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European Regulatory and Insurance Aspects of Carbon Capture and Storage

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Abstract

Carbon capture, use and storage has the potential to significantly reduce carbon emissions, however, because carbon capture, use and storage technology almost exclusively aims for carbon mitigation without co-benefits, this expensive technology has not been widely adopted. In order to make this technology viable, a robust regulatory and legal regime is required both internationally and within the European Union. A comprehensive insurance system is also required to ensure that efficient running of carbon capture, use and storage. With this understanding in mind, this paper analyses the regulatory regime governing carbon capture, use and storage both internationally and in the European Union and also the law governing insurance of this technology. It argues that whilst European regulation has improved with respect to filling regulatory gaps, a number of gaps are identified which still need to be closed. In addition, the paper will argue that special insurance coverage for specialized risks must be in place to diminish any environmental impact and hazard, including cyber-related risks that need to be identified and insured to be properly handled and adequately covered to allow for the successful deployment of carbon capture, use and storage.

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1.0. Introduction

International and European climate agreements call for mitigation techniques—such as carbon capture, use and storage (CCUS)—to reduce carbon emissions and minimize climate change's worst impacts. As CCUS technology is expensive and most applications have only offered CO_2 mitigation options without co-benefits, there has been limited deployment across the European Union.[1] In addition to the financial burden of CCUS, international and European law has been relatively slow in creating a solid legal framework within which to operate. This article contends that in order for CCUS to effectively fulfil the EU's carbon reduction targets, a robust regime is required with respect to legal and insurance matters.

Despite the fact that carbon capture, use and storage technology has been in development since the 1970s, international and European law has only recently been catching up with respect to providing comprehensive legal regulation of the industry. This paper will begin by outlining the regulatory background of CCUS in the European Union, and extent to which the EU intends to promote the technology. The paper will then move on to discuss key international and European legislation relating to CCUS and will conclude that whilst the law of the European Union has developed with respect to CCUS, there are still regulatory gaps that need to be closed in order to provide better regulation for the technology. The paper will then move on to discuss the types of insurance that should be underwritten in order to provide coverage throughout the operation of CCUS. It will outline the way such insurance risks should be identified and worded, potential deductibles and exclusions, and the need for special insurance coverage for environmental pollution and other environmental risks, as well as cyber risks.

2 The need for Carbon Capture, Use and Storage in the European Union

[1] As of the summer 2021, 13 different European countries had announced more than 40 different carbon capture and storage projects, however the majority were yet to become operational. See Lee Beck, 'Europe's Carbon Capture pipeline: 40+ projects. But where's the policy support and market creation?' (*energypost.eu*, 22 June 2021) <https://energypost.eu/europes-carbon-capture-pipeline-40-projects-but-wheres-the-policy-support-and-market-creation/> accessed 12 July 2022.

Climate change is the greatest threat facing mankind. This is an indisputable fact that world leaders have been confronted with for many years. But with the ever-increasing severity of climate change induced weather patterns,[2] recent global protests from younger generations,[3] and a regional shift toward more urgent, strict climate actions (such as achieving climate neutrality), it is clear that mitigation and prevention actions are urgently needed to tackle the current reality of climate change and its increasingly dangerous threat, and that civic interest is in favour of such actions.

In 2015 at COP21 in Paris, world leaders reached a landmark agreement, the Paris Agreement,[4] which aims to combat climate change and mobilize actions needed for a sustainable low carbon future. The Paris Agreement was created with an overall target of keeping global temperature rise this century to well below 2℃ above pre-industrial levels, with an expressed desire to limit this even further to 1.5℃.[5] In addition, the Paris Agreement also contains provisions relating to the conservation and enhancement of sinks and reservoirs of greenhouse gas emissions (article 5), voluntary cooperation and market-based approach between signatories (article 6), the establishment of National Adaptation Plans (NAPs) (article 7), and the need for developed countries to continue to support the efforts of developing countries to build clean, climate-resilient futures (article 8). Of particular interest to this paper is article 5 of the Paris Agreement, which states that "Parties should take action to conserve and enhance, as appropriate, sinks and reservoirs of greenhouse gases".[6] Carbon sinks and reservoirs are systems (often natural) which absorb carbon dioxide from the atmosphere. Perhaps the most well-known nature-based examples are plants and forests, but soil and the ocean can also function as carbon sinks. For many years, climate scientists have explored the possibility of a man-made equivalent to store and use CO_2, known as carbon capture, use and storage (CCUS).

