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The International Law of Energy of Offshore Carbon Capture and Storage: The *Rotterdam Nucleus* Project case study

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Abstract

Achieving net-zero emissions by 2050 infers that the total CO2 emissions would need to fall by around 45% from 2010 levels by 2030. The general sustainable development scenario suggests that change in energy demand will uphold an extensive usage of renewable energy and clean energy technologies. This paper focuses on the Rotterdam Nucleus Project and how it can contribute to large-scale CO2 transportation from the Port of Rotterdam to CO2 storage with capacity within 20 km of the Dutch coast. The Project is a model for establishing a European CCS infrastructure in the North Sea, targeting a gateway transferring CO2 from source to sink. It envisions taking part in the subsequent EU CO2 Project of Common Interest (PCI), facilitating financial support from the Connecting Europe Facility (CEF). In the first section, this paper analyses the ad hoc approach governing the implementation of the Rotterdam Nucleus, including the relevant regulatory framework at both national and local levels and its investment arrangements alongside the EU Commission. The following section stresses the Project's foundational approach and how inter-national law assists the global governance of offshore CCS transportation.

Keywords

energy law, carbon capture and storage, *Rotterdam Nucleus* Project

1. Introduction

Global energy systems are experiencing significant and rapid change. Demand for energy access is growing, driving supply owners to deliver it at an affordable cost with a declining carbon and emissions footprint.[1] But the manner in which we use and see 'energy' is also changing. New technologies are emerging, such as

1. World Economic Forum, 'Fostering Effective Energy Transition, A Fact-Based Framework to Support Decision-Making,' 2018, p.6.

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carbon capture and storage (CCS),[2] but the law remains underdeveloped. This paper will draw upon the existing international legal framework for CCS in offshore waters and the missing gaps in deploying transboundary projects of this nature in relation to the protection of the marine environment.

The Intergovernmental Panel on Climate Change (IPCC) defines CCS as a process comprising the separation of CO_2 from industrial and energy-related sources, transport to a storage location, and long-term isolation from the atmosphere.[3] The ones favourable to CCS affirms it is critical for climate change mitigation strategies.[4] On the other hand, there are many concerns about the risks inherently present in CCS projects, and how invasive they can become in the local environment. Achieving net-zero emissions by 2050 requires total emissions of CO_2 to fall by around 45% from 2010 levels by 2030.[5] The emissions from the power sector would need to be reduced by more than half between 2019 and 2030.[6] In this scenario, renewable energy technologies and CCS became the lifeboat to the many countries wishing to reduce their CO_2 emissions.

Offshore CCS has an important international law dimension that shapes much of the energy law in domestic legislation. There is no uniformity in a body of rules known as international energy law. The field is diverse, complex and involves a series of principles of international law and hard law according to different types of energy resources.[7] Domestic energy law intertwines with the international law of energy in many structural aspects. Oil or gas, renewable energy projects or CCS, all have cross-cutting issues that trigger international responsibility for states, such as energy and the environment.[8]

In this context, this paper shall analyse the foundational basis of CCS deployment under the regime complex of the international law of energy. It connects The *Rotterdam Nucleus* (the 'Pilot Project')[9] designed in the Netherlands by skimming across its domestic and regional legislations references to the international regime complex. The *Rotterdam Nucleus* is a large-scale CCS project that aims to transport CO_2 from the Port of Rotterdam and store it on the sub-seabed floor of the North Sea. It also includes transportation of CO_2 from non-dutch power plants in the North Sea.[10] The goal of the *Rotterdam Nucleus* is to store several hundreds of megatons of CO_2 to offshore lines within a fixed time horizon of 20 years.[11] If the project succeeds, CCS technologies in the European sub-seabed could become role models to push for further investments within the block.

2. The Intergovernmental Panel on Climate Change [IPCC] defines CCS as a process comprising the separation of CO2 from industrial and energy-related sources, transport to a storage location, and long-term isolation from the atmosphere. See IPCC. (2005) IPCC Special Report on Carbon Dioxide Capture and Storage. Prepared by Working Group III of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 442 pp.
3. Id.
4. Cremer, C. (2009). Carbon capture and storage. In M. Ball & M. Wietschel (Eds.), The Hydrogen Economy: Opportunities and Challenges (pp. 168–198). Cambridge: Cambridge University Press.
5. World Energy Outlook 2020 – Analysis - IEA. (2020, October 13). International Energy Agency. Retrieved January 21, 2022, from https://www.iea.org/reports/world-energy-outlook-2020.
6. Id.
7. Wawryk, A. (2014). International energy law: an emerging academic discipline. In P. Babie & P. Leadbeter (Eds.), Law as Change: Engaging with the Life and Scholarship of Adrian Bradbrook (pp. 223–256). University of Adelaide Press.
8. See Wawryk, n 6, p. 110.
9. The project is part of the EU CO2 Project of Common Interest (PCI), facilitating financial support from the Connecting Europe Facility (CEF). About the plans of the European Union to enhance CCS usage in the upcoming years, please see European Commission, "Figure 89: CO2 capture and storage or re-use (2050)," In *Supplementary information Com (2018) 773 (2018)* (p. 73); European Commission, COM(2018) 773 final, "A Clean Planet for all: A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy"(2018).
10. Jakobsen, J., Bysveen, M., Vågenes, E., Eickhoff, C., Mikunda, T., Neele, F., Brunner, L., Heffron, R., Schumann, D., Downes, L., & Hanstock, D. (2017). Developing a Pilot Case and Modelling the Development of a Large European CO2 Transport Infrastructure -The GATEWAY H2020 Project. Energy Procedia, 114, 6835–6843.
11. SINTEF, 2017, Available at https://www.sintef.no/globalassets/sintef-energi/gateway/20170424_rotterdamnucleus_final_presentation_schiedam_public.pdf, Accessed on 14 May 2021.

The Pilot Project can influence the legal structure of future projects with a transboundary nature. Having a chain of public investments to support CCS projects in the European Union raises criticism of vocal environmentalists against the EU for not prioritising other means of mitigation in its plan of work.[12] Scholars note that sub-seabed CCS technologies could have a wider impact on the marine environment than cutting CO_2 emissions.[13] This paper shall analyse the main characteristics of this project by considering the existing international legal framework governing CCS activities. Notably, the operators have an international obligation to protect the marine environment from seabed activities under international treaties.[14] Despite having a robust set of national rules regulating the onshore phase of the project, the Netherlands is a member state of relevant international treaties on protecting the seabed and its biodiversity.[15] Therefore, contractors operating with a Dutch licence, and the Dutch law, shall be consistent with international law. The *ad hoc* analysis [Section 2] has shown that much of the existent Dutch law derives from European standards on CCS application.

