Republic of Congo	Kuwait	Peru	Uganda
Angola	Denmark	Kyrgyzstan	Philippines	Ukraine
Antigua & Barbuda	Djibouti	Lao People's Democratic Republic	Poland	United Arab Emirates
Argentina	Dominica	Latvia	Portugal	U.K. of Great Britain & Northern Ireland
Armenia	Dominican Republic	Lebanon	Qatar	Republic of *Vanuatu*
Australia	Ecuador	Lesotho	Republic of Korea	United Republic of Tanzania
Austria	Egypt	Liberia	Republic of Moldova	Uruguay
Azerbaijan	El Salvador	Libya	Romania	Uzbekistan

296. Parties to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, Status of Ratification (2022), https://www.basel.int/Countries/StatusofRatifications/PartiesSignatories/tabid/4499/Default.aspx [https://perma.cc/8GNP-GKYW]. (As previously mentioned in this article, there are currently 191 parties to the Basel Convention and the United States never ratified it.)

Table 7: Parties to the Basel Convention[296]

Bahamas	Equatorial Guinea	Lichtenstein	Russian Federation	Vanuatu
Bahrain	Eritrea	Lithuania	Rwanda	Venezuela (*Bolivarian Republic of*)
Bangladesh	Estonia	Luxem-bourg	Saint Kitts & Nevis	Vietnam
Barbados	Eswatini	Madagascar	Saint Lucia	Yemen
Belarus	Ethiopia	Malawi	Saint Vincent & the Grenadines	Zambia
Belgium	European Union	Malaysia	Samoa	Zimbabwe
Belize	Finland	Maldives	San Marino	
Benin	France	Mali	Saint Tome and Principe	
Bhutan	Gabon	Malta	Saudi Arabia	
Bolivia (*Plurinational State of*)	Gambia	Marshall Islands	Senegal	
Bosnia & Herzegovina	Georgia	Mauritania	Serbia	
Botswana	Germany	Mauritius	Seychelles	
Brazil	Ghana	Mexico	Sierra Leone	
Brunei Darussalam	Greece	Micronesia (*Federated States of*)	Singapore	
Bulgaria	Grenada	Monaco	Slovakia	
Burkina Faso	Guatemala	Mongolia	Slovenia	
Burundi	Guinea	Montenegro	Solomon Islands	

Table 7: Parties to the Basel Convention[296]

Cabo Verde	Guinea Bissau	Morocco	Somalia
Cambodia	Guyana	Mozam-bique	South Africa
Cameroon	Haiti	Myanmar	Spain
Canada	Honduras	Namibia	Sri Lanka
Central Africa Republic	Hungary	Nauru	State of Palestine
Chad	Iceland	Nepal	Sudan
Chile	India	Netherlands	Suriname
China	Indonesia	New Zealand	Sweden
Colombia	Iran (*Islamic Republic of*)	Nicaragua	Switzerland
Comoros	Iraq	Niger	Syrian Arab Republic
Congo	Ireland	Nigeria	Tajikistan
Cook Islands	Israel	North Macedonia	Thailand
Costa Rica	Italy	Norway	Togo
Republic of *Cote d'Ivoire*	Jamaica	Oman	Tonga
Croatia	Japan	Pakistan	Trinidad & Tobago
Cuba	Jordan	Palau	Tunisia