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The liability framework for the shipping phase of carbon capture and storage:

A critical study of the liability regime for CO_2 leakage during cross-border CO_2-shipping activities in the North Sea.

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SUMMARY

Carbon capture and storage (CCS) has been heralded as a vital tool in the global fight against climate change, with a crucial role in tackling CO_2 emissions whilst ensuring energy security. Except where infrastructure is located directly above a geological storage site, captured CO_2 must be safely transported to the injection reservoir. Accordingly, the transport chain is a central link in the establishment of full-scale CCS facilities and there is a pressing need to ensure the proper regulation of transport options to ensure optimisation of the chain.

This thesis explores the legal challenges with the liability framework which regulates CO_2 leakage during cross-border CO_2-shipping activities in the North Sea. The aim of this thesis is to bring clarity to rhetoric in this area by identifying and analysing the key instruments applicable to CO_2-shipping in respect of loss of cargo within the North Sea. It examines the shortcomings of the liability regime for CO_2-shipping and suggests ways in which it may be revised to better account for the particular nature of the CCS value chain. It suggests that entry into force of the International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea 2010 would overcome many of the challenges of the current regime by implementing a global, harmonised liability regime. Additionally, it argues that inclusion of shipping within Directive 2009/31/EC and the EU Emissions Trading Scheme is necessary to integrate CO_2-shipping into the CCS value chain and incentivise the deployment of CO_2-shipping in the North Sea.

Keywords: CCS, North Sea, CO_2-shipping, cross-border transport, shipowner liability.

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ABBREVIATIONS

CAPEX	Capital expenditure
CCS	Carbon capture and storage
CCS Directive	Directive 2009/31/EC on the geological storage of carbon dioxide
CS	Continental Shelf
CO_2	Carbon dioxide
EC	European Commission
EEA	European Economic Area
EEZ	Exclusive Economic Zone
EFTA	European Free Trade Association
ELD	Environmental Liability Directive
EOR	Enhanced oil recovery
ETS	Emissions Trading Scheme
ETS Directive	Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the community
EU	European Union
GhG	Greenhouse gas
GT	Gross tonnage
HNS	Hazardous and noxious substances
HNS Convention	Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances
IEA	International Energy Agency
IGC	International Gas Carrier
IMO	International Maritime Organisation
IPCC	Intergovernmental Panel on Climate Change
LLMC	Convention on Limitation of Liability for Maritime Claims
LNG	Liquified natural gas
MRV	Monitoring, reporting and verification
NCCS	Norwegian Carbon Capture and Storage Research Centre
O&G	Oil and gas
RSO	Registered shipowner
SCCS	Scottish Carbon Capture and Storage
SDR	Special drawing rights

SOLAS	International Convention for the Safety of Life at Sea
TS	Territorial Sea
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change

1 INTRODUCTION

1.1 Research context

The UNFCCC heralds climate change as the 'common concern of humankind'; placing binding obligations on the international community to strive for a reduction in GhG emissions.[1] This has initiated a gradual move towards traditional mitigation measures such as the development of renewable energy sources and the improvement of energy efficiency.[2] Additionally, it has encouraged the development of newer technologies such as CCS.

CCS allows the continued use of fossil fuels without emitting high CO_2 levels into the atmosphere by capturing CO_2 produced from energy generation and industrial processes and permanently storing it in onshore or sub-sea bed reservoirs.[3] This could be an important measure to significantly reduce levels of CO_2 in the atmosphere.[4] The technology provides mitigation during a transitional period, allowing the continued use of fossil fuels while societies dependence on their use is reduced gradually and large-scale renewable projects are matured. It is therefore a vital tool in the global fight against climate change, playing a crucial role in tackling CO_2 emissions whilst ensuring energy security.[5]

There are three key elements to the CCS value chain: capture, transport and storage.[6] In order for CCS to become commercially viable, each element in the chain must link together

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[1] United Nations Framework Convention on Climate Change (adopted 9 May 1992, in force 21 March 1994) UNTS Volume 1771 Number 30822, Preamble; Kyoto Protocol to the UNFCCC (adopted 11 December 1997, in force 16 February 2005) UNTS Volume 2303 Number 30822, Article 3.
[2] Wilbert Grevers and Lennart Luten, 'Introduction to the CCS Chain: Technological aspects and safety risks,' in *'Legal Design of Carbon Capture and Storage – Developments in the Netherlands from an International and EU Perspective,'* eds. Martha Roggenkamp and Edwin Woerdman, Volume 10 Energy & Law (Oxford: Intersentia, 2009), 5.
[3] ibid.
[4] IPCC, *'Special Report on Global Warming of 1.5 °C,'* Summary for Policymakers, approved at First Joint Session of Working Groups I, II and III and accepted by the 48th Session of the IPCC, Incheon, Republic of Korea, 6th October 2018, 31-32.
[5] Zero Emissions Platform, '*CCS: an essential technology to reconcile energy security with climate objectives,'* (The Hague: ZEP, 2014), 1, http://www.zeroemissionsplatform.eu/library/publication/247-ccsenergysecurity.html.
[6] Andy Raine, 'Transboundary Transportation of CO_2 Associated with Carbon Capture and Storage Projects: An Analysis of Issues under International Law,' *Climate Change Law Review* Volume 4 (2008): 355.

effectively.[7] Except where infrastructure is located directly above a storage site, captured CO_2 must be safely transported from the capture location to the injection reservoir.[8] Accordingly, the transport chain is a central link in the establishment of full-scale CCS facilities.

The two most commercially viable transport options are pipelines and ships.[9] Pipelines have generally been considered the most feasible option as there is already experience in CO_2 pipelines, for the purposes of EOR.[10] However, CO_2-shipping is an important alternative to pipeline transportation in several circumstances. For example, shipping can promote CO_2 storage in the initial phases of CCS, when capture locations are few and at large distances from each other.[11] This is because shipping provides a low-threshold for engagement with storage facilities, by offering a transport option when the volume of CO_2 is too low to justify the high CAPEX of pipeline infrastructure.[12] Additionally, CO_2-shipping is cost-effective in locations where there are small, disparate injection reservoirs which individually do not justify the long-term commitment of pipelines.[13] Shipping is also an important option in States with limited storage capabilities because it offers a practical solution for the transport of CO_2 to suitable storage sites, thus overcoming the major hurdle of developing long-distance transport systems.[14] This could encourage the development of cross-border transport options and the regular transboundary movement of CO_2-ships, which is essential if CCS is to make a significant contribution to climate mitigation efforts.[15] Finally, shipping offers increased flexibility compared to pipelines with regards to the transportation route. This

[7] Rolf de Vos (ed.), *'Linking the Chain: Integrated CATO2 knowledge prepares for the next step in CO_2 Capture & Storage,'* WP0.A-D18 (Zutphen: CATO2 onderzoeksprogramma, 2014), 12.
[8] IPCC, '*Special Report on CCS,'* prepared by Working Group III (Bert Metz et al. eds.) (Cambridge: Cambridge University Press, 2005), 29.
[9] Nils Røkke et al, *'Building Nordic Excellence in CCS NORDICCS – The Nordic CCS Competence Centre,'* (Oslo: SINTEF, 2016), 58.
[10] Vos, *'Linking the Chain'*, 82.
[11] Filip Neele et al., 'CO_2 Transport by Ship: The Way Forward in Europe,' *Energy Procedia* Volume 114 (2017): 6824, doi: 10.1016/j.egypro.2017.03.1813.
[12] Nils Rydberg and David Langlet, '*CCS in the Baltic Sea region – Bastor 2 Work Package 4 – Legal & Fiscal aspects,'* Elforsk report 14:48 (Stockholm: Elforsk, 2014), 46; Røkke et al., *'Building Nordic Excellence,'* 6; Wim Mallon et al., 'Costs of CO_2 transportation infrastructures,' *Energy Procedia* Volume 37 (2013): 2970.
[13] Mitsubishi Heavy Industries, *'Ship Transport of CO_2,'* R&D Programme IEA GhG Report No.PH4/30 (Paris: IEA, 2004), 3-4, 16; Robert de Kler et al., *'Transportation and unloading of CO_2 by ship - a comparative assessment: WP9 Final Report,'* CCUS-T2013-09-D08, 2016, 5-6.
[14] Røkke et al., *'Building Nordic Excellence,'* 10; SCCS, *'SCCS Recommendations and Conference 2013 Report: Unlocking North Sea CO_2 Storage for Europe: Practical actions for the next five years'* (Aberdeen: SCCS, 2013), 30; Robert de Kler et al., *'Transportation and unloading of CO_2 by ship*,' 6, 12; Filip Neele, Hans Haugen and Ragnhild Skagestad, 'Ship transport of CO_2 – breaking the CO_2-EOR deadlock,' *Energy Procedia* Volume 63 (2014): 2643, doi: 10.1016/j.egypro.2014.11.286.
[15] Vos, *'Linking the Chain,'* 118; Raine, 'Transboundary Transportation,' 355.

flexibility could allow CO_2 to be centrally collected in smaller volumes from individual emission sources, before further transport to storage sites. The sharing of transport facilities in this way reduces the overall cost of CO_2 transport and may provide the necessary conditions to accelerate regional CCS infrastructure.[16]

Accordingly, if CCS is to become a full-scale reality, the benefits of CO_2-shipping must be integrated into the chain as a transportation option. This envisages the use of ships in transporting CO_2, where pipelines are not a commercial or practical possibility.

1.2 Research question and importance

In 2005, the IPCC issued a Special Report on CCS identifying that the future of CCS rested on a number of factors, including the development of specific legal and regulatory frameworks.[17] For CCS to reach its potential as a full-scale mitigation option, legal frameworks must be in place to ensure safe and environmentally-sound deployment. This has prompted changes to international and regional laws, including the creation of a tailor-made CCS Directive in the EU.[18] Whilst these regulatory initiatives have removed many of the barriers preventing CCS deployment, they have focused more on pipeline transport than shipping.[19] This stems from widespread practical experience in large-scale CO_2 pipeline transport compared to CO_2-shipping, which is only existent on a small-scale.[20] To support the deployment of large-scale CO_2-shipping, legal and regulatory frameworks need to be developed which integrate shipping within the CCS value chain.

[16] Rydberg and Langlet, '*CCS in the Baltic,'* 46.
[17] IPCC, *'Special Report on CSS: Summary for Policymakers,'* A Special Report of Working Group III (Cambridge: Cambridge University Press, 2005), 15; Global CCS Institute/UCL, *'Carbon Capture Use and Storage Legal Resource Net'* (London: Global CCS Institute, 2014), section 1.
[18] Directive 2009/31/EC on the geological storage of carbon dioxide; Resolution LP.1(1)) on the amendment to include CO_2 sequestration in sub-seabed geological formations in Annex 1 to the London protocol inserting Annex 1(4) 2006; OSPAR Commission Decision 2007/2 on the Storage of Carbon Dioxide Streams in Geological Formations.
[19] Peter Brownsort, *'Ship transport of* CO_2 *for Enhanced Oil Recovery – Literature Survey,'* EOR Joint Industry Project WP15 (Aberdeen: SCCS, 2015), 9, 32; Kim Johnsen et al., 'DNV Recommended Practice: Design and Operation of CO_2 Pipelines,' *Energy Procedia* Volume 4 (2011): 3032, doi: 10.1016/j.egypro.2011.02.214.
[20] Sarah Forbes and Preeti Verma, *'CCS Guidelines: Guidelines for Carbon Dioxide Capture, Transport, and Storage,'* (Washington DC: World Research Institute, 2008), 43.

The aim of this thesis is to consider the legal liability regime for damage which can be attributed to leakage of CO_2 from the transporting ship's cargo, from the time the ship receives CO_2 from the capture facility, to the delivery of CO_2 for injection into an offshore sub-seabed reservoir. The question of liability for damages caused by a loss of containment is crucial because the environmental objective of CCS is to reduce the levels of CO_2 in the atmosphere and leakage of captured CO_2 during transportation should therefore be avoided.[21]

Legal liability issues remain critically important for the deployment of shipping-based CCS.[22] To incentivise investment in the shipping phase of CCS, the liability regime applicable to CO_2-shipping must provide operators with legislative transparency, clarity and stability.[23] This will ensure stakeholders engaged in CCS can properly quantify their risk exposure. It will also ensure the management and monitoring of activities by States and protect the environmental integrity of the CCS value chain.[24] This encourages public support for the technology by ensuring the safe deployment of CCS whilst providing a clear model for remediating damage.[25]

At present, CO_2-shipping liabilities for loss of containment are not specifically regulated within the CCS value chain and therefore, rely on the fragmented application of existing national and EU laws. This is unsatisfactory because it not only fails to ensure the comprehensive regulation of all the types of damages which could arise from CO_2-shipping; but the provisions which do apply, lack the clarity necessary to drive investment in CO_2-shipping. A more effective liability regime would balance environmental objectives in climate mitigation with the need to ensure that CCS is commercially attractive to investors. This means that the liability regime must protect the environmental integrity of the chain by incentivising the safe carriage of captured CO_2 to suitable storage reservoirs. Further, it must impose clearly defined and fair liabilities on operators to incentivise investment in CO_2-shipping.[26] Given the flexibility of shipping transportation routes, these liabilities must

[21] Martha Roggenkamp, 'Transportation of Carbon Dioxide in the European Union: Some Legal Issues,' in *'Carbon Capture and Storage: Emerging Legal and Regulatory Issues'* eds. Ian Havercroft, Richard Macrory and Richard Stewart (Portland Oregon: Hart Publishing, 2018), 245-246.
[22] Global CCS Institute/UCL, *'Legal liability and carbon capture and storage: a comparative perspective,'* (London: Global CCS Institute, 2014), 5.
[23] Baker McKenzie, *'Report to the Global CCS Institute on Legal and Regulatory Developments related to Carbon Capture and Storage between November 2010 – June 2011*,' (Global CCS Institute, 2011), 5.
[24] Vos, *'Linking the Chain'*, 116-117.
[25] ibid.
[26] Baker McKenzie, *'Report to the Global CCS,'* 5.

adequately consider circumstances where CO_2 is transported across national boundaries to suitable storage sites or regional CCS infrastructure.