[2] 'Attributing extreme weather to climate change' (*Carbon Brief*) <https://www.carbonbrief.org/mapped-how-climate-change-affects-extreme-weather-around-the-world> accessed 12 July 2022.
[3] Sandra Laville, Jonathan Watts, 'Across the globe, millions join biggest climate protest ever' (*the Guardian*, 21 September 2019) <https://www.theguardian.com/environment/2019/sep/21/across-the-globe-millions-join-biggest-climate-protest-ever> accessed 12 July 2022; Fiona Harvey, 'Young people resume global climate strikes calling for urgent action' (*the Guardian*, 25 September 2020) <https://www.theguardian.com/environment/2020/sep/25/young-people-resume-global-climate-strikes-calling-urgent-action-greta-thunberg> accessed 12 July 2022.
[4] Paris Agreement, 12 Dec. 2015, 55(4) I.L.M. 740 (2016), entered into force 4 Nov. 2016.
[5] ibid, art 2.
[6] ibid, art 5.

CCUS is a collective term for a larger process which includes capturing CO_2 through a variety of methods, transporting it either through pipeline or by ship, using it and then storing it.[7] The Intergovernmental Panel on Climate Change has divided CCUS into three elements: 1) the separation of CO_2 from industrial and energy-related sources; 2) transport to a storage location and use of it in either chemical, industrial or biological applications (i.e., use as biofuels or other forms of renewable energy, construction materials, etc.); 3) long-term isolation from the atmosphere.[8] The first large-scale CCUS project began operating in Norway in 1996[9] and, as of 2020, there were 65 large-scale CCUS facilities globally at various stages of development. Twenty-one of these were in operation, 3 were under construction, 17 were in advanced development and 24 were in early development.[10]

While Europe took its first steps toward climate policy in 1990 after the IPCC issued its first report and established the European Environmental Agency,[11] the European Union (EU) has issued a number of laws since the Paris Agreement seeking to hasten climate action and the deployment of CCUS technology. In 2019, ahead of COP25, the EU Parliament issued a resolution declaring a climate emergency across Europe and the world, following worldwide movement of youth climate protests, and making Europe the first continent to do so. The resolution required the Commission to ensure all legislative and budgetary proposals align with the target of limiting global warming to less than 1.5℃.[12] At this point, the Parliament recommended cutting emissions by 55% by 2030 and becoming climate neutral by 2050. Parliament also issued a separate resolution for the EU to submit its strategy to achieve climate neutrality swiftly, and by no later than 2050. They also asked EU countries to double their contributions to the international Green

[7] Owain Tucker T, *Carbon Capture and Storage* (IOP Publishing Ltd 2018).
[8] Bert Metz, Heleen De Coninck, Ogunlade Davidson (eds) *Carbon Dioxide Capture and Storage: Special Report of the Intergovernmental Panel on Climate Change* (CUP 2005).
[9] The first operational carbon capture and storage project was the Steiper CO_2 injection project in Norway. For an appraisal of this project see, Anne-Kari Furre et al. '20 Years of Monitoring CO_2-injection at Sleipner' (2017) 114 Energy Procedia 3916.
[10] For recent statistics on global carbon capture and storage see, 'A new era for CCUS' (*IEA*) <https://www.iea.org/reports/ccus-in-clean-energy-transitions/a-new-era-for-ccus> accessed 12 July 2022.
[11] 'The European Environmental Agency' (*EEA*, 13 April 2021) <https://www.eea.europa.eu/environmental-time-line/1990s> accessed 12 July 2022.
[12] Thomas Haahr, 'The European Parliament declares climate emergency' (*European Parliament*, 29 November 2019) <https://www.europarl.europa.eu/news/en/press-room/20191121IPR67110/the-european-parliament-declares-climate-emergency> accessed 12 July 2022.