Transboundary sub-seabed CCS requires extensive cooperation between the states involved in the operation.[16] The United Nations Convention on the Law of the Sea [UNCLOS][17] creates obligations to protect the marine environment in Part XII within coastal states' maritime boundaries or areas beyond national jurisdiction (ABNJ). Yet, the UNCLOS does not mention the injection of CO_2 in geological formations for storage. The treaties under the auspices of the International Maritime Organisation (IMO) became a source of CCS regulations and regional agreements, such as the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR).[18] Yet, some scholars argue that fragmentation of international law in regulating seabed activities, such as sub-seabed CCS, reveals the need to adopt a more comprehensive set of rules about CCS before it becomes a widespread technology around the globe.[19]

The overarching principles governing CCS in the international scenario are crucial for the success of the *Rotterdam Nucleus*. Energy has multiple conceptual objects, including acting as an (I) product, (II) a resource (III) a technology, or (IV) an activity.[20] Note that before any energy project operates, there must be an assessment of the 'energy object' under international law to identify the rules and the frameworks supporting the investment. Notably, international agreements did not envision provision in CCS until the 21st century. Therefore, it is not self-evident whether a CCS project shall be classified as a product, a resource, technology, or as an activity. For this reason, the urgency of having a legal framework about CCS technologies in the energy sector calls for a 'modernisation' of such instruments. The most prominent case is the negotiations under the Energy Charter Treaty (ECT).[21] The Pilot plans, such as the

12. See Galán-Martín, Á., Vázquez, D., Cobo, S. et al. (2021). Delaying carbon dioxide removal in the European Union puts climate targets at risk. Nat Commun 12, 6490.
13. See Doelle, M., & Lukaweski, E. (2012). Carbon capture and storage in the CDM: Finding its place among climate mitigation options?, *Climate Law*, *3*(1), 49–69.
14. The Netherlands is a member state of conventions, such as UNCLOS, Convention on Biological Diversity [CBD] and OSPAR. For a complete list of Treaties signed and ratified by the Kingdom of the Netherlands, please see https://treatydatabase.overheid.nl/en Accessed on 10 January 2022.
15. See n 10.
16. Bankes, N. (2020). "Chapter 17 The Use of Sub-Seabed Transboundary Geological Formations for the Disposal of Carbon Dioxide". In The Law of the Seabed. Leiden, The Netherlands: Brill | Nijhoff.
17. United Nations Convention on the Law of the Sea, adopted 10 December 1982; entered into force 16 November 1994, 1833 UNTS 3.
18. Convention for the Protection of the Marine Environment of the North-East Atlantic, 2354 UNTS 67, adopted on 22 September 1992.
19. See generally, Blomberg, Ann & Waarum, Ivar-Kristian & Totland, Christian & Eek, Espen. (2021). Marine Monitoring for Offshore Geological Carbon Storage—A Review of Strategies, Technologies and Trends. Geosciences. 11. 383.
20. Viñuales, J. E. (2022). The International Law of Energy. Cambridge University Press, Chapter 1.
21. The ECT was concluded in 1994. It entered into force in 1998. It has 52 parties.

Rotterdam Nucleus, will eventually embrace one energy criterion in the ECT and demand cooperation between different energy sectors. In such circumstances, the analysis of the overarching principles [Section 3] helps to transpose one or more energy objects to the case study.

This paper is structured as follows: the second section will briefly recapitulate what is the *Rotterdam Nucleus* and its relevance to the purpose of the present research. It includes identification, organisation and analysis of the permitting process, the regulatory framework, and planning law. The third section focuses on the overarching principles of CCS activities under international law. It draws upon the common rules and standards in different international conventions relating to CCS, namely the deployment of submarine cables and pipelines, re-use of depleted natural gas fields, and the discharge of content on the seas. The fourth section concludes this article.

2. The rotterdam nucleus project

2.1. Brief Introduction

In 2018, the Rotterdam Nucleus began its feasibility study and the pre-planning phase in the Port of Rotterdam. It comprises a one-stop-shop for an open-access CO_2 transport and storage network.[22] Also, it comprises three connected over-size pipelines from the Port of Rotterdam to several storage areas in the southern North Sea, and it aggregates an onshore Dutch industry conglomerate. The project is part of an ambitious European plan of work for Trans-European Networks for Energy (TEN-E), including the use of sub-seabed transboundary geological formations. Several European investment programs, including the Rotterdam Nucleus, are part of a larger energy strategy for the 'Priority cross-border CO_2 network.'[23]

The CCS project comprises three phases: (I) capturing CO_2 at large final emitters, (II) the compression and transportation of the CO_2 to a storage destination and (III) its injection under pressure on an oil/gas field well into the pore space of suitable geological formations.[24] The *Rotterdam Nucleus* involves three main sectors: (I) state-owned companies, i.e., Port of Rotterdam, EBN, Gasonie, are responsible for the investment in the infrastructure of the CCS;[25] (II) private companies interested in participating in joint agreements with the state-owned companies; (III) public authorities, as to the EU, secure funding and enacting the Directives on responsibility and liability for the actors involved in the operation.[26] Thus, the role of the EU in the regional development of CCS networks is to finance energy infrastructure to capture CO_2 for security issues and provide elements of the foundational approach.

Three main pipelines are responsible for the transportation in Dutch's onshore. The Pilot Project only operates in the storage segment of CO_2 and does not entail the injection of CO_2 as a means of enhanced

22. 'The CO2 network is extended to the gas field "Fizzy" in the UK Central North Sea (SNS) sector 50 to facilitate gas production with CO2 separation and storage. Available at https://www.sintef.no/globalassets/sintef-energi/gateway/20170424_rotterdamnucleus_final_presentation_schiedam_public.pdf, Accessed on 31 May 2021.
23. European Commission, "Technical information on Projects of Common Interest accompanying the Commission Delegated Regulation (EU) 2020/389 final of 31 October 2019 amending Regulation (EU) 347/2013 of the European Parliament and of the Council on guidelines for trans-European energy infrastructure as regards the Union list of projects of common interest," 2020.
24. Bankes, N. (2020). Carbon Capture and Storage and the Law of the Sea. In E. Johansen, S. Busch, & I. Jakobsen (Eds.), The Law of the Sea and Climate Change: Solutions and Constraints (pp. 160–183). Cambridge: Cambridge University Press.
25. Read, Andy & Tillema, Onno & Ros, Menno & Jonker, Tom & Hylkema, Hette. (2014). Update on the ROAD Project and Lessons Learnt. Energy Procedia. 63. 6079–6095; Blackford, Jerry & Artioli, Yuri & Clark, James & Mora, Lee de. (2017). Monitoring of offshore geological carbon storage integrity: Implications of natural variability in the marine system and the assessment of anomaly detection criteria. International Journal of Greenhouse Gas Control. 64. 99–112.
26. Id.

hydrocarbon recovery (EHR) or any other oil recovery. The implementation of the pilot plan depends not only on compliance with the *ad hoc* framework. Yet, it must comply with standards and regulations under international law. The Netherlands is a member of the ECT and the London Convention/Protocol (LP/LP). It is also a member of the North Sea Basin Task Force (NSBTRF),[27] which comprises a public-private platform for cooperation in transboundary CCS. The NSBTRF develops common principles for managing and regulating transportation, injection and permanent storage of CO_2 in the North Sea sub-seabed.[28] The regulatory framework under development for the Pilot Project is coherent with international law. That is not the problem. Again, the structure designed for the project benefits from missing gaps in the legal skeleton governing transboundary CCS projects. For this reason, this study aims at identifying the common principles and points of diversion with the international law framework with international obligations on the protection of the marine environment.