With these considerations in mind, this thesis will critically assess the shortcomings of the liability regime for CO_2-shipping in respect of loss of cargo during cross-border transport. The ambition of the thesis is to put forward recommendations that will encourage the adoption of a more effective and balanced legal liability framework which clarifies the potential liabilities of operators, incentivises investment and encourages public support for the deployment of CCS.

1.3 Case study: North Sea

The North Sea has been identified as the most logical place to start CCS in the EU because it has the largest storage capabilities.[27] Additionally, it is surrounded by major industrial regions which could supply CO_2, has existing O&G infrastructure which could be utilised to reduce the start-up costs of storage and it has experience in offshore industries which could develop the storage sector. [28] It is also surrounded by States such as Norway which support the deployment of large-scale CCS.[29]

Shipping is regarded as a key transportation option to deploy CCS in the North Sea region because of its benefits in linking multiple small-scale emitters with storage sites, whilst avoiding the large investment costs needed for pipelines.[30] Shipping is also the only option for States located within the Baltic Sea region which have limited storage capacity and require the long distance transport of CO_2 to the North Sea for storage.[31] For these reasons, the North Sea Basin Task Force expect that CO_2 transport solutions will require the establishment of cross-border transport infrastructure within the North Sea.[32] They anticipate

[27] SCCS, *'SCCS Recommendations*,' 4; Stig Svenningsen, *'What is the North Sea Basin Task Force?'* PowerPoint on behalf of Norwegian Ministry of Petroleum and Energy (London: CCS Association), 6.
[28] SCCS, '*SCCS Recommendations,'* 10-11; Keith Whiriskey, '*North Sea to the Rescue: The commercial and industrial opportunities of* CO_2 *storage in the North Sea,'* (Bellona: Norway, 2015), 9.
[29] Whiriskey, '*North Sea to the Rescue,'* 9.
[30] SCCS, '*SCCS Recommendations*,' 29-30.
[31] Røkke et al., *'Building Nordic Excellence,'* 58.
[32] Svenningsen, *'What is the North Sea,'* 7.

that cross-border transport will play a central role in storage activities by 2030 by allowing the delivery of CO_2 from multiple countries to North Sea storage sites.[33]

Given the importance of the North Sea in deploying CCS in the EU and the important role CO_2-shipping is expected to play in cross-border transport activities in the North Sea, it is an ideal case study to examine the liability regime applicable to transboundary CO_2-shipping. This thesis will therefore focus on identifying the key liability instruments applicable to circumstances where there is a loss of containment during the transboundary CO_2-shipping in the North Sea. The thesis does not intend to provide a comprehensive analysis of national laws in the North Sea region, but will consider national laws as a tool to highlight the uncertainties that exist in the liability regime for CO_2-shipping activities with a cross-border element. Of greater importance are the rules developed at the EU and IMO levels. These are considered in more detail to highlight the potential inadequacies following the anticipated entry into force of the HNS Convention.[34]

1.4 Methodology and scope limitation

The method of legal research was the doctrinal analysis of both primary and secondary library sources such as treaties, legal reports and literature. This required analysis of both the existing regime based on national and EU law as well as an in-depth analysis of the emerging global regime under the HNS Convention. It therefore adopts both a *de lege lata* and *de lege feranda* approach to consider how far the existing and emerging liability regimes contribute to the presence of effective legal frameworks through the CCS value chain. Fieldwork meetings, interviews and presentations were also conducted within the maritime and energy industries to develop the research question.[35]

The scope of this thesis is limited to discussion of the liabilities of the shipowner as a result of loss of containment during CO_2-shipping. The shipowner could be defined as the RSO, charterer, manager or operator of the ship, depending on the specifics of the transport document. In the start-up phase of CCS, CO_2-ships are likely to be purpose built by RSOs to

[33] ElementEnergy, *'One North Sea: A study into North Sea cross-border* CO_2 *transport and storage – Executive Summary,'* Report on behalf of North Sea Basin Task Force 2010, 18.
[34] International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea (adopted 3 May 1996).
[35] See 'Acknowledgements' for further detail.

serve long-term contracts with a capture operator.[36] With this in mind, the thesis will limit discussion to the potential liabilities of the RSO engaged in CO_2-shipping.

1.5 Ongoing regulatory uncertainty

This thesis would be incomplete without noting that CCS including the transboundary movement of CO_2 are prohibited under Article 6 of the London Protocol.[37] In its current form, the Protocol places a real barrier on the deployment of cross-border CCS and it is essential that its amendment be ratified by the requisite number of States before cross-border CO_2-shipping becomes a large-scale reality.[38] In the interim, the IEA have recommended six options to enable transboundary movement of CO_2.[39] This thesis works on the assumption that these options are utilised in the North Sea pending further ratification of the Protocol amendment.

1.6 Structure

Beyond the introduction, this thesis comprises five chapters.

Chapter 2 examines the risks of leakage during CO_2-shipping and the potential damage as a result of CO_2 leakage. It concludes that the potential scale of CO_2-shipping within the North Sea, requires the development of an effective liability regime to govern the loss of CO_2 during CO_2-shipping.

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[36] Gerben Dijkstra (Business Development Manager, Anthony Veder), telephone interview with author 12/01/2018.

[37] Protocol to the Convention on Prevention of Marine Pollution by Dumping of Wastes and Other Matter (adopted 17 November 1996, in force 24 March 2006); Resolution LP.3(4) on the amendment to Article 6 of the London Protocol inserting Article 6(2) 2009.

[38] Tim Dixon, Sean McCoy and Ian Havercroft, 'Legal and Regulatory Developments on CCS,' *International Journal of Greenhouse Gas Control* Volume 40 (2015): 435-436, doi: 10.1016/j.ijggc.2015.05.024; J.M. Brewers, *'Review of International Conventions having Implications for the Storage of Carbon Dioxide in the Ocean and Beneath the Seabed,'* R&D Programme IEA GhG Report PH4/16 (Paris: IEA, 2003), 17.

[39] Organisation for Economic Co-operation and Development/IEA, *'Working Paper: Carbon Capture and Storage and the London Protocol - Options for Enabling Transboundary* CO_2 *Transfer'* (Paris: OECD/IEA, 2011),6; Tom Mikunda and Avelien Haan-Kamminga, *'Overcoming national and European legal barriers to* CO_2 *transport and storage in the North Sea,'* CATO2-WP4.1-D0 2013, 18.

Chapter 3 considers the current regime applicable to circumstances where cargo is lost during CO_2-shipping. This includes analysis of the rules governing third-party, environmental damage and GhG emissions liabilities. It suggests there are two inadequacies within the current liability regime which could hinder the deployment of CO_2-shipping. Firstly, the lack of harmonisation between Member States in the North Sea in respect of CO_2-shipping liabilities and secondly, the failure to properly integrate shipping into the EU's GhG emissions liability framework. The chapter concludes by highlighting there is need for reform of the current regime to promote the deployment of CO_2-shipping in the North Sea.

Chapter 4 considers how the current regime could be reformed by the HNS Convention, to better harmonise CO_2-shipping liability laws between Member States. It recognises the Convention creates a global liability regime which provides greater certainty for RSOs, investors and victims. Nevertheless, it argues there are limitations of the Convention with regards to its application to CCS, including the risk of continued fragmentation despite its entry into force. The chapter concludes by suggesting entry into force of the Convention is desirable but that future amendments may be necessary.

Chapter 5 assesses the need for integration of shipping within the EU's CCS framework. It suggests that amendments to the CCS Directive and ETS Directive must be considered to properly hold RSOs accountable for CO_2 emissions in the North Sea and incentivise investment in shipping-based CCS.

The final chapter will conclude that there is need for reform of the liability regime to ensure deployment of CO_2-shipping in the North Sea. It recommends firstly, entry into force of the HNS Convention to better harmonise liabilities between Member States; and secondly, amendments to the CCS Directive and ETS Directive to ensure the effective integration of CO_2 -shipping within the CCS value chain.

2 THE RISKS OF CO_2-SHIPPING

Legal liability frameworks are required to protect against risks posed by the injurious potential of commercial activities. It must therefore be established that CO_2-shipping risks causing damage which requires legal protection. This chapter will suggest that the scale of planned CCS projects introducing a shipping phase and the potential magnitude of damage following unintended leakage of CO_2, justifies the need for an effective liability regime, in particular in the North Sea region.

2.1 Risk of CO_2 leakage

CO_2 exists in three phases: gaseous, liquid or solid (dry ice). Economically viable large-scale CO_2-shipping will mandate transportation of CO_2 in the liquid phase for increased density and volume reduction.[40] The recommended conditions to transport in the liquid phase are pressures above atmospheric (0.7 MPa) and low temperatures up to -50°C.[41] Although much higher pressures (up to 4.5 MPa) are feasible when temperatures are increased.[42] Technical capabilities to construct large-scale CO_2-ships exist today, with existing CO_2-ships being semi-refrigerated to ensure cargo remains liquid during transportation.[43] Liquid CO_2 is categorised as a harmful, non-toxic and non-flammable substance under IMO classifications.[44] SOLAS makes the IGC Code mandatory for CO_2-ships.[45] The Code prescribes design, construction and equipment standards for ships carrying liquefied CO_2 to minimise risks of transportation. CO_2-ships are constructed using similar technology to

[40] Grevers and Luten, *'Introduction to the CCS,'* 8.
[41] Mitsubishi Heavy Industries, *'Ship Transport,'* 20.
[42] Gassnova/Gassco, *'Feasibility study for full-scale CCS in Norway,'* English translation (Ministry of Petroleum and Energy, 2016), 12, 24.
[43] Ragnhild Skagestad et al., *'Ship transport of* CO_2 *Status and Technology Gaps,'* SINTEF Tel-Tek Report No.2214090 (Porsgrunn: Gassnova, 2014), 7-9; Global CCS Institute/WorleyParsons, *'Strategic analysis of the global status of carbon capture and storage. Report 1: status of carbon capture and storage projects globally,'* (Global CCS Institute, 2009), C-7.
[44] UN Recommendations on the Transport of Dangerous Goods Model Regulations 19th Edition 2015; International Maritime Dangerous Goods Code (IMO, 2018 Edition), Class 2.2.
[45] SOLAS (adopted 1 November 1974, in force 25 May 1980) Volume 1184/1185 Number 18961, Chapter VII; Resolution MSC. 5(48) on the adoption of the IGC Code, 1983; International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk 1983 (IMO, 2016 Edition).

existing LNG carriers, with modern LNG carriers reaching more than 200,000 m^3 capacity.[46] Feasibility studies on CO_2-shipping have so far considered tankers carrying up to 50,000 tonnes of liquid CO_2.[47] If the carriage of these quantities is realised, there is potential for mass leakage of CO_2 from cargo holds.

Maritime accidents as a result of human error are the most common source of cargo leakage.[48] Collisions and groundings caused by factors such as insufficient communication or fatigue may lead to rupture of the cargo tank.[49] Extensive safety procedures and high levels of crew training on LNG tankers has proved effective in reducing the occurrence of maritime accidents, with no major incidents to date.[50] Although large-scale CO_2-ships are predicted to have similar safety projections to LNG, the human element of shipping always risks accidents at sea.[51] Fugitive emissions occur as a result of unintended, physical leakage of cargo during transportation. Inadequate tanker construction may lead to cracking of the hold or irregular leakage through valves when subject to the extreme pressures and temperatures required for transporting liquid gases. Standards for tanker design and structure, repair operations and early leak detection minimise the risk of fugitive emissions but will not remove the possibility entirely.[52] Operational leakages of cargo may also occur during transportation as a result of losses during intermediate storage, loading/unloading or evaporation during transportation.[53] This is a particular concern with regards to the risks of direct injection of CO_2 from a ship during unloading operations at offshore storage structures, which has not yet been fully tested.[54] There is therefore always the risk of CO_2 leakage from cargo holds as a result of maritime accidents, fugitive emissions and operational leakages during CO_2-shipping.

[46] IPCC, '*Special Report on CCS*,' 186.
[47] Mitsubishi Heavy Industries, *'Ship Transport',* 19.
[48] IPCC, '*Special Report on CCS*,' 188.
[49] Stipe Galic, Zvonimir Lusic and Ivica Skoko, 'The Role and Importance of Safety in Maritime Transportation,' *International Maritime Science Conference Book of Proceedings* (2014): 192, 198, https://bib.irb.hr/datoteka/700720.imsc2014.pdf.
[50] IPCC, '*Special Report on CCS*,' 188.
[51] Dik Gregory and Paul Shanahan, '*The Human Element: A guide to human behaviour in the shipping industry'* (London: The Stationery Office, 2010), 1-3.
[52] IMO, *'Carbon Dioxide Sequestration in Sub-Seabed Geological Formations under the London Protocol'* (London: IMO, 2016), 37.
[53] Ragnhild Skagestad et al., 'CO_2 transport from sources to storage in the Skagerrak/Kattegat region,' *Energy Procedia* Volume 4 (2011): 3016-3023, doi: 10.1016/j.egypro.2011.02.212.
[54] Gassnova/Gassco, *'Feasibility study*' 34, 38, 45.