Climate Fund and phase out all direct and indirect fossil fuel subsidies by 2020 (now extended until 2025).[13]

The introduction of the European Green Deal and one of its central elements, the European Climate Law,[14] came a little over a week after the climate emergency declaration. In essence, the European Climate Law writes into law the goal set out in the European Green Deal for Europe's economy and society to become climate neutral by 2050.[15] In October 2020, Parliament adopted its position on the Climate Law that all EU members reach climate neutrality by 2050 and bumped up its 2030 emissions target from 55% to 60%, compared to 1990 levels.[16] In July 2021, the European Climate Law entered into force. Amongst other things, the Climate Law contains a greenhouse gas budget to ensure the EU meets its Paris Agreement targets. What's notable about the Climate Law compared to other named climate targets is that it is legally binding. Therefore, if an EU member fails to comply, the Commission can launch a formal infringement proceeding and take that country to an EU Court. If it fails to comply with an EU court ruling, it can be referred back to the court and ultimately fined. The Law includes measures for tracking progress and adjusting actions in accordance with noted progress.[17]

Further, the period leading up to these benchmark years can be seen in the context of *transitioning* to a climate neutral Europe. Frequently this period is judged through the lens of fairness and justice, where a just transition is considered a method of making the economy climate neutral "that is as fair and inclusive as possible to everyone concerned, creating decent work opportunities and leaving no one behind".[18] In line with this aim, in July 2021, the European Commission provided guidance to EU members on how to handle the social and labour elements

[13] Thomas Haahr, 'EU climate law: MEPs want to increase 2030 emissions reduction target to 60%' (*European Parliament*, 8 October 2020) <www.europarl.europa.eu/news/en/press-room/20201002IPR88431/eu-climate-law-meps-want-to-increase-2030-emissions-reduction-target-to-60> accessed 12 July 2022.
[14] Regulation (EU) of the European Parliament and of the Council 2021/1119 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 [2021] OJ L 241/1 "European Climate Law".
[15] ibid, art 1.
[16] Johanna Store, 'Council adopts European climate law' (*European Council*, 28 June 2021) <https://www.consilium.europa.eu/en/press/press-releases/2021/06/28/council-adopts-european-climate-law/> accessed 12 July 2022.
[17] 'Infringement Procedure' (*European Commission*) <https://ec.europa.eu/info/law/law-making-process/applying-eu-law/infringement-procedure_en> accessed 12 July 2022.
[18] 'Frequently Asked Questions on just transition' (*International Labour Organization*) <https://www.ilo.org/global/topics/green-jobs/WCMS_824102/lang--en/index.htm> accessed 12 July 2022.

of a just transition toward climate neutrality.[19] Also, and importantly, a complete transition to climate neutrality requires noting which industries cannot become climate neutral without intervention, making CCUS a particularly valuable and necessary technology to ensure a shift toward climate neutrality. Whilst criticisms have been led against CCUS from an environmental standpoint based on the fact that the technology focuses on mitigation of climate change rather than prevention,[20] it is becoming increasingly evident that carbon mitigation of all varieties is needed in order to prevent global environmental disaster.

3. Overcoming the International and European Legal Barriers for Carbon Capture, Use and Storage

Despite the fact that carbon capture, use and storage plays a big part in the agenda to tackle climate change, existing international and European law aimed at protecting the environment has needed to play catch up and change dramatically to ensure that the process of CCUS does not break the law and, consequently, help facilitate greater deployment of the technology. This section will analyse international law, followed by the law of the European Union relating to CCUS. This will be followed by an appraisal of the areas in which EU law needs to catch up in order to provide a clear regulatory system in which CCUS can progress.

3.1. International law

For many years, the transportation and storage of CO_2 has neither been expressly prohibited or authorized by international environmental law.[21] This has left stakeholders who wish to embark on CCUS projects, which involve the transportation of CO_2 from one state to another, in an unknown position with respect to international law. Due to the nature of international law requiring approval from multiple countries before it can enter into force, amendments to existing Conventions have taken a long time to put into place, and in some instances have still not been

[19] 'Questions and answers: A fair transition towards climate neutrality' (*European Commission,* 14 December 2021) <https://ec.europa.eu/commission/presscorner/detail/en/qanda_21_6823> accessed 12 July 2022.
[20] The following articles show how public opinion can be negative surrounding Carbon Capture and Storage, as opposed to alternative climate change mitigation techniques: Kevin P. F. Broecks et al., 'Persuasiveness, importance and novelty of arguments about Carbon Capture and Storage' (2016) 59 Environmental Science & Policy 58; Sander van Egmond, Marko P Hekkert, 'Argument map for carbon capture and storage' (2012) 11 International Journal of Greenhouse Gas Control S148.
[21] European law on the other hand has taken a much firmer approach to the question, as outlined below.

resolved today. This can be seen upon examination of the ways in which the Basel Convention, the United Nations Convention on the Law of the Sea (UNCLOS), and the London Convention approach the regulation of CCUS.