The Pilot Project is complex and demands high-level cooperation between the actors involved. This research does not intend to exhaust the local and national legislation applicable to the case. It offers a general overview of the water, waste, sanitation, energy laws in the Netherlands, and general principles of constitutional law. The research shall focus on the main regulatory frameworks applicable to the *Rotterdam Nucleus.* In the following session, this paper presents its permitting process. The pre-assessment phase contains its *ad hoc* legal framework, including the relevant regulatory framework at national and local levels and its investment arrangements with the EU.

2.2. The permitting process

2.2.1. The project management

The Port of Rotterdam is a potential hub in Europe for CCS due to its refining (petro) chemicals, cement, iron, steel, waste incineration, and bio-based industries.[29] Artificial technologies aimed at promoting the mitigation of greenhouse gases (GHGs) in the atmosphere arose from the general understanding that reducing the emission of those gases would not suffice. In this sense, the first phase is to capture the CO_2 from large or small points of emission sources. The capturing process involves separation, compression, and dehydration for transport and storage. Thus, the capturing process engages more actively with the GHGs emitting actors because of its elevated production costs, such as the Netherlands.[30]

The *Rotterdam Nucleus* initiative comprises three state-owned parties, EBN, Gasunie, Port of Rotterdam. The Pilot Project aim is to conclude the licensing by 2023 and start operating in the same year.[31] Another permitting process phase comprises four different regulatory frameworks, namely the local (municipalities), regional (water authorities), regional (provinces), national (ministries and national advisors). The *ad hoc* framework of transnational transport of CCS also includes regional actors, such as the EU law. Yet, it is unclear how the EU law will play a significant role in assessing transportation of CO_2 to the North Sea as many countries in the region are not bound by EU law (e.g, the UK, Norway, Sweden). It seems that international law would actively engage with the transportation phase of the Project once it reaches offshore waters in the region. Some of the most prominent international agreements in this case would be the UNCLOS, LP/LP and the OSPAR.[32]

27. Neele, F., ten Veen, J., Wilschut, F., Hofstee, C. "Independent assessment of high-capacity offshore CO2 storage options," TNO-060-UT-2012-00414/B.2012, 2012.
28. See Jakobsen, J., Bysveen, M., Vågenes, E. n 5.
29. See SINTEF, n 11.
30. See Akerboom, S., Waldmann, S., & Mukherjee, A. (2021). Different This Time? The Prospects of CCS in the Netherlands in the 2020s. Frontiers in Energy Research, 9. https://www.frontiersin.org/articles/10.3389/fenrg.2021.644796/full
31. SINTEF, n 11.
32. See Section 3.

The *Rotterdam Nucleus* management assembles the onshore assessment phase, but there is no clear-cut information under the policy document examined if the Porthos,[33] the Port of Rotterdam Authority, and two state-owned energy companies (Gasunie and EBN), are the responsible actors for the offshore storage management. The sources are part of the pre-permitting assessment concerning environmental hazards, and they are inconclusive. Most of the databases offered by the public authorities do not disclose the actual contractual specificities with the private actors engaged in the transportation and storage phases.[34] Finally, this research could not find aspects of the management plan touching upon the responsibility for linkages.[35] Pollution preparedness and response are not available for the public yet, but such an initiative should be part of the management assessment plan. It would include, for instance, information concerning pollution response equipment and marine salvage which may be made available to other States upon request and its national contingency plan.[36]

2.2.2. *Financial assessment*

The Directive 2009/31/EC[37] of the EU on the Geological Storage of Carbon Dioxide, endorsed by the Netherlands, establishes a legal framework for the environmentally safe geological storage of CO_2. At the regional level, several EU Directives would also cause an effect on the Pilot Project. Directive 2008/1/EC established a mechanism for integrated pollution prevention and control. The Directive governs the externalities of CCS and the risks of the CCS to the environment and human health. Also, the Directive 2004/35/EC of the European Parliament and of the Council of 21 April 2004 on environmental liability is about the prevention and remediation of environmental damage. So far, the ROAD Dutch program, which includes the *Rotterdam Nucleus*, is the only permit awarded under the Directive 2009/31/EC[38] concerning geological storage of CO_2.

Considering the normative scope of regulation provided by the EU Commission, it is possible to attest that there is a sufficient regulatory framework at the regional level to ensure compliance with the environmental and human safety in CCS. Yet, the lack of practical experiences in projects undermines the efficacy of the 2009 CCS Directive. The Pilot Project is innovative and expects to contribute extensively to the mitigation targets on its long-term planning carbon reduction under the future energy governance in the EU.[39] The governance of externalities under regional law reflects the same standards applied in the international spectrum. Being a member State of both the LP/LC and the OSPAR supports the applicability of an environmental and human protection line of action. As member states of the ECT,[40] the implications for the *Rotterdam Nucleus* are not as clear-cut as the international

33. Id.
34. See CO2 reduction through storage beneath the North Sea. (n.d.). Porthos. Retrieved January 24, 2022, from https://www.porthosco2.nl/en/
35. See Porthos, n 33.
36. See, for example, the The International Convention on Oil Pollution Preparedness, Response and Co-operation 1990 (OPRC 90) and the The Protocol on Preparedness, Response and Co-operation to Pollution Incidents by Hazardous and Noxious Substances, 2000 (OPRC-HNS Protocol). Pollution Preparedness and Response. (2022). International Maritime Organisation. Retrieved January 25, 2022, from https://www.imo.org/en/OurWork/Environment/Pages/Pollution-Response.aspx
37. Directive 2009/31/EC of the European Parliament and 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, OJ L 140, 5.6.2009, p. 114–135.
38. Id.
39. Karimi, Farid & Komendantova, Nadejda. (2017). Understanding experts' views and risk perceptions on carbon capture and storage in three European countries. GeoJournal. 82. 10.1007/s10708-015-9677-8.
40. See Etty, T., Heyvaert, V., Carlarne, C., Huber, B., Peel, J., & Van Zeben, J. (2021). Energy Transition in a Transnational World. Transnational Environmental Law, 10(2), 197–204.

agreements mentioned above. The ECT legal definition of CO_2 as part of an energy cycle is still underdeveloped.[41]

2.3. The regulatory framework and planning law

In 2007, the CCS Business platform envisioned starting the CSS deployment and enabling financial aid, following the European climate action package announcement in January 2008. The timeline has four phases. Phases 3 and 4 occurred from 2008 to 2011.[42] Our analysis could not find any specific information about phases 1 and 2, and the last documents made publicly about the project mention that private companies, such as Shell, are expected to operate in 2024. The *Rotterdam Nucleus* requested EU financial support under the European Commission's NER proposal, and it explores the possibility of becoming a member of the European NER300 subsidy scheme.