2.2 Potential harms of CO_2 leakage

CO_2 leakage may be caused by slow gradual releases (fugitive emissions) or large sudden releases (maritime accidents) and the effects of the leakage will differ accordingly.[55] A change in temperature or pressure may alter the density of CO_2 and could result in a change of phase to gas or dry ice.[56] At atmospheric pressures, CO_2 is denser than air and may accumulate in low-lying areas (particularly if there is no air movement).[57] This presents asphyxiation risks due to air displacement which may stop the ships engines and in worst case, lead to death or unconsciousness of persons in the vicinity. CO_2 interactions with the sea in large-quantities are not yet fully understood but may lead to increased temperature differences, inducing strong currents and challenging navigational conditions.[58] Release of highly pressurised CO_2 also carries the risk of explosion and frostbite injuries.[59] Impurities in the captured CO_2 stream and the subsequent presence of other gases may also alter the expected consequences of leakages at sea.[60] The UK Marine Accident Investigation Branch revealed that the unintentional release of CO_2 from marine fire-extinguishing systems caused 72 deaths and 145 injuries between 1975 and 2000.[61] The 1986 Lake Nyos disaster killed over 1,700 people and 3,500 livestock when CO_2 escaped and displaced air within 25 kilometres.[62] Survivors were left with injuries such as paralysis, lesions and respiratory problems and inhabitants of the area were forced to evacuate.[63] It is therefore foreseeable that large releases of CO_2 at sea could similarly lead to third-party damage such as loss of life, personal injury and property damage.

Additionally, CO_2 leakage may cause changes in ocean chemistry and induce localised ocean acidification; affecting marine ecosystems, corals and fisheries as well as local populations

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[55] IMO, *'Carbon Dioxide Sequestration,'* 27.
[56] Forbes and Verma, *'CCS Guidelines,'* 44.
[57] ibid, 49.
[58] Viktor Weber and Michael Tsimplis, 'The UK liability framework for the transport of CO_2 for offshore CCS operations,' *International Journal of Marine and Coastal Law Volume* 32(a) (2017): 154, doi: 10.1163/15718085-12341419.
[59] Weber and Tsimplis, 'The UK liability framework,' 154.
[60] Global CCS Institute/Anthony Veder/Vopak, '*Knowledge sharing report.* CO_2 *liquid logistics shipping concept (LLSC): overall supply chain optimization'* (Global CCS Institute, 2011), 20.
[61] Peter Harper, *'Assessment of the major hazard potential of carbon dioxide*' (Merseyside: UK Health and Safety Executive, 2011), 3.
[62] George Kling et al., 'The 1986 Lake Nyos Gas Disaster in Cameroon, West Africa,' *Science* Volume 236 Issue 4798 (1987): 169, doi: 10.1126/science.236.4798.
[63] ibid, 174.

dependent on them.[64] Contributions to climate change and related indirect impacts of GhG emissions can also not be overlooked. Large releases of CO_2 from ships may have a profound effect on the climate due to its properties as a GhG.[65] This is particularly relevant given CCS is intended as a climate mitigation technology. The unintended leakage of CO_2 from cargo holds during CO_2-shipping could therefore present major hazards to both the localised and global environment.

2.3 The projected scale of CO_2-shipping in the North Sea

The risk of CO_2 leakage and the potential magnitude of damage only justifies consideration where the projected scale of CO_2-shipping is significant. CO_2-shipping has predominantly been used in the food and beverage industries, with only four small-scale ships in operation until 2005.[66] The risk of damage due to leakage was therefore relatively small and there was no pressing need to adopt a comprehensive liability regime for CO_2-ships. However, new developments such as the adoption of the 2015 Paris Agreement and the publication of the IPCC's 2018 Special Report indicate the need for larger recourse to mitigation strategies such as large-scale CCS.[67] This means that the quantity of CO_2 being transported for CCS will likely increase and with it, the potential magnitude of damage as a result of leakage during transportation. Specifically, this is relevant in the North Sea, where large-scale CO_2-shipping is expected to play a central role in planned CCS activities.[68]

The Norwegian Government aims to realise a full-scale CCS chain by 2022, by shipping CO_2 from capture facilities in Eastern Norway to receiving terminals located in Western Norway

[64] Adna Pop, 'The EU Legal Liability Framework for Carbon Capture and Storage: Managing the Risk of Leakage While Encouraging Investment,' *Aberdeen Student Law Review* Volume 6 (2016): 39, https://www.abdn.ac.uk/law/documents/ASLR_Vol6_Dec15_32-56_Pop.pdf; IMO, *'Carbon Dioxide Sequestration,'* 26, 36.
[65] Rieks Boekholt*, 'Regulation of liability and safety in ship transport of* CO_2 *– a comparative analysis,'* CATO2-WP4.1-D11 2013, 36.
[66] IPCC, '*Special Report on CCS*,' 186.
[67] Paris Agreement (adopted 12 December 2015, in force 4 November 2016) UNTS Number 54113, 1; IPCC, *'Special Report on Global Warming of 1.5 °C,'* Chapter 2: Mitigation, pathways compatible with 1.5°C in the context of sustainable development, 55; Weber and Tsimplis, 'The UK liability framework,' 140.
[68] Global CCS Institute/Anthony Veder/Vopak, '*Knowledge sharing report',* 20.

for onward pipeline transportation to the North Sea.[69] Additionally, the Rotterdam Climate Initiative's Liquid Logistic Shipping Concept envisages the use of ships to transport CO_2 between the Port of Rotterdam and empty O&G reserves in the North Sea for storage.[70] This project will require the establishment of cross-border shipping networks between a number of offshore storage facilities. Shipping is identified as the primary option for decarbonisation efforts in Wales with CO_2-shipment to Scotland, Teeside or Norway for future storage.[71] It has also been suggested that States situated in the Baltic Sea region without storage capabilities, such as Finland and Estonia, will require large-scale shipping solutions to transport captured CO_2 to the North Sea for suitable storage sites.[72] Sweden have also identified shipping as a prerequisite to the commercial viability of CCS in the Baltics.[73] Maersk planned to transport CO_2 by ship from two Finnish power plants to the North Sea for EOR and storage.[74] Additionally, the Nordic CCS Competence Centre concluded that CO_2-shipping is the most cost-effective option in 80% of Nordic CCS cases, both for transport between individual sources, and to and from potential clusters/onshore hubs to collect CO_2 from various sources.[75] The Centre have proposed the shipping of CO_2 from three central Danish power plants to the North Sea for EOR and storage.[76] It is therefore clear that CO_2-shipping within the North Sea will play a central role in the deployment of CCS for both surrounding and distance States.

[69] Heidi Seglem and Ruben Larsen (Legal Department, Equinor), personal meeting with author (Oslo: Equinor Oslo, 08/03/2018); Equinor, 'Statoil, Shell and Total enter CO_2 storage partnership,' last modified 04/10/2017, https://www.equinor.com/en/news/statoil-shell-total-co2-storage-partnership.html.
[70] Global CCS Institute/Anthony Veder/Vopak, *'Knowledge sharing report,'* 12-13; Wim van Sluis, '*CCS in Rotterdam – a network approach: A business case for CCS in Rotterdam, '(*Rotterdam: RCI, 2012); Rotterdam Climate Initiative, 'CO_2 *Capture, transport and storage in Rotterdam: Report 2009,'* (Schiedam: DCMR Environmental Protection Agency, 2009), Annex III.
[71] UKCCS Research Centre, *'Delivering Cost Effective CCS in the 2020s: an overview of possible developments in Wales and areas linked to Welsh CCS activities via shipping. A Chatham House Rule Meeting Report'* (Sheffield: UKCCSRC, 2016), 2 -3, 12-13.
[72] Jan Kjärstada et al., 'Ship transport—A low cost and low risk CO_2 transport option in the Nordic countries,' *International Journal of Greenhouse Gas Control* Volume 54 (2016): 169, doi: 10.1016/j.ijggc.2016.08.024; Nicklas Nordbäck et al., '*CGS Baltic seed project (S81): Project substance report,'* Baltic Carbon Forum Task Force on Geological Storage 2017, 9, 13, http://bcforum.net/content/CGSBalticSeedProject_SubstanceReport_2017.pdf
[73] Rydberg and Langlet, '*CCS in the Baltic,'* 46.
[74] Mikko Iso-Tryykäri et al., 'FINNCAP - Meri-Pori CCS demonstration project,' *Energy Procedia* Volume 4 (2011): 5600; Maersk, *'Sustainability Report – Setting the Course,'* (Copenhagen: A.P. Moller-Maersk Group, 2010), 40.
[75] Røkke et al., *'Building Nordic Excellence,'* 9, 11.
[76] Marit Mazzetti, 'NORDICCS CCS Roadmap - Technical Report D1.2.1301,' *Energy Procedia* Volume 51 (2013): 3.

Given the injurious potential of CO_2 leakage and the projected scale of shipping-based CCS in the North Sea, the establishment of an effective liability regime must be a priority for legislators.

3 THE CURRENT REGIME: A CASE FOR REFORM

At the global level, there is no existing regime which regulates liabilities arising from CO_2 leakage during CO_2-shipping. The imposition of liability for damage arising from CO_2 leakage in the North Sea therefore relies on a combination of national and EU laws.[77]

This chapter will consider the existing regime for third-party, environmental damage and GhG emissions liabilities arising from CO_2-shipping incidents. It will suggest that the current regime is inconsistent and fragmented across Member States and lacks the clarity needed to encourage deployment of CO_2-shipping. Additionally, it will find that CO_2-shipping is not properly integrated into the liability instruments applicable to CCS in the North Sea. This is evidenced by the exclusion of shipping from the CCS Directive and the EU ETS. With these considerations in mind, it will argue there is need for reform of the existing regime to provide a clearer and more harmonised liability regime which better considers the integration of CO_2-shipping into CCS value chains.

3.1 Inconsistencies in third-party liabilities

Any third-party claims in the North Sea for personal injury, property damage or economic loss resulting from CO_2 transportation at sea are governed by national civil liability rules.[78]

In the majority of States surrounding the North Sea, civil liability arising from a shipping incident is based on fault, meaning any act or omission breaching a tortious obligation will result in liability where conduct falls below the expected duty of care.[79] Fault can be defined by differing concepts such as intention, negligence or gross negligence, and the standard of proof can vary depending on the type of jurisdiction.[80] For example, English common law

[77] Boekholt*, 'Regulation of liability*,' 15.
[78] Peter Wetterstein, 'Carriage of Hazardous Cargoes by Sea - The HNS Convention,' *Georgia Journal of International and Comparative Law* Volume 26 Number 3 (1997): 597, https://digitalcommons.law.uga.edu/gjicl/vol26/iss3/4.
[79] DLA Piper, '*Study on EU Member States' national civil liability regimes in relation to rail accidents between Railway Undertakings and Infrastructure Managers in so far as they may present a barrier to the internal market,'* Final report 2010, 63.
[80] ibid, 54.

imposes liability where there is a breach of a 'reasonable' duty of care.[81] In contrast, Dutch national law is regulated by the Dutch Civil Code which requires a broader assessment of evidence to determine whether the five cumulative conditions are met, including the requirement for imputability.[82] Most national systems impose a condition for a causal link between the breach of duty and the damage suffered.[83] However, causation theories differ between Member States, with Belgium requiring merely a link between the act or omission, Denmark requiring the link be 'adequate' and Germany requiring the link be 'relevant' to the damage suffered.[84]

Given the infancy of large-scale CO_2-shipping, there has not yet been any case where claims for third-party liability have arisen in the North Sea.[85] It is therefore difficult to assess how these principles will be applied in practice. Nevertheless, the imposition of liability on an RSO will be dependent on the functioning of the national courts where the incident takes place. In an international industry such as shipping, different national laws across shipping routes risk unpredictable liabilities for RSOs engaged in CO_2-shipping. This makes it challenging and costly for RSOs to assess their potential legal liabilities during cross-border transport. Similarly, it will have a detrimental impact on victims of CO_2-shipping incidents by creating fragmented standards for compensation.

Notably, the shipowner can limit compensation claims relating to personal injury or property damage in accordance with the 1976 LLMC, as amended by the 1996 Protocol and 2012 Resolution.[86] In the EU, Member States are obliged to obtain compulsory insurance up to the applicable limits of the LLMC.[87] This ensures victims of CO_2-shipping incidents can recover compensation through the RSOs P&I insurer whilst allowing RSOs to quantify their

[81] British Institute International and Comparative Law, 'Introduction to English Tort Law,' last accessed 04/09/2018, https://www.biicl.org/files/763_introduction_to_english_tort_law.pdf.
[82] EC, *'Study on Analysis of integrating the ELD into 11 national legal frameworks: Final Report,'* 2014.1174 (Brussels: EU, 2013), 82, doi: 10.2779/69062; Global CCS Institute, *'ROAD CCS permitting process: special report on getting a CCS project permitted'* (Global CCS Institute, 2014), 60-61.
[83] DLA Piper, '*Study on EU Member States,'* 56.
[84] ibid, 10.
[85] Global CCS Institute/UCL, *'Legal liability,'* 17.
[86] Convention on Limitation of Liability for Maritime Claims (adopted 19 November 1976, in force 1 December 1986) UNTC Volume 1456 Number 24635, 221; Protocol to the Convention on Limitation of Liability for Maritime Claims (adopted 2 May 1996, in force 13 May 2004), Articles 1, 2(1), 5, 6; Resolution LEG.5(99) on amendments to the limitation amounts set out in article 3 of the 1996 Protocol 2012.
[87] Directive 2009/20/EC on the insurance of shipowners for maritime claims; Resolution A.898(21) of the IMO Assembly on Guidelines on Shipowners' Responsibilities in Respect of Maritime Claims 1999.

maximum liabilities for third-party damage claims. Nevertheless, the LLMC does not ensure consistency in the standards for the imposition of liability across Member States. It therefore fails to ensure the evaluation of third-party claims on a level-playing field. This risks lack of foreseeability and certainty regarding the outcome of third-party claims and may jeopardise public support for large-scale CO_2-shipping.[88]

3.2 Fragmented transposition of the ELD

Environmental damage liability in the North Sea is specifically governed by the ELD.[89] The ELD is an EU public liability instrument, imposing liabilities on operators of economic activities to ensure environmental precautions and remedies for environmental damages. It does not make possible private claims for compensation as a consequence of environmental damage or the threat of such damage.[90] The operator is defined as the person controlling any economic activity 'to whom decisive economic power over the technical functioning of such activity has been delegated, including permit holders and persons registering the activity'.[91] The RSO can therefore be held liable for environmental damage occurring as a result of an incident during CO_2-shipping.