The Basel Convention[22] entered into force in 1992 with the aim of establishing a global regime to control international trade of hazardous waste. Today, the Convention has 53 signatories; however, the US has not ratified the Convention's requirements. Substances and their characteristics of what constitutes 'hazardous waste' fall within Annexes I to III of the Convention. If a substance is categorized as a 'hazardous waste' under the Convention, parties are bound by a number of general obligations relating to the manner in which they handle the waste, particularly under article 4(2). Previously, there was concern over whether the Convention would pose an obstacle for the transportation of carbon dioxide;[23] however, as carbon dioxide is not listed in any of these annexes, it should be concluded that the transportation of carbon dioxide will not be restricted by the provisions of the Convention.

Despite not being explicitly named a hazardous substance that falls within the remit of the Convention, CO_2 does contain some of the hazardous characteristics that are outlined in Annex III of the Convention in certain circumstances. Under Annex III, there are 14 separate characteristics of substances that could constitute a hazardous nature. CO_2 would fall under categories such as corrosiveness and toxicity.[24] It is also possible that carbon capture and storage could fall within the remit of the Convention under Annex IV which covers activities such as injection and storage of waste.[25] In 2005, an IPCC report argued that CO_2 would only fall within the remit of the Basel Convention if it were to be mixed with another substance that is deemed hazardous by the Convention, but this interpretation has not been agreed or confirmed.[26] This area of law shows that there is a legislative gap in the Convention with respect to CCUS which requires further clarity.

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[22] Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, 22 March 1989 (1673 U.N.T.S. 126) ("The Basel Convention").

[23] Andy Raine 'Transboundary transportation of CO_2 associated with carbon capture and storage projects: An analysis of issues under international law' (2008) 2008 Carbon & Climate L Rev I 353.

[24] 'UCL Carbon Capture Legal Programme. CO_2 transport for storage: Regulatory regimes – Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, 1989 (Basel Convention)' (*UCL Carbon Capture Legal Programme*) <https://www.ucl.ac.uk/cclp/ccstransport-int-waste-basel.php> accessed 12 July 2022.

[25] The Basel Convention (n 22) annex IV.

[26] 'Transboundary carbon capture and storage project activities: Technical Paper' (*United Nations Framework Convention on Climate Change*, 1 November 2012) <https://unfccc.int/resource/docs/2012/tp/09.pdf> accessed 12 July 2022.; Viviane Romeiro, Virginia Parente, 'Carbon capture and storage and the UNFCCC: Recommendations to address trans-boundary issues' (2012) 3 (3A) Low Carbon Economy 130.

Another major piece of international legislation governing the environmental protection of oceans is the United Nations Convention on the Law of the Sea (UNCLOS).[27] The main provisions relating to environmental protection can be found in Part XII of the Convention. At present, this Convention has 158 signatories and 168 parties.[28] The Convention outlines a set of rules and regulations for different areas of the seabed and includes some key provisions on preventing pollution in these areas. The Convention divides the ocean into the following zones: territorial sea, contiguous zone, the exclusive economic zone, the continental shelf, the high seas and the area. Each zone has its own set of provisions regulating it. Article 192 contains a general obligation on states to "protect and preserve the marine environment"[29] and Article 195 states that "in taking measures to prevent, reduce and control pollution of the marine environment, States shall act so as not to transfer, directly or indirectly, damage or hazards from one area to another or transform one type of pollution into another".[30] It is not clear as to whether CO_2 constitutes a hazardous substance or pollutant under UNCLOS; however, it is also clear that it is not prohibitively banned by this Convention.

UNCLOS does provide certain restrictions on transporting CO_2 by ship and by pipeline, depending upon the ocean zone through which the CO_2 is being transported. For pipelines to be laid in territorial seas, consent will be required from all states whose territorial sea is crossed with the pipeline, and states can also object to the laying of pipes in their exclusive economic zone and continental shelf. As the high seas do not fall under the jurisdiction of any one state in particular, no permission is needed to lay pipelines in this area. Regarding the transportation of CO_2 by ship, this is permitted through all designated areas of the ocean, but care must be taken to ensure that the regulations for each area are met when ships pass through. Overall, it can be concluded that UNCLOS does not prohibit CCUS; however, stakeholders must take care to ensure they abide by the Convention's provisions when transporting CO_2.