The permitting process requires several conformities with environmental acts from both sides. During phases 3 and 4, five new legislation came into force, including the Act on Modernising the Environmental Impact Assessment (EIA) in July 2010; the amendment of the Mining Act (implementation of the EU CCS Directive 2009/31/EC) in September 2011, and the decision on the EIA in April 2011.[43] The overarching principles suggests that transit and transport regulation of CO_2 not for enhanced oil recovery [EOR][44] or enhanced hydrogen recovery [EHR][45] are not transparent in their scope of application to CCS technologies. Should the Pilot Project include EHR or EOR in its planning application? In practice, this is one area that inconsistencies may affect the project under the international legal framework. There is no coherent application of the law in regards to CCS offshore for the purpose of EHR, especially for transboundary CCS.[46]

2.3.1. Dutch regulation

The Dutch law prohibits onshore geological storage of CO_2, and the permitting process has three different stages: capture, pipeline transmission, and storage. The National Coordination Scheme governs the last two permitting processes under the Spatial Planning Act.[47] At the national level, in the second pre-processing phase, the Dutch Ministry of Environment and the Rotterdam Climate Initiative (RCI) signed a cooperation agreement (Memorandum of Understanding or MU) to advance the accomplishment of CCS Technologies in the Port of Rotterdam.

The Dutch regulatory framework,[48] including permits and authorities for the *Rotterdam Nucleus,* are: (1) at the national and local levels, compliance with the Environmental Protection Act by conducting an EIA; (2) under the Dutch Emission Authority, the submission of emission permits (for capture, transport, and storage). The capture of CO_2 requires four specific regulations under Dutch law. First, there is an "all-in-one" permit for physical aspects under the General Environmental Conditions Acts (Local level).

41. See generally Bankes, 24.
42. See CCUS Rotterdam, n 16.
43. European Commission, "Directive 2009/31/EC of the European Parliament and 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, OJ L 140, 5.6.2009," p. 114–135.
44. About EOR, see further on Bankes, Nigel & Brennan, Elizabeth. (2013). Enhanced oil recovery and the geological sequestration of carbon dioxide. paper prepared for Natural Resources Canada, http://www.law.ucalgary.ca/files/law/final_june7_enhanced-oil-recovery-and-the-geological-sequestration-of-carbon-dioxide.pdf.
45. See IEAGHG. (2013, April). Interaction of CO2 Storage with Subsurface Resources. 114. https://ieaghg.org/docs/General_Docs/Reports/2013-08.pdf, pp. 17–69.
46. See Bankes and Brennan, 42.
47. Id.
48. Global CCS Institute: Home. Retrieved January 21, 2022, from https://www.globalccsinstitute.com/

Second, environmental building permits address the national agency responsible for granting capture allowances in the Netherlands.[49] Third, under the 1998 Nature Protection Act,[50] the permit addresses the local level (Province of South Holland). Last, under the Water Act,[51] the Water Permit for capturing CO_2 addresses the National level (Ministry of Infrastructure and Environment), delegated to the State Water Authority in the Netherlands.

The timeline for the Minister to shorten or prolong the permit if the operator does not surrender emissions allowances under the ETS is uncertain. The law confers to the Minister the discretionary power to alter the period of costs for the operator. This results in severe incertitude for contractors. At the transport phase, the regulatory framework divides into provincial and national (central) laws. First, under the Spatial Planning Act, a State Zoning Plan shall be directed to the Ministry of Economic Affairs, Agriculture and Innovation, and the Ministry of Infrastructure and Environment (national level). Second, under the Environmental Protection Act, an EIA shall be addressed to both Ministries of Economic Affairs and Infrastructure at the national level. Third, the Water Permit and Railway Permit are competence of the Ministry of Infrastructure and the ProRail department, directed to the Ministry of Economic Affairs and Agriculture (national level). Environmental laws in the Netherlands were altered in 2017, in which the Nature Conservation Act substituted three environmental laws, including the Fauna and Flora Act.[52]

In the storage phase, two considerations of the regulatory framework that are applicable to the case are presented. First, the “all-in-one" permit for physical aspects under the GECA. Second, the Mining Act[53] directs the storage permit to the Ministry of Economic Affairs (national level). By adopting this one package deal as part of the environmental licensing scheme, there is a risk that it will leave some procedural elements of the risk assessment. The social interactions affected by the project should also be part of a risk assessment evaluation rather than just taking part in the post-phase of risk management. It is also unclear whether there is a discrepancy between the Fauna and Flora Act and the EU legislation on environmental law. Notably, the same problem is seen in some of the most prominent international legal agreements for CCS activities. Many of the externalities governed by the international law of energy do not entertain critical social assessments before the licensing begins.

The Dutch regulation offers a "dispensation" for work activities, presenting a "risk to nature." This "special request" is supposed to make an "exception to the rules for this activity."The adaptation of the Dutch Mining Act to the EU 2009 Directive on the Geological Storage of Carbon Dioxide (2009) deserves two considerations. There is no clarification from the EU Directive to the general risks to human health, environment, and safety. It is problematic regarding possible leakages from the storage site. Medical associations highlight that potential health risks of CCS include asphyxiation of humans and animals, compromise of safe drinking water supplies, in addition to the well-known cardiorespiratory disease and mortality consequences of continued coal combustion.[54] Besides, international agreements, such as UNCLOS, define "pollution of the marine environment" as including "deleterious effects as harm to living resources and marine life, hazards to human health."[55]

49. Id.
50. Legislation protecting nature in the Netherlands | Nature and biodiversity. (n.d.). Government.nl. Retrieved January 21, 2022, from https://www.government.nl/topics/nature-and-biodiversity/legislation-protecting-nature-in-the-netherlands
51. Water Act | Leaflet. (2009, December 31). Government.nl. Retrieved January 24, 2022, from https://www.government.nl/documents/leaflets/2009/12/31/water-act
52. The Kingdom of the Netherlands, n 48.
53. The Dutch Mining Act - KPMG Nederland. (2021, April 14). KPMG International. Retrieved January 24, 2022, from https://home.kpmg/nl/nl/home/insights/2021/04/the-dutch-mining-act.html
54. Fogarty, J. &McCally, M. (2010). Health and Safety Risks of Carbon Capture and Storage. American Medical Association, Vol 303, No 1, p. 1.
55. UNCLOS, Art. 1.

Not having an explicit framework for human safety may contravene several international obligations contained in multilateral agreements, preventing the marine environment from suffering pollution damage.

In conclusion, the Directive upholds a moratorium of 20 years before the responsibility for the storage site can be shifted from the operator to the competent authority.[56] In conclusion, the transposed EU laws to the Dutch law are incredibly beneficial from an environmental protection point of view. Yet, not every transposition is entirely positive and supportive of stricter rules on CCS deployment. The social assessment risk is one of the points that references to the EU moratorium, for instance, only mentions projects under the developing phase. Therefore, the regime still applies for ongoing projects (with all its uncertainties).[57]

3. Overarching principles

3.1. Overview

The first phase of CCS is the capture of CO_2 from large or small points of emission sources. Under International law, the capturing process involves 1) separation, 2) compression, and 3) dehydration for transport and storage.[58] For the widespread deployment of CCS technologies, the capturing demand actors' involvement because of its elevated production cost.[59]

Two legal distinctions deserve further attention. First, they are not acting as a replacement for fossil fuels in the short or long term. They are complementary strategies for a continuous energy service supply. The CCS implementation and efficiency depend on a series of events that are not necessarily affordable and disposable on a global scale. One of these events is the actual fraction of CO_2 captured in power plants and the demand for additional energy required for capture, transport, and storage.[60] The efficiency of a CCS program accounts for eventual leakages from the transport of the fraction of CO_2 kept in storage over the long term.[61]