The ELD establishes two distinct liability regimes based on the polluter pays principle.[92] The first provides for strict liability for damage to land, water, protected species and natural habitat where the operator undertakes activities listed in Annex III.[93] The second applies to activities falling out with the scope of Annex III and imposes liability on operators for damage to protected species and natural habitats based on their fault or negligence. It therefore becomes essential to determine whether CO_2-shipping falls within the strict or fault-based liability regime. Annex III includes provision for transport by sea as defined in

[88] Wetterstein, 'Carriage of Hazardous Cargoes', 596.
[89] Directive 2004/35/CE on environmental liability with regard to the prevention and remedying of environmental damage, Articles 2(1), (2), (6); EC, *'Study on Analysis of integrating the ELD,'* 105-115.
[90] ELD, Article 3(3); Grant Lawrence, *'Environmental Liability Directive: A Short Overview'* EC (Brussels: EU, 2006), 1.
[91] ELD, Article 2(6), 2(7); EC, '*Environmental Liability Directive, Protecting Europe's Natural Resources Brochure'* (Brussels: EU, 2013), 6.
[92] ELD, Article 3; Lawrence, *'Environmental Liability Directive,'* 2.
[93] Directive 1979/409/EEC on the conservation of wild birds as amended by Directive 2009/147/EC; Directive 1992/43/EEC on the conservation of natural habitats and of wild fauna; Directive 2000/60/EC establishing a framework for the Community action in the field of water policy.

Directive 93/75/EEC concerning minimum requirements for vessels bound for or leaving Community ports and carrying dangerous or polluting goods.[94] CO_2 is categorised as a dangerous good under this Directive and accordingly, CO_2-shipping falls within Annex III and the strict liability regime.[95] This means RSOs will be under the strict obligation to take all immediate steps to prevent environmental damage causing or threatening significant adverse effects and bear the costs of any required preventive or remedial measures.[96]

The ELD is designed to implement a minimum threshold for liability by complementing existing national laws where they are broader and more stringent than the Directive itself.[97] Transposition of the ELD into national law has varied considerably across Member States, leading to a patchwork of liability systems for environmental damage in the North Sea.[98] The scope of application of the ELD is limited in respect of EEA States as the rules regarding damage to protected species and natural habitats do not apply in accordance with the EEA Agreement.[99] This means that liability rules protecting biodiversity in Norway could vary substantially from other North Sea States. It has also emerged that many States continue to apply existing domestic law due to difficulties in interpreting the thresholds, exceptions and options of the ELD.[100] This means national law may impose liabilities for types of environmental damage not covered by the ELD.[101] For example, England have extended the scope of the liability regime to nationally protected biodiversity.[102] The imprecise wording of the ELD has led to crucial differences in the transposition of its provisions, including the interpretation of the 'significance' trigger for liability.[103] There has also been fragmentation with regards to the availability of optional defences to environmental damage liability. The ELD allows Member States to unilaterally exempt the RSO where permit conditions are fully complied with or the state of scientific and technical knowledge proves the activity was not

[94] Repealed by Directive 2002/59/EC establishing a Community vessel traffic monitoring and information system.
[95] Directive 93/75/EEC, Article 2(c) and Directive 2002/59/EC, Article 3(g) classify CO_2 as a dangerous good in accordance with Chapter 19 of the IGC Code; Weber and Tsimplis, 'The UK liability framework', 150.
[96] ELD, Articles 2(1), 5(1), 6(1), 8(1).
[97] ibid, Article 16; Global CCS Institute/UCL, '*Carbon Capture Use and Storage*,' section 1.1.
[98] EC, *'Study on Analysis of integrating the ELD,'* 5.
[99] Agreement on the EEA, Annex 20, para 1i.
[100] EC, *'Report on environmental liability with regard to the prevention and remedying of environmental damage*' COM(2016) 204 final (Brussels: EU, 2016), 5.
[101] ibid, 2.
[102] EC, *'Study on Analysis of integrating the ELD,* 47, 49.
[103] ibid, 8, 12-13.

likely to cause environmental damage.[104] The availability of these defences varies between States, with Germany transposing the defences as defences to costs yet the UK interpreting them as defences to liability.[105] Accordingly, the availability of remediation for environmental damage may be delayed or less likely in States which allow defences to liability.[106]

These divergences pose a barrier to the successful harmonisation of environmental damage liabilities. The failure to secure harmonised implementation of the ELD risks continued fragmentation for environmental damage claims. Differences in the requirements for liability between Member States is important because it means RSOs are more likely to be liable in some States than in others.[107] These regulatory uncertainties make it difficult and costly for RSOs to quantify risk exposure where activities have a cross-border dimension. Further, the imposition of strict liability for environmental damages departs from the fault-based standards for third-party liabilities. This creates fragmentation between the various heads of liability for CO_2-shipping incidents in the North Sea, with different standards for different types of damage arising from the same incident. It is also unsatisfactory that more serious claims such as loss of life are subject to less stringent standards than public environmental damage claims. There is therefore not only a need to align the standards for claims under the ELD but also, reduce fragmentation between the standards for third-party damage claims with those arising from environmental damage.

3.3 Exclusion of shipping from the EU's GhG emissions liability framework

3.3.1 GhG emissions liability under the EU ETS

[104] ELD, Articles 8(3), 8(4); Pop, 'The EU Legal Liability,' 47.
[105] UK Government, '*Environmental Liability Directive 2004/35/EC- UK report to the European Commission on the experience gained in the application of the Directive,'* (Brussels: EC, 2013), para 21; EC, *'Study on Analysis of integrating the ELD,'* 12, 52-53, 88-89.
[106] UK House of Commons Environment, Food and Rural Affairs Committee, *'Implementation of the Environmental Liability Directive Sixth Report of Session 2006–07,'* (London: The Stationery Office, 2007), 20-21.
[107] EC, *'Study on Analysis of integrating the ELD*,' 82.

Emissions trading is a key tool for combatting climate change and enabling cost-effective emissions reduction.[108] The ETS Directive established the first and largest carbon market for regulating the trading of GhG emission allowances in the EU.[109] The scheme operates under a cap-and-trade principle where there is a cap on the total number of GhG emissions allowed from specified installations. The operators of installations identified in Annex I of the Directive must obtain a permit from their competent national authority which allocates the installation an annual number of emission allowances. At the end of each year, operators must then surrender these emission allowances to cover their emissions for that year. One emission allowance, determined by the market price at the time, must be surrendered for every ton of GhG emitted from an Annex I installation. To protect the environmental integrity of the system, operators are obliged to adhere to strict procedures requiring operators to monitor and report all GhG emissions from the covered installation.[110] Operators emitting more than their emissions allowance may take measures to reduce their annual emissions or may purchase additional allowances on the carbon market from operators with surplus allowances.[111] The carbon market creates a value for GhGs, dependent on the quantity of allowances, which can be traded between operators. This administrative system imposing an obligation to surrender allowances for the annual GHG emissions of an installation has been termed 'GhG emissions liability'. Failure to surrender the accurate number of emission allowances at the end of the year leads to the imposition of fines. Where activities fall out with the scope of Annex I, no emissions permit is needed and emission allowances do not need to be surrendered.

3.3.2 Inclusion of CCS in the EU ETS

[108] EC, 'EU Emissions Trading System (EU ETS),' last accessed 05/10/2018, https://ec.europa.eu/clima/policies/ets_en.
[109] Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community, amending Council Directive 96/61/EC as amended by Directive 2009/29/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community.
[110] Decision 2010/345/EU amending Decision 2007/589/EC as regards the inclusion of monitoring and reporting guidelines for greenhouse gas emissions from the capture, transport and geological storage of carbon dioxide.
[111] Nigel Bankes and Martha Roggenkamp, 'Legal aspects of carbon capture and storage'. In *'Beyond the Carbon Economy: Energy Law in Transition'* eds. Donald Zillman and Catherine Redgwell (Oxford: Oxford University Press, 2008), 373.

In 2013, each element of the CCS chain was included in the list of installations identified in Annex I of the ETS Directive.[112] Any CO_2 captured from an Annex I installation and transported for permanent storage in verified storage sites will be considered not emitted. Capture operators engaging in CCS will therefore not need to surrender emission allowances for any successfully stored CO_2. This acts as an economic incentive to engage in CCS activities. Operators of capture, transport and storage installations are required to obtain an emissions permit and comply with MRV obligations. If any CO_2 escapes into the atmosphere during CCS, the holder of the permit will be required to surrender emission allowances for the emitted CO_2 at the end of the compliance cycle.[113] This includes any CO_2 not permanently stored in the storage site as well as CO_2 emitted during operation of the CCS chain. A prerequisite to inclusion in the ETS is that activities conform to the CCS Directive. CCS activities not complying with the Directive will not be eligible under the ETS and operators of GhG emitting Annex I installations will remain liable to surrender emission allowances for permanently stored CO_2. This acts as an incentive to comply with the requirements of the Directive.

3.3.3 Exclusion of shipping as a transportation option

The CCS Directive defines the transport phase of CCS as 'the network of pipelines, including associated booster stations, for the transport of CO_2 to the storage site'.[114] This definition is important because it does not mention the possibility of shipping CO_2 between the capture facility and storage site. The CCS Directive therefore excludes the possibility of ship transportation falling within the remit of the ETS as CO_2-shipping is not an identified installation falling within Annex I.[115] Shipping is also not expressly covered by the Monitoring and Reporting or Accreditation and Verification Regulations.[116] This is because

[112] Laetitia Birkeland et al., '*Improving the Regulatory Framework, optimizing organization of the CCS value chain and financial incentives for* CO_2*-EOR in Europe,'* Bellona ECCO project 2010, 6.
[113] Rieks Boekholt, *'Overview of regulatory uncertainties with regard to offshore CCS'* CATO2-WP4.1-D10 2013, 33.
[114] CCS Directive, Article 3(22).
[115] Marijn Holwerda, 'Carbon capture and storage' in *'Essential EU Climate Law'* eds. Edwin Woerdman and Martha Roggenkamp (Cheltenham: Edward Elgar Publishing, 2015), 196.
[116] Regulation No.601/2012 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC; Regulation No.600/2012 on the verification of greenhouse gas emission reports and tonne-kilometre reports and the accreditation of verifiers pursuant to Directive 2003/87/EC.

when the CCS Directive was drafted, the parties had not envisaged large-scale CO_2-shipping.[117]

Exclusion of shipping means operators engaged in CO_2-shipping for the purposes of CCS would interrupt the MRV obligations and break the value chain of CCS endorsed by the CCS Directive.[118] It follows that transport operators engaging in CO_2-shipping for CCS would not be required to obtain an emissions permit, comply with MRV procedures or surrender allowances for GhG emissions.[119] This means there is no GhG emissions liability imposed on RSOs for leakage of CO_2 during ship transportation. This has wide implications for the successful deployment of CO_2-shipping as a transportation option in CCS. Where the MRV obligations are not met, the EU ETS will not allow capture operators to claim CO_2 was successfully stored. This is because the quantity of CO_2 emitted from installations during operation of the CCS chain cannot be verified.[120] Operators would remain liable to subtract emission allowances for CO_2 permanently stored because the CCS activities would not conform to the requirements of the CCS Directive. Any CO_2 transferred to a ship for storage will be added to the capture and storage installations total annual CO_2 emissions.[121]

Article 49(1)(c) of the Monitoring and Reporting Regulation allows operators to subtract emissions where they are transferred out of an Annex I installation to a storage site permitted under the CCS Directive. This could be regarded as allowing the operator to subtract CO_2 regardless of the means of transportation, provided it is transferred to a suitable storage site.[122] However, this logic would act contrary to the EU's system of MRV, which states 'all parts of the installation [...] shall be included in the emissions permit and accounted for in the associated monitoring plan'.[123] Given shipping is not covered by the MRV Regulations or the EU ETS, it is irreconcilable that Article 49 would allow the subtraction of CO_2 where shipping is the chosen transport option.[124] The exclusion of shipping from the CCS Directive and EU ETS therefore negates the commercial incentive for engaging in CCS and fails to

[117] Boekholt, *'Overview of regulatory uncertainties,'* 33.
[118] Global CCS Institute/Bech-Bruhn, *'EOR/CCS 360-degree legal review,'* (Global CCS Institute, 2011), 10-11.
[119] Boekholt, *'Regulation of liability and safety,'* 50.
[120] Rydberg and Langlet, '*CCS in the Baltic*,' 47; Global CCS Institute/Bech-Bruhn, *'EOR/CCS,'* 2.
[121] Global CCS Institute/Bech-Bruhn, *'EOR/CCS,'* 11.
[122] Rydberg and Langlet, '*CCS in the Baltic,'* 47-48.
[123] Regulation No.601/2012, Annex IV, 21(A).
[124] Rydberg and Langlet, '*CCS in the Baltic,'* 47-48.

ensure the environmental integrity of the value chain.[125] This could prevent the development of shipping-based CCS in the North Sea.