Finally, another significant international convention which applies to the transportation of CO_2 is the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other

[27] United Nations Convention on the Law of the Sea 1982, 1833 UNTS 3 ("UNCLOS").
[28] 'Status of the United Nations Convention on the Law of the Sea' (*United Nations*) <https://treaties.un.org/pages/ViewDetailsIII.aspx?src=TREATY&mtdsg_no=XXI-6&chapter=21&Temp=mtdsg3&clang=_en> accessed 12 July 2022.
[29] UNCLOS (n 27), art 192.
[30] ibid, art 195.

Matter 1972, also known as the London Convention.[31] This Convention entered into force in 1975 and aimed to protect the marine environment from the deliberate disposal of waste and other matter. In 1996, the London Protocol was added to the Convention to modernize the Convention's requirements.[32] The Protocol entered into force in 2006. The Convention prohibits the dumping of substances outlined in Annex I, and states that substances outlined in Annex II can only be dumped if a permit has been obtained. As with the Convention named above, CO_2 was not listed as a substance that falls within either Annex I or II and is, therefore, not prohibited under the Convention.

In order to clarify the situation and ensure that carbon capture and storage projects will not fall under activities prohibited by the Convention, a proposal was submitted to amend Annex I of the London Protocol in order to include CO_2 storage as a permitted activity. This amendment entered into force on 10th February 2007. Within this amendment, detailed circumstances under which CO_2 streams may be considered for dumping were included:

> 1. Disposal is into a sub-seabed geological formation; 2. They consist overwhelmingly of carbon dioxide. They may contain incidental associated substances derived from the source material and the capture and sequestration processes used; and 3. No wastes or other matter are added for the purpose of disposing of those wastes or other matter.[33]

Since this time, a number of other amendments have been made to the Protocol.[34] In February 2008, a Legal and Technical Working Group on Transboundary CO_2 Sequestration Issues considered the compatibility of Article 6 with CCUS activities – particularly with respect to the transportation of CO_2 from one state to another before it is stored.[35] The group concluded that, as it stood, Article 6 prohibited the export of CO_2 from one contracting party to other countries, and

[31] Convention on the prevention of marine pollution by dumping of wastes and other matter 1972 (London) 26 UST 2403, TIAS 8165; UKTS 43 (1976) Cmnd. 6486, 11 ILM (1972) 1294. In force 30 August 1975. Replaced by 1996 Protocol. 1046 UNTS 120.

[32] Protocol to the Convention on the prevention of marine pollution by dumping of wastes and other matter, 36 ILM (1997) 7. In force March 2006. Amended in 2006

[33] Resolution LP.1(1) on the amendment to include CO_2 sequestration in sub-seabed geological formations in annex 1 to the London Protocol (Adopted on 2 November 2006).

[34] 'UCL Carbon Capture Legal Programme. Offshore Storage: International Marine Legislation – Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1996 (London Protocol)' (*UCL Carbon Capture Legal Programme*) <https://www.ucl.ac.uk/cclp/ccsprotocol.php> accessed 12 July 2022.

[35] Report of the 1st Working Group of the Legal and Technical Working Group on Transboundary CO_2 Sequestration (25 - 27 February 2008) [IMO Document LP/CO21/8]

therefore an amendment was required. In October 2009, contracting parties adopted Resolution LP.3 (4) which included amended text for Article 6. This states:

> 1. Contracting Parties shall not allow the export of wastes or other matter to other countries for dumping or incineration at sea; 2. Notwithstanding paragraph 1, the export of carbon dioxide streams for disposal in accordance with annex 1 may occur, provided that an agreement or arrangement has been entered into by the countries concerned. Such an agreement or arrangement shall include: 2.1 confirmation and allocation of permitting responsibilities between the exporting and receiving countries, consistent with the provisions of this Protocol and other applicable international law; and 2.2. in the case of export to non-Contracting Parties, provisions at a minimum equivalent to those contained in this Protocol, including those relating to the issuance of permits and permit conditions for complying with the provisions of annex 2, to ensure that the agreement or arrangements does not derogate from the obligations of Contracting Parties under this Protocol to protect and preserve the marine environment. Hence, a Contracting Party entering into such an agreement or arrangement shall notify it to the Organization.[36]

The amendment was adopted in 2009, but it was not until Resolution LP.5(14) was adopted on 11 October 2019 that the amendment came into force.[37] This signifies a major hurdle that has been overcome; the London Protocol no longer stands as an obstacle for the transportation and storage of CO_2.