Second, the energy and economic sectors have no expectations of deploying CCS technologies on a large scale for the next upcoming years. Its strategic implementation plan aligns with an explicit policy that limits the emission of greenhouse gas emissions [GHGs] into the atmosphere.[62] Because of that, investments in the CCS sector are likely to rise proportionately and become more competitive with other large-scale mitigation options. It is possible, of course, that technologies, such as CCS, demanding substantial investments in infrastructure reveals the profound disproportion between nations in the sector. States interested in deploying CCS are comparably low to states interested in low-emission renewable energy tech. The movement towards more equitable energy use challenges CCS technologies for their disruptive effect on communities and small fisheries communities.[63]

Despite criticism of non-governmental organisations asking for an end to fossil fuels subsidies instead of natural manipulation of the sub-seabed geological formations, the demand for transboundary CCS is likely to increase in energy hubs, such as the North Sea, with the depletion of gas and oil power plants. But there

56. See 2009 EU Directive, n 41.
57. See 2009 EU Directive, n 41.
58. Bankes notes different storage systems: "closed systems [characterised by a formation surrounded laterally by impervious boundaries and vertically by sealing the formations). See Bankes, n 8, p 402.
59. See IEAGHG, n 33, p.12.
60. Id.
61. Id.
62. IPCC, n 38, p. 341.
63. On energy justice and distribution of benefits to local communities, please see Anchustegui, I. H. (2021). "Chapter 10 Distributive Justice, Community Benefits and Renewable Energy". In Sustainable Energy Democracy and the Law. Leiden, The Netherlands: Brill | Nijhoff.

are mechanisms in which we can demand the cessation or even non-deployment of projects that point to severe risks to the environment. For example, civil society should require national laws with rigorous risk assessment and management plans based on well-consolidated principles of international environmental law, such as the precautionary principle.[64]

As a general observation, the existing international legal framework does not provide a clear definition of CO_2 as part of the energy cycle in CCS. In offshore transportation, the CO_2 capture is subjected to a transit mode of operation to be stored and may 'lose' its character as a stock considered as flow. Vinuales gives the example of oil or gas stocked for power allocation. But eventually are also subjected to transit and transport.[65] The complexity of a carbon and capture project designed to entertain an offshore stage suggests that CO2 has many contrasting nuances in energy law, and one defined as a 'resource' or as an activity is paradoxical to attest to the present stage.

This section identifies the main rules under international law of sub-seabed CCS facilities. It will show that it still misses a comprehensive approach to new technologies aiming to store CO_2 in the sub-seabed floor. First, a distinction between transboundary and non-transboundary CCS is needed. Only the first category has the characteristics necessary for this analysis. The transboundary movement of CO_2 implies large-scale damages to the marine environment if redress operations are not satisfactory. Another legal issue if transboundary CCS operations are whether it would amount to an exception to the industrial waste export prohibition.[66]

3.2. Storage facility

3.2.1. CCS and the future re-use of depleted natural gas fields

International law requires states to remove abandoned or disused installations or structures at seas to ensure the safety of navigation and due regard to fishing, the surrounding marine environment, and the rights and duties of other states.[67] UNCLOS allows member states to have the exclusive right "to construct, authorise and regulate the construction, operation, and use of all installations necessary to exploit energy offshore" [functional jurisdiction'].[68] The search for re-utilisation of depleted natural gas fields has been increasing in light of the interest in finding a new economic purpose for offshore installations.

The IMO Guidelines suggest that only a 'permanent disused' would determine the disused of the installation.[69] The IMO documents are from the early 1990s, and their application to CO_2 storage does not fill all the requirements for large-scale CCS. Some scholars note that the IMO Guidelines imply that coastal states have some 'discretion as to the timing of the removal.' Yet, both documents essentially apply to offshore

64. See Bankes, n 8.
65. Vinuales, n 5, p. 20.
66. In the International Law Commission [ILC] Draft Articles on the Law of Transboundary Aquifers, Art. 2 explains that: Utilisation' is defined in a non-exhaustive manner to include not only extraction of water but also the extraction of heat for thermal-energy, extraction of minerals in aquifers, as well as storage or disposal of waste, such a new experimental technique to utilise an aquifer for carbon dioxide sequestration [emphasis added]." It is an open question whether utilisation CCS on the high seas would fall under the regime of disposal of wastes or not. The commentary to article 4 notes "an aquifer may also be used for disposal, in particular through a new experimental technique to utilise aquifers for carbon dioxide sequestration." This use is peripheral to the present draft articles." International Law Commission, Draft Articles on the Law of Transboundary Aquifers, with commentaries, adopted at the ILC 60th Session, (2008) online: <http://untreaty.Un.Org/ilc/texts/instruments/English/commentaries/8_5_2008.pdf> (ILC Draft Articles).
67. See UNCLOS, Art. 56 (1) (b) (i), 56 (1) (a), 60 (2) (EEZ).
68. UNCLOS, Art. 60 (1) (b), 56 (1) (a), 80.
69. See further on Carbon Capture and Sequestration. (n.d.). International Maritime Organisation. Retrieved January 21, 2022, from https://www.imo.org/en/OurWork/Environment/Pages/CCS-Default.aspx

installations, which leaves the onshore or field-to-shore pipelines removals to the discretion of the coastal state. In this sense, transboundary CCS projects, such as the *Rotterdam Nucleus,* are left with the following legal implications: (I) the Pilot Project comprises three main pipelines, two of them cross offshore regions in the southern North Sea, and one goes into the onshore of the Dutch territory. The latter would not fall into the obligation under UNCLOS to a compulsory removal after the cessation of operations of the natural gas fields abroad. (II) If the partner oil and gas fields offshore cease operations and transform the installations into CO_2 storage facilities, then the former two pipelines may subject themselves to the international rules related to removing power stations.

The law is unclear on the extent to which removal of offshore installations also applies to pipelines (and cables) that are part of an external installation outside the territorial waters of a coastal state. Besides, UNCLOS does not identify the exemptions on the state's obligation to remove the plant if the gas fields are now due to serve a new purpose.[70] Concerning CO_2 injection in saline formations, injecting CO_2 in the geological formation would affect a larger geographical area than injection in a depleted reservoir.[71] The injection into a depleted oil and gas reservoir causes less significant harm to the surroundings because it involves an injection into an under pressured formation instead of injecting at natural formation pressure.[72]

This finding could positively influence politicians and the business sector to reconsider opening new storage fields without re-using the gas fields depleted in offshore waters. Yet, states willing to invest in CCS in a depleted field face many legal uncertainties about whether this operation will conform with international obligations, especially concerns about changing the qualification of the activity being conducted in the power plant (from a gas field to CCS). The international lawyers will have to clarify whether contractors should establish a time-lapse between the cessation of the previous service and the new CO_2 storage field is unclear from a legal perspective to declare its lawfulness.