3.4 The need for reform

In light of the above considerations, there is need for reform of the existing regime for CO_2-shipping liability. There are two inadequacies in the current regime that must be revised to encourage full-scale deployment of cross-border CO_2-shipping in the North Sea.

Firstly, the current regime for third-party and environmental liabilities remains fragmented. Further steps are required to harmonise these liabilities and establish a level playing field between RSOs in the North Sea.[126] It is desirable to have a more harmonised and simplified legal framework for the various heads of liability in cross-border CO_2-shipping. Unified liability rules regulated on a global basis may drive investment in cross-border CO_2-shipping by providing consistent liabilities for RSOs and ensuring predictable compensation for victims.

Secondly, existing EU frameworks governing CCS activities fail to acknowledge the role of shipping within the value chain. Exclusion of shipping from the GhG emissions liability regime could prove detrimental to the large-scale deployment of CO_2-shipping. Where there is no GhG emissions liability for CO_2 leakages during transport, there is no economic incentive under the EU ETS for engaging in the activity. Protecting the environmental integrity of CCS through the imposition of adequate MRV obligations is also crucial to ensuring public support for large-scale CCS deployment. There is therefore a need for shipping to be better integrated into the existing legal frameworks for CCS in the North Sea through the inclusion of shipping within the CCS Directive and EU ETS.

[125] ibid, 72; Norwegian Shipowners' Association, *'Think Ocean: Maritime Outlook Report 2018,'* (Oslo: Norwegian Shipowners' Association, 2018), 29.
[126] EC, *'Report on environmental liability,* 2

4 TOWARDS GLOBAL HARMONISATION

The current regime for damage arising from CO_2-shipping incidents in the North Sea creates a fragmented and unpredictable system of liability, with compensation contingent on the legal rules applicable in the jurisdiction the incident occurred.[127] This is an unsatisfactory position because it creates fragmentation between the standards imposed on RSOs across North Sea States. It is therefore desirable that a global liability regime replace the existing regime to ensure greater cross-border certainty.

The HNS Convention was drafted to fill the gap in the global regime for liability and compensation. The Convention regulates non-contractual liability for incidents involving the carriage of HNS by sea and is based on the well tested model for oil pollution liability.[128] Liquid CO_2 falls within the definition of an HNS by virtue of the IGC Code.[129] Its provisions therefore have direct implications for incidents involving the cross-border carriage of CO_2 in bulk by ship in the North Sea.

The Convention faced barriers to entry into force stemming from onerous reporting obligations on States prior to ratification and difficulties of identifying the diverse range of HNS cargoes.[130] This led to negotiations of a 2010 Protocol to amend the contentious aspects of the Convention and encourage speedy ratification.[131] Although the requirements for entry into force are yet to be satisfied, it is anticipated they will be in the near future.[132] Ratification remains high on the agenda of the IMO Legal Committee and the EU Council has been vocal in encouraging all Member States to ratify the Convention.[133]

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[127] Global CCS Institute/UCL, '*Carbon Capture Use and Storage*,' section 3.
[128] IMO, '*Facilitation of the Entry into Force and Harmonised Interpretation of the HNS Protocol 2010: Understanding the HNS Convention. Submitted by Canada*,' LEG 102/3/1 (London: IMO, 2015), 2; International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (adopted 18 December 1971, in force 16 October 1978) UNTS Volume 1110 Number 17146, 57; International Convention on Civil Liability for Oil Pollution Damage (adopted 27 November 1992, in force 30 May 1996) UNTS Volume 973, Number 14097, 3.
[129] HNS Convention, Article 1(5)(a)(v); Resolution MSC.220(82) of the Maritime Safety Committee on the addition of CO_2 to Ch. 19 of the IGC Code 2006.
[130] Rosalie Balkin*, 'The HNS Protocol*,' IMO Legal Affairs and External Relations Division (London: IMO, 2010), 4.
[131] Adopted 30 April 2010; Viggo Bondi, '*Shipowners' Perspective on the 2010 HNS Convention,*' ICS Presentation for Workshop on the HNS Convention (London: IMO, 2018), 4.
[132] HNS Convention, Article 46; Boekholt*, 'Regulation of liability and safety,'* 37.
[133] IMO, '*Report on the Work of its 105th Session,'* LEG 105/14 (London, IMO: 2018), 4, 8; Council Decision on the ratification and accession by Member States, in the interest of the EU, to the HNS Protocol of 2010. 2015/0135 (NLE). Brussels, 2015.

When the Convention enters into force, it will replace the existing regime in the North Sea for CO_2-shipping liabilities for third-party and environmental damages.[134] With this in mind, it is necessary to explore whether the HNS Convention can overcome the challenges faced by the current regime. This chapter will consider each tier of liability under the Convention and suggest that entry into force would provide greater certainty to RSOs by globally harmonising the liability rules for CO_2-shipping. However, it will also suggest that there are limitations of the Convention in addressing circumstances where CO_2 is transported for the purposes of storage. It will conclude that the failure of the Convention to account for CCS activities may fail to provide the certainty required for deployment of cross-border CO_2-shipping in the North Sea.

4.1 2010 HNS Convention

The HNS Convention implements a two-tiered liability model for damage arising from the carriage of CO_2 at sea. The first-tier channels strict liability to the RSO for loss or damage to persons, property and the environment, including loss of profits and the costs of reasonable reinstatement measures.[135] This means the RSO of a CO_2-ship will be liable for damage caused by the hazardous nature of CO_2, regardless of fault on the part of the RSO, ship or crew. No liability will attach to the RSO where any of the predetermined exemptions are met, including where damage resulted from the personal act or omission of another, committed with intent or recklessness with the knowledge such damage would result.[136]

Where no exemption is applicable, the RSO must constitute a compensation fund for a sum representing their limit of liability which is determined by the tonnage of the ship, up to a maximum of 100 million SDR for the carriage of bulk CO_2.[137] All claims are channelled towards this compensation fund and the RSO cannot be pursued on other legal grounds.[138] RSOs engaged in CO_2-shipping must obtain an insurance certificate or financial security up to their limitation value and the Convention allows direct action against the P&I insurer.[139]

[134] ELD, Annex IV; Weber and Tsimplis, 'The UK liability framework', 148.
[135] HNS Convention, Articles 1(3), 1(6), 7.
[136] ibid, Articles 7(2), 7(3).
[137] ibid, Article 9(a); International Convention on Tonnage Measurement of Ships 1969 (adopted 23 June 1969, in force 18 July 1982) UNTS Volume 1291 Number 21264, 3.
[138] HNS Convention, Articles 7(4), 10(1).
[139] ibid, Article 12.

Funds will be distributed among the claimants in proportion to the amounts of their established claims, with loss of life and personal injury claims having priority.[140]

The second-tier of liability is engaged if the shipowner has insufficient funds to compensate, the shipowner is exempted or where damage exceeds the owner's limitation of liability.[141] Victims can look to the HNS Fund to provide compensation for damage up to a limit of 250 million SDR (including tier one compensation).[142] There is a general account divided into two sectors: bulk solids and other substances.[143] There are also separate accounts for oil, LNG and LPG.[144] Receivers importing over a specified quantity of HNS within the accounts are obliged to make initial and annual contributions to the Fund to meet the compensation costs of incidents arising within its sector.[145] The precise contributions payable are set on the basis of the quantities of HNS received by the contributing cargoes in the preceding year.[146]

This two-tiered system of liability simplifies the existing liability regime for North Sea CO_2-shipping incidents by harmonising the rules applicable to a broad range of claims. The channelling of strict liability to the RSO and the limitation of liability expediates the establishment and quantification of liability. It creates a consistent liability regime for CO_2-shipping, without the need for lengthy wrangling.[147] This makes it possible for RSOs operating cross-border CCS activities in the North Sea to properly quantify their risk exposure. The requirement for mandatory insurance, the availability of direct action and the fair prioritisation of the most serious claims ensures predictable compensation for victims of CO_2-shipping incidents.

Additionally, the Fund creates a balanced regime through the shared liability of RSOs and the HNS industry. By imposing liability on the receivers of CO_2 based on their import quantities, the Fund ensures the equitable apportionment of liability between stakeholders involved in CO_2-shipping. The Fund also ensures the availability of prompt and adequate financial

[140] ibid, Article 11.
[141] ibid, Article 14(1).
[142] ibid, Articles 14(5), 24.
[143] ibid, Article 16(1).
[144] ibid, Article 16(2).
[145] ibid, Articles 16(3), 17(1).
[146] ibid, Article 17(3).
[147] IOPC Funds, '*Compensation Matters – Consistent Application of 1992 Conventions: Submitted by the International Chamber of Shipping and the International Group of P&I Associations*,' IOPC/APR17/4/6 (London: IMO, 2017), 2.

compensation to victims of damage arising from CO_2-shipping incidents beyond what would otherwise be recoverable.[148]

The HNS Convention therefore creates a high level of certainty for victims, RSOs and other stakeholders, allowing them to coordinate contracts, risk assessments and insurance in compliance with this regime.[149] It provides legislative stability for investors and may encourage the deployment of CO_2-shipping.

4.2 Limitations of the Convention

Although the HNS Convention brings value to the harmonisation of the current regime for CO_2-shipping liabilities in the North Sea, there is also need for the Convention to be scrutinised in its application to the specific circumstances of CCS. The Convention will only bring a valuable contribution to the deployment of CCS where it is carefully tailored to the characteristics of the value chain.[150] Evidently, the Convention was not drafted with CCS in mind and there are difficulties in applying its provisions to these circumstances. These include the potential for continued application of the ELD, the reasonableness of imposing a strict liability standard and the difficulties of applying the Fund model to the unique contractual relationships in the CCS value chain.

4.2.1 Risk of continued fragmentation in environmental damage claims

A key aim of the Convention is to replace the disparity in the national and regional approaches to liability with a global, harmonised and better integrated liability regime. However, the complex scope of the HNS Convention may fail to entirely remove the existing liability regime for CO_2-shipping incidents in the North Sea. This risks the possibility of continued disparity between Member States.

[148] ibid, 2-3.
[149] ibid.
[150] Pop, 'The EU Legal Liability,' 41.

Application of the Convention depends on the type of damage suffered, the jurisdictional zone in which damage occurred and whether the ship is registered by a State Party.[151] Where the HNS incident occurred in the TS, any damage within the scope of the Convention is recoverable. Where the incident occurred within the EEZ (or equivalent area), environmental damages are recoverable but personal injury and property damage claims are only recoverable where the ship is registered by a State Party. Where the incident occurred on the High Seas, all damages are recoverable provided the ship is registered by a State Party. The costs of preventative measures are recoverable wherever taken.

The ELD states it will not apply to environmental damage arising from an incident in respect of which liability falls within the scope of the HNS Convention.[152] The question is whether the ELD applies where the incident falls out with the scope of the Convention. The absence of wording expressly stating the ELD will apply in certain circumstances indicates the drafters may not have intended its continued application. However, the complex geographical scope of the Convention leaves open the possibility of the ELD applying after entry into force of the Convention.[153] This will depend on the specific circumstances of the case; however, it risks the imposition of different liability regimes for damages arising from the same incident in the North Sea. Fragmentation with regards to the transposition of the ELD in Member States adds another layer of complexity to the liability regime for CO_2-shipping as the scope of national instruments may extend environmental damage liability beyond the intended scope of the Convention.

Additionally, the HNS Convention applies from the period of time commencing when CO_2 'enter[s] any part of the ship's equipment, on loading, to the time it ceases to be present in any part of the ships equipment, on discharge'.[154] In contrast, the ELD applies to the entire duration of occupational activities, from the moment the transport operator gains decisive economic power until that control extinguishes or passes to another.[155] The liability period of the ELD may therefore be longer than the Convention where the RSO has control over operations prior to the cargo entering the ships equipment.[156] Although this ensures

[151] IMO, *'An Overview of the International Convention on Liability and Compensation for Damage in connection with the Carriage of Hazardous and Noxious Substances By Sea, 2010 (The 2010 HNS Convention),'* LEG 98/4/1 (London: IMO, 2011), 2.
[152] Article 4(2); Weber and Tsimplis, 'The UK liability framework', 152.
[153] Boekholt, *'Regulation of liability,'* 37-38.
[154] HNS Convention, Article 1(9).
[155] ELD, Article 2(6).
[156] Weber and Tsimplis, 'The UK liability framework', 162.

environmental accountability of operators throughout the value chain, by providing a fall-back liability regime for circumstances where the HNS Convention does not apply, it may fail to entirely remove the application of the ELD as intended.[157]

Given the benefits of regulating the maritime industry on a global level, it is unsatisfactory that the ELD may continue to apply to environmental damage arising from a CO_2-ship after entry into force of the Convention. It will fail to ensure consistency in liability standards during cross-border shipping in the North Sea and retain the implications of fragmentation in the current regime. As entry into force of the Convention nears, the EC should provide guidance on the application of the ELD to HNS incidents at sea. Specifically, they should ensure that application of the ELD is removed where incidents fall wholly or partly under the scope of the HNS Convention. This will ensure RSOs can quantify their risk prior to engaging in CCS and encourage early investment in large-scale CO_2-shipping. Guidance could also advocate aligning the liability periods of the RSO through contractual arrangements in which the port operator assumes legal responsibility for cargo until it enters the ship's equipment.

4.2.2 Reasonableness of imposing strict liability on RSOs

The Convention aims to remove inconsistencies in the current regime with regards to the diversity of liability thresholds. Although this brings greater uniformity, it may not be appropriate to impose strict liability where the purpose of transportation is CCS.