It has been evidenced that international law has posed a number of challenges for CCUS over the past thirty years. Where international law relates to the transportation and storage of hazardous substances, there have often been gaps where CO_2 is neither expressly prohibited or authorized. For the Basel Convention, this remains the case. However, after many years of negotiation and efforts to reach an agreement, the London Protocol has now been sufficiently amended to ensure that the safe transportation and storage of CO_2 is not prohibited under international environmental law.

[36] Resolution LP.3(4) on the Amendment to Article 6 of the London Protocol (Adopted on 30 October 2009)
[37] Resolution LP.5(14) on the Provisional Application of the 2009 Amendment to Article 6 of the London Protocol (adopted 11 October 2019).

3.2 European law

By contrast to international law, the EU issued a preliminary legal framework to enable deployment of elements of CCUS as a means to meet the abovementioned climate target of achieving climate neutrality by 2050, and the European Commission is charged with overseeing its implementation.

In 2009, the European Parliament issued Directive 2009/31/EC,[38] which laid down a preliminary regulatory framework for the environmentally safe transport and geological storage of CO_2 across the EU—and, as of 2012, has been integrated into the EEA Agreement[39]—and applicable to the whole life cycle of storage sites, from choosing and overseeing an operating site to establishing closure and post closure requirements. Article 1 states that, 'the purpose of safe geological storage of CO_2 is permanent containment of CO_2 in such a way as to prevent and, where this is not possible, eliminate as far as possible negative effects and any risk to the environment and human health [and combat climate change].'[40]

Many factors paved the way for the issuance of this Directive, which itself notes the barriers removed in international law by the London Protocol. In 2007, a European Commission Working Group was established to research the viability of CCS as a mitigation measure, which acknowledged that climate change was named a priority for action in 2002 by the European Parliament.[41] The Directive itself was generated under the expressed belief that all mitigation options must be undertaken in order to achieve the 2℃ limit, citing a 2007 Communications.[42] Factoring into the debate for or against employment of CCS, the Directive also states that the employment of CCS should not incentivize the creation of more fossil fuel plants or supplant the need for renewables, energy saving policies, and other low carbon technologies.[43]

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[38] Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide and amending Council Directive 85/337/EEC, European Parliament and Council Directive 2000/60/EC, 2001/80/EC, 2006/12/EC, 2008/1/EC and Regulation (EC) No 1013/2006 [2009] OJ L140/114 ("Directive 2009/31/EC").

[39] Decision of the EEA Joint Committee No 115/2012 of 15 June 2012 amending Annex XX (Environment) to the EEA Agreement [2012] OJ L 270/38.

[40] Directive 2009/31/EC (n 38), art 1.

[41] 'A legal framework for the safe geological storage of carbon dioxide' (*European* Commission) <https://ec.europa.eu/clima/eu-action/carbon-capture-use-and-storage/legal-framework-safe-geological-storage-carbon-dioxide_en> accessed 12 July 2022.

[42] Directive 2009/31/EC (n 38), pt 3.

[43] Directive 2009/31/EC (n 38), pt 4.

As a primary feature, the Directive details the requirements for selecting a CCUS site.[44] For a site to be chosen, the operator must hold a valid exploratory permit. A prior analysis must demonstrate that a site poses 'no significant risk of leakage or damage to human health or the environment.'[45] Before the injection of CO_2 begins, the site operator must also demonstrate financial security to ensure the requirements for operating a storage facility can be met. It also includes provisions pertaining to capture and transport elements that are meant to be interpreted in conjunction with pre-existing EU environmental legislation, including the Environmental Impact Assessment (EIA) Directive and the Industrial Emissions Directive.[46]

Once storage permission has been granted, the sole operator must maintain a valid storage permit that was granted during the valid period of the exploratory permit and assure that there be no conflicting uses of the site. The Directive lays out explicit details regarding the procedural and substantive requirements of the storage permit throughout Chapter 3, while Chapter 4 storage site closure and post-closure requirements. Chapter 4 also specifies that the captured substances 'must consist overwhelmingly of CO_2 to prevent any adverse effects on the security of the transport network or the storage site' and sets a system in place in case of leakage and resulting damages. For one, operators are automatically included in the EU Emissions Trading System, which would require that they surrender emission allowances for any emissions resulting from the leak. Whereas local damage to the environment is handled using the Directive on Environmental Liability, damage to health and property is subjected to the regulation of EU Member States.