3.2.2. Cables and pipeline transportation systems

The offshore CCS plan also requires placing cables and pipelines for CO_2 transportation. According to Arts. 87 and 112 (2) of UNCLOS, member states can exercise their respective rights in the high seas, including the right to lay new pipelines and cables, without the need of consent. There is no right of 'immersion' of third states in the territorial sea. Any project specificities shall assess a demanded pipeline from a given offshore location, and contractors or owners bear the costs of repairing the cables or pipelines that cause a break in or injury of other cables or pipelines.[73] UNCLOS applies the same liability regime to the Exclusive Economic Zone (EEZ) (Part V) and the continental shelf, but the latter has different rules concerning laying cables or pipelines. The coastal state possesses the sovereign right in its territorial waters and the right to exercise jurisdiction on the equipment used for exploiting the Continental Shelf.

Often, the states exploring the seabed agree on a memorandum of understanding [MoU].[74] But this is not true in all cases of CCS, and there is not sufficient empirical analysis to support this affirmation so far. The cables and pipelines are fundamental components to interconnect a CCS project work. In offshore CCS, defining its course will direct the energy transmission from oil and natural gas installations to the storage

70. Bankes notes that "Not all fields are suitable for CO_2 \EOR operations or even for CO_2 storage in a depleted reservoir," See IEAGHG Interaction Report, n 33, p. 12; Bankes, n18, p 403.
71. Id.
72. Birkholzer, J. T., Oldenberg, C., & Zhou, Q. (2015). CO2 migration and pressure evolution in deep saline aquifers. International Journal of Greenhouse Gas Control, 40(203), 209.
73. See UNCLOS, Art. 114 and Art. 112 (2).
74. On UK regulations, see 'Pipeline Crossing Agreement & Proximity Agreement Pack October 2015,' available at: https://oilandgasuk.co.uk/product/pipeline-crossing-agreement-proximity-agreement-pack/.

location. The chosen route may cross the territorial water of a third party to the project. The transposing of the territory of a third party should trigger responsibility to the contract parties under international law if the hazard to the environment comes into play. Causing transboundary harm is prohibited under several international agreements and is part of customary international law. In a specific CCS case, conducting a robust risk assessment before the submission of the licensing scheme could prevent hazardous transboundary impact to the environment as much as the compensation scheme of harm or exposure to a high risk of significant damage resulting from the outline relates to multi sectors in international law.

Another missing gap in international law relates to the content of those crossing agreements on cables and pipelines. First, there must be an assessment of the parties involved and identifying the crossing point. The agreement must also offer the contracting parties a disclosure of data information and assess prior notification to the onshore contracting state and the secretariat of any given international agreement signed by the parties. The laying of cables in the EEZ imposes on coastal states the obligation to protect and preserve the marine environment. In this sense, Davenport notes that: 'a coastal state may not enforce further environmental measures on cable operations in the EEZ or continental shelf apart from preventing pollution that would apply to all ships, including cable ships'.[75]

Cooperation in placing transboundary CCS plays a fundamental role in assessing the responsibilities and liabilities of the actors engaged in post-assessment operations. Especially in offshore projects, the general duty to cooperate[76] is more challenging from a practical point of view because it demands from contractors more cost-effective logistics to be present in situ in the event of a problem. Who shall act in case of pollution damage? For instance, the infectivity of a contractor to control and reduce pollution on the high seas can raise questions on a subsidiary responsibility of the state in which the company has an official headquarters. International law misses a more comprehensive approach to activities that may cause 'pollution' and do not entertain submarine cables or laying and repair activities.[77]

In light of the demanding mutual aid in the CO_2 storage operation, the obligation to cooperate forms the basis of the whole chain of production and transportation between the onshore affected state, their transport (international regulations), and the public/private actor responsible for the storage. In the *Mox Plant Case,*[78] the ArbitralTribunal stresses the vital role of the duty to cooperate in protecting and preserving the marine environment, according to Part XII of UNCLOS. The Tribunal notes that: "that the duty to cooperate is a fundamental principle in the *prevention of pollution of the marine environment* under Part XII of the Convention and general international law and that rights arise therefrom which the Tribunal may consider appropriate to preserve under article 290 of the Convention [emphasis added].[79] In the conclusions, the Tribunal stressed the UK must cooperate, (a) exchange information, (b) monitor risks or the effects of the operation and (c) measures to prevent pollution of the marine environment.[80]

The laying down of energy cables for a CCS shall consort to the freedom of the seas in the sense that all member states may exercise their intentions to dispose of those transmission lines in the common areas. Yet, the right is not unlimited. The cable companies do not have a legal capacity to entertain any damage claim in international courts forums. The opposite is that a coastal or affected state may only pursue compensation claims in international tribunals through a State responsible for the activity. Thus, the rules on the seabed

75. Davenport, n 16, p.213.
76. See Draft Articles on the Law of Transboundary Aquifers, Article 7, General obligation to cooperate.
77. Article 1, UNCLOS.
78. See *MOX Plant Case* (Ireland v. the United Kingdom) (ProvisionalMeasures), Order of 3 December 2001 (2002) 41 ILM 405.
79. Id, p. 82.
80. Id, p. 111.

must follow specific guidelines in the auspices of UNCLOS distribution of powers to the International Seabed Authority (ISA).[81]

The present research has shown the laws of coordination in the CCS procedural phase. There are many implications relating to the maintenance of cables and pipelines transporting the CO_2 for international waters. Our first finding is that the maritime zone under which the actors carry the pilot plan is decisive for the legal analysis of competence and jurisdiction.[82] Secondly, the laying of cables or pipelines for carbon and storage follows a similar procedure to other energy transmission activities, including respecting the laws protecting the surrounding environment, such as the protection of transboundary aquifers.

3.3. Operations

The London Protocol (LP)[83] provides for the overall legal spectrum of marine pollution, dumping of wastes, and other matters at sea. The Protocol supersedes the London Convention (LC)[84] in many contemporary wastes management issues as it imposes a more stringent legal framework than its predecessor. The LC and its Protocol's regulation exceptionally allowed the injection of CO_2 into the ocean as long as it resulted in mineral resource processing.[85] Two recent amendments presented by contracting parties created a relevant legal basis in international law for the CCS regulation. In 2006, the amendment on Annex I of the Protocol allowed CO_2 storage in sub-seabed geological formations for permanent isolation.