Exposure to strict liability for damage caused by CO_2-shipping will be a consideration for RSOs engaging in CCS, particularly as the HNS Convention may impose higher limits of liability than the LLMC.[158] However, it must be questioned whether the imposition of strict liability is fair considering the social value of CCS. It has been heralded as a vital technology to prevent climate change and its adverse consequences. Additionally, deployment of CCS in the North Sea has been actively encouraged by the EU as a means of achieving emissions

[157] UK Government, '*Environmental Liability Directive*,' para 35.
[158] IMO, 'Convention on Limitation of Liability for Maritime Claims (LLMC),' last accessed 05/09/2018, http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/Convention-on-Limitation-of-Liability-for-Maritime-Claims-(LLMC).aspx.

reduction targets under the UNFCCC.[159] It is arguable whether operators engaging in CCS should be subject to potentially large liabilities where there is no fault on their part. This is particularly relevant given that large-scale CCS is not yet commercially viable and the activities are not merely conducted for pure commercial gain.[160] In fact, many CCS projects are backed by economic support from North Sea State governments.[161] The Convention provides for only limited exemption to strict liability and does not consider circumstances where the activity was carried out for the public good. The imposition of strict liability in CCS therefore creates an unfair apportionment of responsibilities between the public and private sphere given the inevitable risks associated with deploying climate mitigation technologies.[162] This will remain true during the early investment stages where full-scale value chains are not yet proven.[163]

The maritime industry has a long history of operating under strict but limited liability standards for shipping incidents. This system provides certainty within the industry through the use of insurance providers and the provision of security guarantees. Liability based on fault is highly dependent on the specific circumstances of the case such as the jurisdiction where the incident occurred, the foreseeability of the damage and whether the RSO failed to take adequate safety precautions or properly instruct their crew.[164] Removing the strict liability standard of the HNS Convention and reverting to a fault-based regime may therefore provide less certainty with regards to cross-border CO_2-shipping and may disincentivise investment in shipping-based CCS.

An alternative solution could be the inclusion of indemnity provisions in the charterparty which allow the RSO to seek recourse action against the charterer; who may be in a stronger financial position. The Convention does not rule out the possibility of recourse action against charterers of HNS ships.[165] Where a vessel is chartered for the purposes of CCS, the charterer

[159] EC, *'Communication from the Commission to the European Parliament, Council and European Economic and Social Committee on the Future of Carbon Capture and Storage in Europe'* COM(2013) 180 final (Brussels: EU, 2013), 11-12.
[160] Forbes and Verma, 'CCS Guidelines,' 8.
[161] Norwegian Ministry of Petroleum and Energy, *'The Norwegian Government continues with the planning of a demonstration project for CO_2 capture, transport and storage'* Press Release No.025/2018, proposed funding of 280 million NOK for Norwegian CCS demonstration projects.
[162] Pop, 'The EU Legal Liability,' 48.
[163] IEA, *'Five keys to unlock CCS investment'* (Paris: IEA, 2018), 13.
[164] Global CCS Institute, *'ROAD CCS,'* 61*;* Global CCS Institute/UCL, *'Legal liability,'* 24.
[165] HNS Convention Article 7(6) and 18; Chris Hendriks, M.J. Mace and Rogier Coenraads, '*Impacts of EU and International Law on the Implementation of Carbon Capture and Geological Storage in the EU,*' Order of the EC (London/Utrecht: ECOFYS and FIELD, 2005), 121.

is likely to be the capture operator or perhaps, the North Sea State providing funding for the project. The availability of indemnity would depend on the provisions of the charterparty, a product of commercial negotiation between the charterer and RSO. Analysis of existing standardised charterparties applicable to LNG transport indicates that the triggering of indemnity would require fault on the part of the capture operator.[166] However, it is possible that charterparties developed for CO_2-shipping would allow recourse action against the capture operator regardless of fault, to better balance the commercial risk. This may be necessary at least in the short-term until large-scale CO_2-shipping becomes a viable commercial enterprise.

4.2.3 Duty to cross-subsidise liabilities for other types of cargo

The second-tier of liability depends on the rules and procedures required by the HNS Fund. However, there are several difficulties in applying these rules due to the unique contractual relationships involved in CCS.

During negotiation of the Convention it became clear that constituting one account within the Fund would disadvantage industries which transport large volumes of HNS cargo by sea.[167] In view that high volume cargoes would not necessarily be more hazardous, it would be unfair to oblige these industries to cross-subsidise liabilities arising from HNS carried in lower volumes.[168] The LNG industry also maintained that, given their exceptional safety record, the sector should not be expected to make contributions for liabilities incurred by more dangerous cargoes.[169] This led to the formation of separate accounts within the Fund. At the time of drafting, large-scale CO_2 transportation was not envisaged by the Convention and there is no separate CO_2 account.[170] This means second-tier compensation claims arising from CO_2-shipping will fall to the general account ('other HNS' sector). Receivers importing over 20,000 tonnes of bulk CO_2 transported by ship are required to make contributions to the general account on the basis of the quantity of total CO_2 received in the preceding year.[171] Feasibility studies for CO_2-shipping envisage the carriage of up to 50,000 tonnes of CO_2 per

[166] ShellLNGTime 1 Charter Party (London: Shell, 2015), clause 29(a).
[167] Balkin, '*The HNS Protocol,*' 6-7.
[168] ibid, 7.
[169] ibid.
[170] Boekholt*, 'Regulation of liability,'* 55.
[171] HNS Convention, Article 18(1).

voyage.[172] Accordingly, large-scale receivers of CO_2 for the purposes of storage could be obliged to make large contributions to the Fund. This could have detrimental effects to dissemination of CCS technology which is not yet commercially viable. It may also seem unfair to require high contributions from CO_2-shipping considering safety records are projected to be similar to the LNG industry. In fact, risks of CO_2-shipping are not seen as significant compared to LNG because CO_2 is not combustible.[173] The CO_2-shipping industry therefore has strong merits to argue for the inclusion of an additional separate CO_2 account.[174] This would better protect the CCS industry from liabilities to the Fund by ensuring CO_2 receivers are only faced with claims resulting from incidents involving their sector.

For the Fund to operate effectively, each sector must be able to sustain their separate account through sufficient contributions from the industry. Until specified thresholds of contributing cargo are met, all claims will be managed out of the general account to ensure the sector has the capacity to compensate claims arising from contributing cargo.[175] Given the predicted growth of CCS, it is feasible that large-scale CO_2-shipping could support any compensation claims arising from the industry. This would support the amendment of the Convention through the establishment of a separate CO_2 account ahead of large-scale CCS.

Nevertheless, the division of the Fund into four accounts was organised in accordance with the character traits of each substance. HNS listed within the general account therefore have coherent chemical traits which are distinguished from LNG, LPG and oil cargoes. It could be argued that if CO_2 is not significantly, characteristically different from the other substances in the general account there is no real justification for the inclusion of a separate CO_2 account.[176] Whilst this may be true, it fails to properly protect stakeholders disseminating climate mitigation technologies which are not yet commercially viable. There is clearly justification for the inclusion of a separate CO_2 account where the purpose of transportation is CCS. Notwithstanding there would need to be debate on whether a new account would apply only to receivers of CO_2 for the purposes of storage, or whether it would also include CO_2 received for other purposes. There may also be a need for caution in the creation of a new

[172] Mitsubishi Heavy Industries, *'Ship Transport',* 19.
[173] ibid, 8.
[174] Boekholt*, 'Regulation of liability,'* 47, 51.
[175] HNS Convention, Article 19(1); Weber and Tsimplis, 'The UK liability framework,' 164.
[176] Jan Engel de Boar (Senior Legal Officer, Legal Affairs and External Relations Division of the IMO), personal interview with author (London: IMO headquarters, 14/09/2018).

account on the grounds of climate mitigation as it may open the door to other substances within the general account, such as hydrogen, arguing for separate accounts in the future.

4.2.4 Unsatisfactory definition of 'receivers' in offshore storage activities

When applying the principles of the Fund to CCS, it is not clear who the receiver of CO_2 is for the purposes of contributing to the general account. To ensure equity in the sharing of liability, there may be a need to separately define the receiver in CCS operations.

Receivers are defined as 'the person who physically receives contributing cargo which is discharged in the ports or terminals of a State Party'.[177] In offshore CCS, the person physically receiving CO_2 from the RSO is the operator of the offshore structure receiving CO_2 for injection; as offshore structures fall within the meaning of 'ports and terminals'.[178] In accordance with the Convention, the storage operator would therefore be liable to make contributions to the Fund for the quantity of CO_2 received. Even if damage as a result of CO_2 incidents at sea is unlikely or nominal, storage operators would remain liable to the general account for incidents involving other hazardous contributing cargo. It may therefore be unfair to impose such liabilities on storage operators for liabilities incurred during CO_2-shipping activities. This is particularly relevant given storage operators do not have the same interest in receiving HNS cargo as a stakeholder in the HNS industry. The Convention aims to share liability between RSOs and the HNS industry but was not drafted to account for circumstances where the receiver has no commercial use for the delivered substance (beyond their contractual obligations). It is therefore arguable whether storage operators engaging in CCS are 'receivers' within the meaning of the Convention. Given the vast quantities of CO_2 that could be transported on ships for storage, the obligation to make large contributions to the general account may disincentivise the involvement of offshore operators in storage activities.[179] It may also encourage storage operators to favour pipeline transportation to the injection facility as there would be no equivalent liability under the pipeline regime.

The creation of a separate account for CO_2 incidents applicable only to CCS activities may provide a justifiable compromise to offshore storage operators, ensuring their liabilities to the

[177] HNS Convention, Article 1(4).
[178] Boar, personal interview with author, 14/09/2018.
[179] Boekholt, '*Regulation of liability,'* 49-50.

Fund are confined to incidents involving CO_2. Alternatively, it may be more equitable to hold another party operating within the chain liable for contributions to the Fund. In considering the incentive for CCS in the North Sea, the capture operator has the economic interest in CO_2 being received as they do not have to surrender emission allowances to the EU ETS for permanently stored CO_2. With this in mind, it would perhaps be desirable for the capture operator to be liable for contributions to the Fund where transportation is for CCS. This may be deemed fairer than requiring the physical receiver at the injection facility to be liable under the shipping regime. It would also remove the possibility of storage operators favouring one transportation method over another.

There are three possible ways to channel liability to the Fund towards the capture operator. Firstly, the Convention states that where the physical receiver acts as an agent for another, the principal can be regarded as the receiver where they are disclosed to the Fund.[180] It is therefore possible for the storage operator to be regarded as an agent acting on behalf of the capture operator for the purposes of receiving CO_2.[181] However, this option proves difficult in practice as there is no third-party relationship and the storage operator will have a conflict of interest as a result of the storage contract with the capture operator. The law of agency could therefore make it difficult to establish a principal-agent relationship.

Secondly, the Convention allows national jurisdictions to impose unilateral definitions for the purposes of identifying the receiver; provided total contributing cargo received according to the national law is 'substantially the same' as that which would have been received under the Convention. Given the quantity of CO_2 received would be equivalent to that received by the storage operator, national laws could define the capture operator as the receiver where the purpose of CO_2-shipping is CCS. This option would allow individual States to channel liability towards the capture operator but would fail to ensure consistency in the application of the Convention to cross-border activities. It would result in fragmentation between North Sea States and fail to provide guarantees to storage operators operating in a number of jurisdictions that they will not be liable to make contributions.

The most convincing argument for channelling liability towards the capture operator stems from the definition of receiver in the LNG account. The LNG account allows the physical receiver of contributing cargo to direct liability towards the titleholder of transported cargo

[180] HNS Convention, Article 1(4).
[181] Transport Canada, '*Presentation by Canada - Comparison of the HNS Convention with other regimes,'* Workshop on HNS Convention (London, IMO: 2018), 6.

immediately after discharge.[182] This modified approach was introduced to ensure protection for the unique contractual arrangements in place within the LNG transport industry. The option is therefore particularly relevant considering large quantities of CO_2 are anticipated to be transported on similar contractual terms to LNG.[183] Application of this provision to the transportation of CO_2 would allow the capture operator (the titleholder of CO_2) to be regarded as the receiver for the purpose of contributions to the Fund.[184] This would require prior contractual agreement between the capture and storage operators, where the capture operator assumes responsibility to the Fund and the storage operator informs the relevant State Party of such agreement.[185] It may also open the door to burden-sharing arrangements between the capture and storage operators with regards to contributions to the Fund.