Chapter 7 contains Amendments to pre-existing Directives to better enable safe CCS and closes with Chapter 8 outlining required procedures for review of its implementation (with a report due by 2015), opening the door for formal revisions to be drafted in the event certain components are considered insufficient after the review period. It's important to note that the Directive does *not* contain provisions regarding the usage element of CCUS, instead focusing on the capture and storage component of this mitigation method.

In addition to Directive 2009/31/EC, the European Union later issued Directive 2018/2001 which promotes use of energy from renewable resources, such as renewable fuels of non-biological

[44] Directive 2009/31/EC (n 38), ch 2.
[45] 'A legal framework for the safe geological storage of carbon dioxide' (n 41).
[46] ibid.

origin, including fuels made from captured CO_2 (the CCU component of CCUS).[47] The Directive states that the promotion of renewable energies is one of the goals of EU energy policy, as named within Article 194(1) of the Treaty on the Functioning of the European Union.[48] Unlike the CCS 2009 Directive, it does not exclusively pertain to CCS and, in fact, does not refer to the technology as a whole; rather, it deals with carbon storage and utilisation as distinct procedures generating emissions savings.

It pays special attention to admissions savings through the generation and use of energies considered renewable and details the method of calculations of the production of use of various energy forms, including CCS and CCU (the ladder referred to carbon capture replacement, or CCR, in the corresponding Annex).[49] In doing so, it acknowledges the value of carbon capture utilisation without detailing pertinent regulatory procedures associated with various forms and applications of CCU.

3.3 What's lacking in EU CCUS law

While progress has been made toward establishing a complete regulatory framework for CCUS within European law, gaps remain to facilitate its timely and efficient deployment. While Directive 2009/31/EC in 2009 operationalizes an initial framework to jumpstart CCUS deployment, several elements are lacking. For one, it fails to address (and, thereby, potentially encourage) erecting CCUS clusters, hubs and networks, whereby CCUS is undertaken as a joint project to bring down costs and increase efficiency of deployment. To generate said clusters, hubs and networks requires additional site selection criteria which involves "scoping of multiple potential storage sites in reasonable proximity to each other" and, to abide by the existing Directive may require the establishment of a third party or dominant party to act as the sole permit holder.[50] So too, as it relates to addressing the creation of CCUS hubs, clusters and networks, a comprehensive

[47] Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources [2018] OJ L 328/82 ("Directive (EU) 2018/2001").
[48] Consolidated Version of the Treaty on the Functioning of the European Union [2012] OJ C326/47, art 194(1).
[49] Directive (EU) 2018/2001 (n 47), annex V.
[50] 'Global Status of CCS: Special Report – Understanding Inudstrial CCS Hubs and Clusters' (*Global CCS Institute,* June 2016) <https://www.globalccsinstitute.com/wp-content/uploads/2019/08/Understanding-Industrial-CCS-hubs-and-clusters.pdf> 9.

regulatory framework may seek to ensure a continued supply of CO_2 in the event a partner emitter ceases capture operations for whatever reason.[51]

Other shortcomings should also be noted. Explicit CCUS regulation is lacking within current Directives, as is a supportive regulatory framework that promotes the deployment of CCUS technologies pertaining to production and demand (for example, creating lead markets for low carbon products).[52] Further regulatory work on CCUS may also be necessary to ensure industries that otherwise cannot meet net zero objectives—such as the cement industry, whose production inherently involves the production of carbon emissions, causing ⅔ of the emissions associated with the cement industry—are able to benefit from CCUS and transition to a climate neutral economy.[53] It's also important for regulatory frameworks to comprehensively cover energy-intensive industries, such as chemicals and steel, which have few alternatives to CCUS to achieve climate neutrality. Such regulation is needed to avoid further delays in deployment in these industries.