The amendment provided two significant changes to Art. 1 and 4 of Annex I.[86] First, the 2004 amendment amplified the scope of Art. 1 to include "CO_2 streams from carbon dioxide capture processes for sequestration."[87] The second normative change was to confirm it with the Treaty's provisions on dumping exceptions. Those streams shall cumulatively fulfil the following criteria: (1) disposal is placed into a sub-seabed geological formation; (2) the CO_2 stream is of high purity containing only incidental amounts of associated substances; and (3) no wastes or other matter are added to dispose of those wastes or other matter.[88]

The 2006 amendment does not intend to regulate the transboundary transportation of CO2 for permanent sub-seabed storage. The contracting states wishing to invest in CCS technologies must conduct an EIA, which is mandatory to all signatories of the LP. The Protocol aimed at a compulsory development of a Risk Assessment and Management Framework [RAMF] for CO_2 Sequestration in Sub-Seabed Geological Structures (CS-SSGS). Another procedural obligation instituted by the 2006 amendment is that member states shall inform the secretariat of any relevant likely operational releases and provide information on the post-injection management that may include leakages.[89]

81. ISA, "Memorandum of Understanding Between the International Cable Protection Committee and the International Seabed Authority signed on 15 December 2009," Annex to Note by the Secretariat at the 16th session, 26 April to 7 May 2010.
82. See further on Catherine Redgwell, 'Mind the Gap in the GAIRS: The Role of Other Instruments in LOSC Regime Implementation in the Offshore Energy Sector' in Nigel Bankes and Seline Trevisanut (eds), Energy from the Sea: An International Law Perspective on Ocean Energy, Brill Nijhoff (2014).
83. Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, London, 7 November 1996.
84. Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, London, 13 November 1972.
85. See Article III (c) of the London Convention and Article I 4.3 of the London Protocol.
86. IMO, "Notification of amendments to Annex 1 to the London Protocol 1996," LC-LP.1/Circ.5 (2006).
87. See IMO. Report of the Thirty-Fifth Meeting of the Scientific Group of the London Convention and the Six Meeting of the Scientific Group of the London Protocol, LC/SG 35/15. London: IMO; 2012.
88. Id.
89. IMO, "Risk assessment and management framework for co2 sequestration in sub-seabed geological structures [cs-ssgs)" available at https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/CO2SEQUESTRATIONRAMF2006.doc, Accessed on 29 May 2021.

At the regional level, the Directive 2004/35/EC[90] of the European Parliament and the EU Council of 21 April 2004 on environmental liability concerning the prevention and remediation of environmental damage.[91] The EU Directive 2009/31/EC[92] (Geological Storage of Carbon Dioxide) establishes a legal framework for the environmentally safe geological storage of CO2. The EU Directive relates to the onshore level of its member states. Another directive came into play a few years later in the EU. The Directive 2008/1/EC[93] established a mechanism for integrated pollution prevention and control. It relates to the externalities of CO_2 capture, storage, and the risks of the CCS to the environment and human health. So far, the ROAD dutch program, which includes the Rotterdam Nucleus, is the single permit awarded under the Directive 2009/31/EC on the geological storage of CO_2.

The 2004 Report from The Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR)[94] Commission concluded that the OSPAR allows CO_2 storage in the North-East Atlantic (including seabed and subsoil) through a pipeline linked to the land of the member state, only if it does not require any subsequent activities through a vessel or an offshore installation (e.g., an oil or gas platform).[95] The OSPAR will play a significant role in dispute settlements between member states since the North Sea will become a CCS hub. It would also apply to future CCS projects to circumvent the obligations under the OSPAR and obligations to protect the marine environment under UNCLOS Part XII.

The OSPAR Report analyses the legality of CCS based on three components: (I) If the following storage activities involve a vessel or an offshore-derived CO_2; (II) Experimental or EOR purposes; (III) Dumping or exemptions from discharges and emissions. The report is unclear about the circumstances relating to transportation by pipeline to an offshore installation and then disposed of accounts for a prohibition under the OSPAR. Both OSPAR and LP relate to activities that involve ships or platforms, but only OSPAR controls governing pipeline discharges from land-based sources.

3.4. Discharge of the content

Art. 6 of the LP allows the export of wastes for dumping. Two considerations are relevant for legal compatibility with the subsequent 2006 and 2009 LC/LP amendments. First, both export and receiving countries shall provide an agreement or arrangement for the transportation of CO_2 that is consistent with the LP and international laws. [96] Yet, if the CCS Project involves a non-state party, the agreement must include provisions relating to issuing permits and conditions for complying with Annex 2 (protection and preservation of the marine environment). Despite the 2009 amendment's approval by contracting parties, it has not entered into force yet, leaving a legal gap for offshore transportation of CO2 for CCS technologies. In 2012, the IMO issued an additional report on risk assessment for sub-seabed CCS in geological formations, including

90. Directive 2004/35/EC of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage (the Environmental Liability Directive).
91. OJ L 143, 30.4.2004, p. 56.
92. LC/LP, Directive 2009/31/EC.
93. Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive), p. 8.
94. Convention for the Protection of the Marine Environment of the North-East Atlantic, adopted 22 September 1992; entered into force 25 March 1998, 2354 UNTS 67.
95. OSPAR Commission, "Report from the Group of Jurists and Linguists on the placement of carbon dioxide in the OSPAR maritime area." Annex 12 to 2004 Summary Record.
96. See Justine Garrett, Sean McCoy, Carbon Capture and Storage and the London Protocol: Recent Efforts to Enable Transboundary CO2 Transfer, Energy Procedia, Volume 37, (2013), p 7747–7755; Also, IMO. Report of the Thirty-First Consultative Meeting and the Fourth Meeting of Contracting Parties, LC 31/15. London: IMO; 2009 and IMO, Report of the Thirty-Third Consultative Meeting and the Sixth Meeting of Contracting Parties, LC 33/XX. London: IMO; 2011.

a waste prevention audit. It notes that the initial sequestration phase should include an evaluation of 1) the amount and form of the CO_2 streams and their associated hazards and 2) the sources of CO_2 streams.[97]

Both LC and LP regulations of waste management and dumping at sea provide a global regulatory framework for protecting the marine environment. The compliance mechanisms enable the contracting parties to fulfil their obligations under both frameworks, and they play an imperative role in regulating CCS transportation offshore. An example of compliance with the exceptions on dumping is in Art. 1 (4) (3) of the Protocol. These exceptions were present in the *Sleipner Project*.[98] The rationale behind implementing the first European CCS project was to reduce the amount of CO_2 contained naturally in the gas produced in Sleipner.[99]

In 2007, the OSPAR member states adopted an amendment on discharging content at sea.[100] The 2007 Amendments allow for the storage of CO_2 in geological formations in the seabed under certain conditions.[101] The Decision 2007/1 prohibits the placement of CO2 streams in the water column (or on the seabed). Yet, there are two exceptions: it results from normal operations as described in Article 1(g)(i) of the OSPAR or is for a purpose other than the mere disposal thereof in Article 1(g)(ii)[102] of the Convention and is following the relevant provisions of the OSPAR. The storage at the geological formation will not be counted then as dumping if conducted in geological formations in the sub-soil of the OSPAR maritime area.[103]

The *Rotterdam Nucleus* does not constitute dumping if placing the CO_2 is other than for the mere disposal thereof under the UNCLOS, the LC/LP, and OSPAR. The following section addresses the purpose of energy activities and whether CCS would classify as part of an energy cycle or another object of the energy cycle, as mentioned in introducing this paper.