4.2.5 Method of calculating contributions fails to account for leakages during injection

Under the HNS Convention, State Parties are subject to onerous obligations to MRV the quantities of CO_2 transported by ship.[186] However, the obligations raise important legal questions regarding what method of calculating received CO_2 would be used for the purpose of assessing contributions to the Fund.[187]

Contributions based on the amount of CO_2 received at the offshore structure, after unloading but prior to storage, would conform to normal practice under the Convention by ensuring operational leakages are deducted from final calculations of received cargo. However, this methodology fails to account for leakages during the injection process. This risks potential for discrepancies between the quantity of contributing cargo under the HNS Convention and the quantity of CO_2 reported as stored under the EU ETS. For example, the receiver is liable to the Fund for the total amount of CO_2 received at the offshore platform. They are also liable for any CO_2 leakage during the injection process through their obligation to surrender emission allowances for CO_2 not successfully stored. This creates the unsatisfactory position of the receiver being liable to pay contributions for the receipt of CO_2 not successfully stored and with no commercial value under the EU ETS. Although the loss of CO_2 during injection

[182] HNS Convention, Article 19(1)*bis*(b).
[183] Balkin, *'The HNS Protocol,'* 7.
[184] Boekholt*, 'Regulation of liability,'* 40.
[185] HNS Convention, Article 19(1)*bis*(b), 19(1)*bis*(c), 19(1)*bis*(d).
[186] ibid, Article 21.
[187] Weber and Tsimplis, 'The UK liability framework,' 165.

may simply be a part of the capture operators' commercial risk, the position may lead to operators favouring pipeline transport and stall the deployment of large-scale CO_2-shipping.[188]

It may be desirable for calculations to be assimilated with MRV procedures under the EU ETS. The calculation of contributing cargo could be based on the number of emission allowances retained as a result of successful storage. It would follow that one ton of CO_2 stored would provide the operator with one additional emission allowance, as well as one ton of contributing cargo. This would ensure the operator is only liable to the Fund for the amount of CO_2 successfully stored. Careful guidance for the calculation of received CO_2 would have to be formulated for Member States. Additionally, the Fund would have to establish differing calculation methods where the purpose of CO_2-shipping is not for CCS and the receiver does not receive benefit under the EU ETS. This would create a complicated system for calculating contributions for CO_2-shipping. In particular, it would require harmonisation between the global HNS Fund and the regional EU ETS.[189] Nevertheless, it could be a workable scenario as coordination would ensure efficiency and reduce the administrative burden of the Convention by allowing values monitored through one system to be applicable in the other.

4.2.6 Absence of GhG emissions liability

The HNS Convention does not impose liability for the release of CO_2 into the atmosphere. This is because the HNS Convention categorises CO_2 as a hazardous substance and does not recognise its GhG characteristics.

The transportation of CO_2 is unique compared to other HNS cargoes because CO_2 leakage contributes to climate change and its adverse consequences. At the time of drafting the 1996 Convention, climate change was not widely recognised as a matter of pressing concern in the maritime industry. There was therefore no justification for including provisions on GhG emissions liability for CO_2-shipping. More recently, the IMO has recognised the need to

[188] Boar, personal interview with author, 14/09/2018.
[189] HNS Convention, Article 15.

regulate GhG emissions from ships through their work on low-carbon shipping.[190] Their initial strategy for GhG emissions from the shipping industry focuses on reduction strategies for emissions from the ship and its ancillary functions.[191] It does not regulate leakage of CO_2 from cargo holds. This leaves a significant gap in the international liability regime for harms arising from CO_2-shipping incidents.[192] In the context of CCS, it must be questioned whether this is a satisfactory position given it is intended as a climate mitigation technology. Any leakage of captured CO_2 contradicts the ultimate objective of transportation and jeopardises the environmental integrity of the CCS value chain.

With this in mind, there may be a need for the HNS Convention to broaden the definition of 'damage' to account for the unique harm posed by the carriage of CO_2. Although this would impose an additional layer of liability on RSOs engaged in CO_2-shipping, it would do so only where the activities are linked directly to CCS.[193] The inclusion of climate damage from CO_2 cargoes within the definition of damage would remove concerns regarding the exclusion of shipping from the EU ETS.[194] If liabilities for loss of CO_2 cargoes are accounted for under the HNS Convention and other CO_2 emissions are addressed by the IMO's emissions reduction strategy, there would be full emissions accountability of the shipping phase in CCS. In turn, there would be strong justification for retaining the economic incentive of CCS under the EU ETS where shipping is utilised.

Despite the attractiveness of this option, there are practical challenges to imposing liability for GhG leakage at an international level which could prove critical. CO_2 leakages have a cumulative effect on climate change but specific emissions cannot be directly attributed to harm.[195] Where there is no ETS, there is difficulty in quantifying liability for GhG emissions because there are no emission permits, allowances or carbon markets to dictate the price of carbon. It is therefore unclear exactly how the imposition of GhG emissions liability would work in practice. Nevertheless, in the long-term, there may need to be a global push for the

[190] Resolution MEPC.304(72) on the initial IMO strategy on reduction of GhG emissions from ships 2018, in '*Note by the IMO to the UNFCCC Talanoa Dialogue: Adoption of the initial IMO strategy on reduction of GhG emissions from ships and existing IMO activity related to reducing emissions in the shipping sector'* (London, IMO: 2018), Annex I.
[191] IMO, 'Low carbon shipping and air pollution control,' last accessed 04/10/2018, http://www.imo.org/en/MediaCentre/HotTopics/GHG/Pages/default.aspx.
[192] Boekholt*, 'Regulation of liability,'* 47, 49-50.
[193] Mikunda and Haan-Kamminga*, 'Overcoming national and European,'* 18.
[194] Pop, 'The EU Legal Liability,' 48-49.
[195] Jutta Brunnee et al., 'Overview of legal issues relevant to climate change' in *'Climate Change Liability'* eds. Richard Lord et al. (Cambridge: Cambridge University Press, 2012), 23.

extension of the IMO's emissions reduction strategy to cover GhG emissions where the source of leakage is cargo. Of course, given the slow pace of development at the IMO level, this option is unlikely to be achievable before the establishment of large-scale CO_2-shipping in the North Sea.[196]

4.3 An adequate future liability regime?

The HNS Convention promotes the adoption of harmonised global rules for determining questions of liability for damages caused by CO_2-shipping incidents.[197] Channelling of liability to the RSO, compulsory insurance requirements up to the liability limitation, the possibility for direct action and the constitution of the Fund introduce an effective framework to ensure adequate compensation is awarded to victims of such incidents. The imposition of strict liability also ensures a level playing field for the shipping industry and removes much of the fragmentation present in the current regime. This ensures the imposition of predictable and consistent liabilities on RSOs in cross-border CO_2-shipping, allowing risk exposure to be properly quantified.

However, the HNS Convention was not drafted with CO_2-shipping in mind and therefore cannot provide the flawless liability regime necessary to encourage shipping-based CCS. There is need for greater clarity with regards to the Conventions application to CCS activities. In particular, there is a need to clarify the interaction between the Convention and the ELD in respect of CO_2-shipping incidents arising in the North Sea. It is also necessary to close the gap in international law with regards to GhG emissions liability where the source of leakage is cargo. The Convention has experienced four amendment cycles since its origins in 1984.[198] It is therefore unlikely that States will be willing to make amendments to the 2010 version prior to its entry into force.[199] Proposals to amend would likely undermine the Convention and stall its ratification. Caution should therefore be erred in recommending amendments given its valuable contribution to the unification of liability laws.

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[196] Edie.net, 'International Maritime Organisation 'too slow' on emissions strategy,' published 04/04/2018, https://www.edie.net/news/6/International-Maritime-Organisation--too-slow--on-emissions-strategy-/.
[197] IOPC Funds, *'IOPC Funds' Strategic Plan: Note by the Director,'* IOPC/OCT17/7/4 (London: IMO, 2017), 1.
[198] Diplomatic Conference on HNS (London: 1984).
[199] Boar, personal interview with author, 14/09/2018.

Additionally, many of the limitations of the Convention's application to CCS activities may be better understood following entry into force of the Convention. Lack of real experience of cross-border CO_2-shipping makes it difficult to anticipate the precise challenges that may be encountered by RSOs.[200] The International P&I Association reported that between January 2002-2010, 192 HNS incidents were reported with 189 of these falling under the RSO's limit of liability.[201] Of the three remaining incidents, only one would have fallen to the Fund as two of the incidents occurred in jurisdictions unlikely to accede to the Convention (Brazil and the US).[202] This indicates that very few cases involving HNS are likely to require recourse to the second-tier of liability. Limitations regarding application of the Fund procedures to CCS-specific circumstances are, therefore, perhaps more theoretical than practical. Only after the establishment of shipping-based CCS in the North Sea, can the magnitude of the limitations be fully assessed through feedback from the CCS industry. If in practice real barriers emerge, amendments could be considered to better protect the commercial viability of such a socially valuable technology. This may include the creation of a separate CO_2 account within the Fund or the harmonisation of rules for MRV obligations under the Convention and the EU ETS. In the interim, many of the issues may be solved through the drafting of charterparties which carefully balance the commercial interests of stakeholders. It is also clear that once CCS becomes commercially viable, CO_2-shipping will be conducted for profit and there would perhaps be less need to protect the industry from the implications of the HNS Convention.

As long as the Convention is not in force, its provisions remain ineffective.[203] It is therefore necessary that the HNS Convention enters into force to bring certainty to the liability regime, before cross-border CO_2-shipping becomes a reality in the North Sea. There has been recent traction following the 105th Legal Committee Session Meeting (April 2018) which led to ratifications by Denmark and Canada. Preparations from Japan and South Korea indicate they will accede to the Convention in the near future and this will likely be followed by Sweden, Finland, the Netherlands and Germany.[204] Many of these States have prepared the documents necessary for accession but require more time to prepare the industry for the implications of

[200] Dixon, McCoy and Havercroft, 'Legal and Regulatory Developments,' 445.
[201] Steamship Mutual, '*P&I Club experience of HNS incidents,'* Workshop on the HNS Convention (London, IMO: 2018), 6.
[202] ibid.
[203] Boekholt*, 'Regulation of liability,'* 2, 52.
[204] Boar, personal interview with author, 14/09/2018.

ratification.[205] The UK has shown very little interest in ratification of the HNS Convention, indicating that ratification by certain States is not a priority. It is therefore important that widespread ratification of the Convention continue to be encouraged by the IMO and the EU.

[205] ibid.

5 INTEGRATION OF SHIPPING WITHIN THE CCS VALUE CHAIN

The HNS Convention provides a valuable contribution to the cross-border CO_2-shipping liability regime in the North Sea. However, the Convention cannot alone address the inadequacies of the current liability regime for cross-border CO_2-shipping. Despite evidence that shipping will be necessary to deploy CCS in the North Sea, existing EU frameworks fail to acknowledge the role of shipping within the CCS value chain. The exclusion of shipping from the CCS Directive means that CO_2 delivered from a ship for storage will not count as verified under the EU ETS.[206] There is therefore no GhG emissions liability imposed on RSOs for leakage of cargo during CO_2-shipping and no economic incentive for engaging in shipping-based CCS. This remains a real barrier to the deployment of CO_2-shipping in the North Sea and could hinder the development of CCS in countries reliant on long-distance transport options. It is therefore essential that CO_2-shipping be included in the CCS Directive and EU ETS to ensure the integration of shipping within the CCS value chain. This would also ensure the environmental integrity of CO_2-shipping activities by overcoming the gap in the international regime regarding GhG emissions liability for loss of cargo.

This chapter will consider the options for inclusion of shipping within the CCS Directive and EU ETS. It suggests that amendments to the CCS Directive and ETS Directive must be considered as a priority to ensure a balanced liability regime for cross-border CO_2-shipping in the North Sea. However, it will also identify several challenges which must be overcome to allow inclusion of CO_2-shipping within the EU ETS. It will conclude that inclusion of shipping within the CCS Directive and EU ETS is an effective option for ensuring the integration of CO_2-shipping within the CCS value chain.

5.1 Options for inclusion within the CCS Directive and ETS Directive

[206] Global CCS Institute/Bech-Bruhn, '*EOR/CCS,*' 25.

The inclusion of CO_2-shipping could be done on an ad hoc basis, through the use of the opt-in option of the ETS Directive, or through formal amendments to the CCS Directive and ETS Directive.

Under Article 24 of the ETS Directive, Member States may apply for the EC's approval to unilaterally include activities not listed in Annex I. However, it is questionable whether inclusion of shipping by the EC would be binding on other Member States in which the ship traverses for the purposes of CCS.[207] The case-by-case basis of including shipping within the ETS is untested and will not create the necessary conditions for long-term investment in cross-border CCS projects.[208] This is particularly relevant for the Baltic States which will be heavily reliant on the flexibility of shipping for long-distance transportation to the North Sea.[209] It is therefore suggested that the CCS Directive and ETS Directive be considered for amendments in order to explicitly incorporate CO_2-shipping where the purpose of transport is CCS.[210] This would provide a clear market signal with regards to the future of CO_2-shipping in the North Sea by formerly integrating CO_2-shipping into the CCS value chain. In turn, it may encourage a higher use of CO_2-shipping in CCS projects than the existing Article 24 opt-in inclusion process.[211]

In 2015, the EC concluded the CCS Directive was fit for purpose and there are no plans to review the Directive.[212] Nevertheless, there is a clear case for amendment of the CCS Directive to allow CO_2-shipping to develop as a commercially viable alternative to pipeline transport. The Directive does therefore not appear to be fit for purpose and amendment must be a priority for legislators.[213]

5.2 Challenges to inclusion within the EU ETS

5.2.1 Opposition from the international maritime industry

[207] Global CCS Institute/Bech-Bruhn, '*EOR/CCS,*' 25-26; Rydberg and Langlet, *'CCS in the Baltic,'* 72.
[208] Triple/RICARDO-AEA/TNO, '*Support to the review of Directive 2009/31/EC on the geological storage of carbon dioxide (CCS Directive): Final deliverable'* (Rotterdam: Trinomics, 2015), 127.
[209] Rydberg and Langlet, *'CCS in the Baltic,'* 48.
[210] Boekholt*, 'Regulation of liability,'* 52.
[211] Triple/RICARDO-AEA/TNO, '*Support to the review*,' 128.
[212] EC, '*Report on review of Directive 2009/31/EC on the geological storage of carbon dioxide,'* COM(2015) 576 final (Brussels: EU, 2015), 6.
[213] Rydberg and Langlet, *'CCS in the Baltic,'* 48.