3.5. Purpose of the activity

3.5.1. Co_2 as part of an energy cycle or a product

The section will analyse the ECT.[104] In brief, the ECT is an international treaty dealing with investments in the energy sector. The ECT does not envisage any investor's protection relating to CCS technologies. The ECT has general provisions on 1) Energy cycle, 2) Energy material, and 3) Products that are part of economic activity. The EU is one of the member states pushing for modernisation or re-adaptation of the

97. IMO, "2012 specific guidelines for the assessment of carbon dioxide for disposal into sub-seabed geological formations adopted 2 November 2012 (lc 34/15, annexe 8)" available at https://wwwcdn.imo.org/localresources/en/ourwork/environment/documents/2012%20specific%20guidelines%20for%20the%20assessment%20of%20carbon%20dioxide.pdf
98. The field became operative in October 1996. This field meant that the world's first offshore CO2 capture plant was operating concurrently with the world's first CO2 storage project in a geological layer 1,000 metres below the seafloor.
99. The Energy Charter Secretariat, 'Investment and Market Development in Carbon Capture and Storage Role of the Energy Charter Treaty,' 2009, p.31.
100. See OSPAR, Annex II and III. Convention Text. (n.d.). OSPAR Commission. Retrieved January 25, 2022, from https://www.ospar.org/convention/text
101. OSPAR Decision 2007/01 to Prohibit the Storage of Carbon Dioxide Streams in the Water Column or on the Sea-bed, OSPAR 07/25/1, Annex 5.
102. The Art. 1 (g) (ii) reads as follows: "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."
103. Id.
104. See further ECT, available at https://www.energycharterTreaty.org/provisions/understanding-and-decision-with-respect-to-the-treaty-as-a-whole/, Accessed on 29 May 2021.

ECT to fit energy investments in new technologies, such as CCS.[105] Additionally, It created obligations to promote and protect foreign direct investments, trade-in energy, freedom of energy transit, improvement of energy efficiency, among others.[106] As previously mentioned, the ECT does not envisage the CCS technologies, but its general provision on the energy cycle and energy material and products as part of economic activity may affect the governance of CCS.[107]

There are mainly four legal implications of the ECT to CCS Technologies. First, Art. 1 (5) of ECT defines the scope and context of economic activity in the energy sector. The list of gases included as an 'energy product or material' mentioned only combustible gases, and for this inference, the CO_2 is not the Annex EM. Yet, in the ECT understanding and decision concerning Article 1 (5), the parties to the Treaty recognised that the construction and operation of power generator facilities and the removal and disposal of wastes from energy-related facilities are an 'economic activity in the energy sector.'[108] It seems then that the CCS technologies would fall under the scope of one of the following sections: 1) it would be considered as a simple waste or 2) industrial commodity.

Concerning the general application of Art. 19 (3)(a), we can pose the following question: would the CO_2 removed from a power plant and transported for storage be classified as part of the whole energy cycle disposed of in the previous article? If CO_2 is part of the energy cycle, interpreting CCS relates to the treatment and management of wastes and the production, storage, and transport of the various forms of energy. The drawback would be not recognising CO_2 as an 'energy material or product,' and the ECT regulating its transit would not apply to CCS. Another issue arising from interpreting the ECT is the protection offered to investors in which cases are they covered by its regulations, and if it covers transboundary operation or a multi-sectoral investment in the energy sector.

Due to the complexity of CCS operations, it is not implausible that many actors will be involved in sectorial operations. It would start from the ownership of the power plant capturing the CO_2 to its transportation in seabed pipelines and includes the storage phase in facilities offshore. To this end, the investments in CCS are covered by the ECT in the following criteria. First, the Art. 10(8) covers the operators under the protection of exchanged information, and Art. 10 (7) protects against discrimination. The CCS is also compatible with Art. 13 (1) on investment protection against expropriation, nationalisation, or any subjection to measures equivalent to the prohibitions mentioned in the article above.[109] In the event of the transport of CO_2 for an offshore natural gas pipeline, the result of the transaction suggests the applicability of the ECT. Yet, should CO_2 relate to the energy cycle since it allows further energy production at the beginning phase of this cycle?[110]

Finally, the ECT does not have a clear-cut solution for the CCS strategies yet, and the urgencies of a new era for energy investments and technologies in the renewable sector pressures the "modernisation" of the

105. The EU Proposal reads as follows: "This document is the European Union's (EU) additional submission to its text proposal for the modernisation of the Energy Charter Treaty (ECT), sent to the ECT Secretariat on 19 May 2020, and tabled for discussion with the Contracting Parties to the ECT. It complements the placeholders for paragraphs (4), (4bis) and (5) of Article 1 (Definitions). The actual text in the final agreement will result in negotiations between the EU and the Contracting Partners." See EU, "European Union text proposal for the modernisation of the Energy Charter Treaty," available at https://trade.ec.europa.eu/doclib/docs/2021/february/tradoc_159436.pdf

106. See Viñuales, J. (2012). Foreign Investment and the Environment in International Law (Cambridge Studies in International and Comparative Law). Cambridge: Cambridge University Press. doi:10.1017/CBO9780511902567.

107. See generally, Carolina Arlota, Hirdan Katarina de Medeiros Costa, Chapter 1 - International Energy Law: still a brave new world? Editor(s): Hirdan Katarina de Medeiros Costa, Carolina Arlota, Carbon Capture and Storage in International Energy Policy and Law, Elsevier, 2021, Pages 3–17; and ECT, n 70.

108. The ECT Secretariat, n 70.

109. The ECT Secretariat, n70, p.32.

110. The ECT Secretariat, n70, p.34.

Treaty.[111] In May 2020, the European Union drafted a proposal for the modernisation of the ECT requesting some drastic changes in Part III and to the list of Energy Materials and Products in Annex EM. The tentative of adopting a new harmonised set of system codes to the 'other energies' sectors would include Low Carbon Hydrogen, namely 'means fossil-based hydrogen with carbon capture and electricity-based hydrogen, with significantly reduced full life-cycle greenhouse gas emissions.'

4. Concluding remarks

By promoting CCS, large emitters can invest in low-carbon emissions project plans. Yet, the usage of off-shore facilities and the construction of new cables and pipelines to transport the carbon dioxide to storage seems at variance with the 'clean energy' catchline supporting the CCS deployment.

Our analysis of the international law framework suggests that the law is absent in many regulatory frameworks features. One exemption to the rule is LP/LC, having established coherent and structured guidelines for implementing CCS by its member states. The EU seems aligned with the purposes of LC in its EU Directives on CCS. The same does not apply to the ECT Directives, which contribute to the debate on the 'modernisation of the energy provisions contained at the international level'. The adaptation of hard law instruments on energy is an alternative to new regimes under international law. Our finding concludes that international law has the mechanisms to protect the marine environment from damages arising from CCS projects. Ensuring that such general provisions, such as Part XII of UNCLOS, duly complied with by member states as the competent authorities issuing the environmental licence is the missing gap.

The *Rotterdam Nucleus* can become a relevant case study to measure the effectiveness of the law on reduction, control, and prevention of pollution. Implementing such a complex project will help the key players in CCS to assess its attainability on a large scale for the upcoming years. International law now has the challenge of accommodating investor's rights under the ECT and pushing for the carve-out from fossil fuels. It is not an easy task, but if CCS is one of the suggested mechanisms to be implemented, civil society must be part of negotiations on the modernisation of treaties in the interest of present and future generations.

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111. ECT, "Approved topics for the modernisation of the Energy Charter Treaty," 2018, Available at https://energycharter.org/media/news/article/approved-topics-for-the-modernisation-of-the-energy-charter-treaty, Accessed on 29 May 2021.