Opposition from the international maritime industry due to the commercially sensitive nature of information required by MRV systems has thus far prevented shipping being included in the EU ETS.[214] The European Parliament proposed the inclusion of shipping in the ETS from 2023 unless the IMO introduced a system for GhG emissions liability by 2021.[215] Under the proposals, CO_2 emissions from ships arriving at or departing from ports within the EU would be subject to ETS permits and allocated allowances.[216] This move was heavily criticised by the maritime industry for impeding the work of the IMO in developing a climate mitigation strategy for shipping.[217] Since publication of the IMO emissions reduction strategy, there is concern that any further proposals to include shipping within the EU ETS would undermine (and overlap) the developing global regime by polarising debate.[218] However, there is perhaps a distinction between the inclusion of shipping for the purposes of CCS and the inclusion of all commercial shipping operations. The EU ETS does not currently impose liabilities on the operators of all pipeline systems; rather, the pipe must be used to transport CO_2 for the purposes of CCS.[219] It follows that the inclusion of shipping in the CCS Directive would not necessarily lead to the inclusion of all shipping operations in the EU ETS. Rather, the scope of GhG emissions liability under the EU ETS could be extended solely to ships transporting CO_2 for the purposes of storage in accordance with the CCS Directive.

5.2.2 Construction of emission permits and surrendering of allowances

In order for CO_2-shipping to be effectively integrated into the CCS value chain, RSOs would need to obtain an emissions permit from a Member State and they would be obliged to surrender allowances to that State for any leakages during transport. Under the EU ETS,

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[214] Edmund Hughes (Head of Air Pollution and Energy Efficiency, IMO Marine Environment Division). Personal interview with author (London: IMO headquarters, 17/08/2018); Per Kågeson, *'Linking* CO_2 *Emissions from International Shipping to the EU ETS'* Commissioned by the Federal Environment Agency, Germany (Stockholm: Nature Associates, 2007), 25, 26-27; World Maritime News, 'ICS, ESPO against Inclusion of Shipping in EU ETS,' published 16/02/2017, https://worldmaritimenews.com/archives/212959/ics-espo-against-inclusion-of-shipping-in-eu-ets/.
[215] Eva Grey, 'Shipping emissions: EU vs IMO?' Ship Technology, published 06/03/2017, https://www.ship-technology.com/features/featureshipping-emissions-eu-vs-imo-5753670/.
[216] ibid.
[217] World Maritime News, 'Shipping Should Not Be Included in EU Emissions Trading System?,' published 25/10/2017, https://worldmaritimenews.com/archives/233317/shipping-should-not-be-included-in-eu-emissions-trading-system/.
[218] MarineLog, 'ICS: CO_2 roadmap under fire from some NGOs,' last accessed 12/10/2018, https://www.marinelog.com/index.php?option=com_k2&view=item&id=23732:ics-co2-roadmap-under-fire-from-some-ngos&Itemid=257.
[219] Roggenkamp, 'Transportation of Carbon Dioxide,' 246.

operators are liable to surrender allowances to the State in which the Annex I installation is located. However, ships differ from other Annex I installations because they are not fixed structures and therefore move between jurisdictions.[220] Ships are subject to the jurisdiction of the flag State which may not be involved in CCS activities and may not be a member of the EU. This raises the question of whether it is the flag State or the Member State exporting CO_2 for storage who must report emissions to the EU ETS. It is also apparent that a flag State not falling within the scope of the EU ETS would not be eligible to apply for emission permits. One solution may be that shipping operators are liable to surrender emission allowances in the State which is exporting CO_2 for storage.[221] In practice, the RSO would require an emissions permit from the exporting Member State. Notably, requirements for pipeline transportation permits require the routes and functions of the pipeline to be predetermined during the active period of the permit. Emissions permits for ships would need to allow for greater flexibility to ensure shipping operations can be reactive to the needs of cross-border CCS projects.

5.2.3 Overlap with the global GhG emissions reduction strategy

The presence of adequate MRV systems is not only a precondition to integrating CO_2-shipping within the EU ETS, it is also critical to quantifying the operator's GhG emissions liability.[222] It would therefore be necessary for MRV regulations to be developed to allow inclusion of shipping within the EU ETS.[223]

The CCS Directive states that the transportation phase of CCS includes all ancillary plants functionally connected to the pipeline transport network.[224] Pipeline operators are liable to surrender emissions from 'any process functionally connected to the transport network, fugitive emissions, vented emissions and emissions from leakage incidents.'[225] This ensures accountability for the full life-cycle of CO_2 emissions from capture installation to post-injection. If these principles are applied to CO_2-shipping, the ancillary functions of the ship

[220] Rydberg and Langlet, *'CCS in the Baltic,'* 48.
[221] Birkeland et al., *'Improving the Regulatory Framework,'* 6.
[222] EC, '*Impact Assessment: Accompanying document to the Proposal for a Directive amending Directive 2003/87/EC so as to improve and extend the EU greenhouse gas emission allowance trading system,'* Staff Working Document COM(2008) 16 final (Brussels: EU, 2008), 49-50.
[223] Røkke et al., *'Building Nordic Excellence,'* 28; Nordbäck et al., '*CGS Baltic seed project,'* 51.
[224] CCS Directive, Article 3(22).
[225] Regulation (EU) No.601/2012, Annex IV, 22(A).

would be encompassed by the MRV regulations.[226] These principles would overlap with the IMO's emissions reduction strategy which includes CO_2 emissions from the operation of ships. To better secure acceptance of the inclusion of CO_2-shipping within the EU ETS, it is necessary that the EU not extend its remit into areas regulated by the IMO. This means MRV regulations should be limited to leakage of CO_2 from the cargo of the ship.

The EC has already adopted MRV rules for shipping despite its absence from Annex I of the ETS Directive. From January 2018, Regulation 2015/757 requires ships over 5000 GT calling at any EU/EFTA port, to monitor the port of departure and arrival, amount of fuel consumed, CO_2 emitted, and total transport work.[227] Accordingly, a system is already in place to monitor the weight and type of cargo carried on board ships, as well as the quantity of CO_2 emitted.[228] It may be possible for the generated results to be used as a means of quantifying GhG emissions liability for CO_2-ships used in CCS projects.[229] The Regulation could be used to verify the amount of cargo delivered for storage at the loading port and received at the unloading facility.[230] The European Sustainable Shipping Forum have developed technical rules for monitoring the quantities of cargo carried by ships included in Regulation 2015/757. These could be used to ensure best practices and accuracy in the methods of quantifying the amount of CO_2 received and delivered by CO_2-ships.[231] These rules are only applicable to the largest ships; however, the quantities envisaged for large-scale CO_2-shipping would likely meet this requirement. Where smaller ships are used, MRV regulations would need to be extended to ensure consistency across shipping-based CCS projects. This would ensure full environmental integrity of the CCS value chain by requiring RSOs to be liable to the EU ETS for any loss of cargo during CO_2-shipping, as well as liability under the IMO's global regime for other sources of CO_2-shipping emissions.

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[226] Lauri Kujanpää and Sebastian Teir, 'Implications of the new EU maritime emission monitoring regulation on ship transportation of CO_2,' *Energy Procedia* Volume 114 (2017): 7416, doi: 10.1016/j.egypro.2017.03.1871.7416.

[227] Regulation 2015/757 on the monitoring, reporting and verification of carbon dioxide emissions from maritime transport, amending Directive 2009/16/EC, Article 6 (3), 9(1) and Annex II; DNV-GL, 'EU MRV Regulation,' last accessed 04/10/2018, https://www.dnvgl.com/maritime/eu-mrv-regulation/index.html; DNV-GL, 'Preparing for the MRV regulation,' published 14/09/2016, https://www.dnvgl.com/news/preparing-for-the-mrv-regulation-revised-version--75297.

[228] European Sustainable Shipping Forum, '*Final report on the work of the MRV sub-group on Shipping MRV Monitoring,'* (Brussels: EU, 2016), 5; EC Implementing Regulation 2016/1928 on determination of cargo carried for categories of ships other than passenger, ro-ro and container ships pursuant to Regulation 2015/757.

[229] Kujanpää and Teir, 'Implications of the new,' 7419.

[230] Regulation 2015/757, Article 6(h)(ii).

[231] Kujanpää and Teir, 'Implications of the new,' 7421.

5.2.4 Insurance implications

Integration of shipping within the EU ETS introduces an unquantifiable level of liability for RSOs as there is inherent uncertainty in the price of emission allowances on the market during the compliance cycle.[232] An RSO contracting to transport CO_2 will be liable to pay for any leakage of cargo. There is a risk the value of CO_2 during transportation changes and effects the RSOs liability exposure, altering the commercial balance of the transport document.[233] At present, there exists no type of insurance that would cover RSOs for this type of liability as there are difficulties in quantifying leakage risk.[234] During the start-up phase of large-scale CO_2-shipping, these uncertainties could lead to high insurance premiums for RSOs which may discourage investment. It is therefore imperative that a proper insurance framework be developed for circumstances where shipping is included in CCS projects.[235]

5.3 An effective option for integrating shipping within the CCS value chain?

It is clear that there are challenges to integrating CO_2-shipping into the EU ETS; however, these challenges can be overcome through carefully defining the scope of inclusion and the content of MRV regulations, as well as the establishment of an insurance framework for GhG emissions liability.

Ultimately, the EU must facilitate the integration of shipping within the CCS value chain by establishing a business case for shipping-based CCS. This is best achieved by formal amendments to the CCS Directive and ETS Directive which will send strong market signals to investors that shipping is an integral transport option for deploying CCS in the EU. Additionally, it would protect the environmental objective of CCS by imposing GhG emissions liability for CO_2 leakage from a ships' cargo during the transport phase of CCS. The inclusion of CO_2-shipping within the EU ETS will therefore create a more balanced

[232] Mikunda and Haan-Kamminga, *'Overcoming national and European*,' 19.
[233] Pop, 'The EU Legal Liability' 48-49.
[234] Vos, *'Linking the Chain',* 116-117.
[235] This requires greater stability of the carbon price. See EU measures to this end: EC, 'Market Stability Reserve,' last accessed 11/10/2018, https://ec.europa.eu/clima/policies/ets/reform_en.

liability regime for cross-border CO_2-shipping in the North Sea and allow it to develop as a viable alternative to pipeline transport.

6 CONCLUSIONS AND RECOMMENDATIONS

An effective legal liability regime for CO_2-shipping in the North Sea would balance the environmental objective of CCS in reducing CO_2 levels in the atmosphere with the need to ensure activities throughout the value chain are commercially attractive to investors. The current regime for CO_2-shipping liability in the North Sea fails to achieve this balance for two reasons. Firstly, it creates inconsistencies and fragmentation with regards to the standards of liability during cross-border transportation in the North Sea. This uncertainty disincentivises investment in cross-border CO_2-shipping because it is challenging and costly for RSOs to quantify their risk exposure. Secondly, existing EU frameworks fail to acknowledge the potential role of shipping within the value chain. Exclusion of shipping from the CCS Directive and EU ETS means that there is no GhG emissions liability for loss of captured CO_2 during CO_2-shipping. This not only fails to properly protect the environmental integrity of the chain by not accounting for CO_2 emissions from the ship's cargo, it also means there is no economic incentive for shipping-based CCS in the North Sea. This could prove detrimental to the large-scale deployment of CO_2-shipping.

In light of these inadequacies, there is need for reform of the current regime for cross-border CO_2-shipping in the North Sea. Entry into force of the HNS Convention would bring greater clarity to liabilities for cross-border CO_2-shipping by reducing fragmentation between North Sea States through the global harmonisation of standards. This not only incentivises investment in large-scale CO_2-shipping but ensures adequate compensation is awarded to victims of such incidents. Of course, it is acknowledged that the Convention may not establish a flawless regime for CO_2-shipping liability where the purpose of transportation is CO_2 storage. In particular, it may be necessary to consider the formation of a separate CO_2 account to ensure the CCS industry do not have to cross-subsidise incidents arising in other sectors. It may also be desirable for liabilities to the Fund to be directed towards the capture operator to ensure storage operators do not favour pipeline transportation. Nevertheless, given the infancy of full-scale CCS, the precise consequences of the Convention may be better assessed when there is practical experience of large-scale CO_2-shipping. This is important because the exact consequences of large-scale CO_2 leakage and the magnitude of potential liabilities are unknown. There is great confidence within the sector, with safety records projected to be similar to the LNG industry. If these results transpire, many of the concerns regarding application of the Convention to CO_2 storage will be removed. With this

in mind, it is important that the IMO and EU continue to put pressure on States to ratify the Convention, particularly States situated around the North Sea which have shown no signs of ratifying.

Additionally, the EU must seek to integrate shipping within the CCS value chain. A failure to impose GhG emissions liability for CO_2 leakage during the transport phase of CCS, including those from a ships' cargo, fails to protect both the environmental and commercial objectives of CCS. As a matter of priority, the CCS Directive and ETS Directive must be amended to impose liability for loss of containment of CO_2 during the shipping phase of CCS. This will ensure the comprehensive regulation of all the types of damages which could arise from CO_2 leakages and establish an economic incentive for CO_2-shipping in the North Sea. It will therefore create a more effective liability regime for CO_2-shipping by ensuring the environmental integrity of the CCS value chain, whilst encouraging investment in shipping-based CCS.

The IPCC's 2018 Report highlighted that 'the decisions we make today are critical in ensuring a safe and sustainable world for everyone'.[236] If shipping-based CCS is to play a role in the global fight against climate change then the legal liability framework proposed should be implemented as a matter of urgency.

[236] IPCC Press Release, 'Summary for Policymakers of IPCC Special Report on Global Warming of 1.5ºC' 2018/24/PR, last accessed 29/10/2018, http://ipcc.ch/pdf/session48/pr_181008_P48_spm_en.pdf, 2.

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