Despite Directive 2009/31/EC's implementation and integration within the EEA Agreement, CCUS deployment has lagged.[54] Therefore, additional shortcomings of Directive 2009/31/EC have yet to be identified. At this point, the EU has issued communications, a strategy[55], funding and R&D support all striving to deploy and scale the technology to combat climate change. As the Green Deal and corresponding Climate Law makes clear, issuance of a comprehensive strategy and deadlines helps motivate action, and the same tactic can be applied to issuing a legislative package to ensure a comprehensive regulatory framework (including

[51] ibid, 10.
[52] Christopher Jones, Andris Piebalgs 'The role of CCUS on the EU road to climate neutrality' (*EUI Florence School of Regulation*, January 2022) < https://cadmus.eui.eu/bitstream/handle/1814/73595/PB_2022_04_FSR.pdf?sequence=1&isAllowed=y> accessed 12 July 2022.
[53] ibid.
[54] CCUS has been effectively deployed offshore in Norway (while not an EU member, is party to the EEA Agreement) since 1996, due to its established fuel infrastructure, and the Netherlands has developed some CCUS projects. For more information, see Israel Araujo Lacerda de, 'Chapter 8 – Regulatory framework carbon capture, utilization, and storage in Europe: a regulatory review and specific cases' in Hirdan Katarina de Medeiros Costa and Carolina Arlota *Carbon Capture and Storage in International Energy Policy and Law* (*Elsevier* 2021). Additionally, Norway's experience with CCUS helped international law develop on the topic and provided a basis for the EU directive. For more information see, 'The EEA Agreement and Norway's other agreements with the EU' (*Norway Ministry of Foreign Affairs*) <https://www.regjeringen.no/globalassets/upload/ud/vedlegg/europa/nou/meldst5_ud_eng.pdf> accessed 12 July 2022. Additional experience deploying CCUS in different EU regions could help further develop the existing Directive.
[55] 'About the Project' (*Strategy CCUS*) <https://www.strategyccus.eu/#:~:text=STRATEGY%20CCUS%20is%20an%20ambitious,utilisation%20and%20storage%20(CCUS)> accessed 12 July 2022.

insurance) for CCUS is in place by a certain date, followed by a detailed plan to develop the CCUS grid across the region, which could also encourage member states to establish cooperative policies toward joint CCUS projects.[56]

4. Special Insurance Aspects

4.1. The Environmental Pollution Insurance Landscape

In the early 1940s, property and casualty insurers started offering commercial general liability (CGL) insurance; this covered liability arising from accidental or unexpected and unintended property damage or bodily injury that happened during the policy period, even if a claim was not made until long after the policy period.[57]

From the early 1970s, property and casualty insurers began to include "qualified" pollution exclusion in their policies, which excluded bodily injury or property damage unless sudden and accidental.[58] Around 1986, insurers began including the "absolute" pollution exclusion in CGL policies, which excluded coverage for pollution claims whether or not they were sudden and accidental.[59] By the mid-1980s, insurers either stopped offering environmental impairment liability (EIL) coverage, or policyholders stopped buying EIL coverage –either because it had become prohibitively expensive or claim expenses had outpaced premium revenues. Yet, by the late 1990s, new environmental insurance products began to appear, such as "Pollution Legal Liability Insurance", "Clean-up Cost Cap Insurance", or a number of more specialized products, such as "Contractors Pollution Liability Insurance", "Commercial Real Estate Pollution Legal Liability Insurance", and "Contaminated Property Development Insurance".

The word "accidental" means that the loss suffered by the insured has been an "unlooked-for mishap or an untoward event which is not expected or designed."[60] The mere fact that the insured subject has sustained damage is, therefore, not sufficient to trigger coverage under a

[56] ibid.
[57] Plumer M, Lathrop A, Suomela K. 'Insurance for Environmental Claims'. New Appleman on Insurance: Current Critical Issues in Insurance Law, Lexis Nexis, Spring 2010, 33.
[58] E.g., ISO 1973 Standard Form for CGL Policy.
[59] 'Insurance for Environmental Claims' (n 57), 3.
[60] Of the many authorities on "accident", see, e.g. *Fenton v Thorley* [1903] A.C. 443; *Patrick v Royal London Mutual Insurance Society Ltd* [2006] EWCA Civ 421; *C A Blackwell (Contractors) Ltd v Gerling Allegemeine Verischerungs AG* [2007] EWHC 94 (Comm); *Sheehan v Lloyds Names Munich Re Syndicate Ltd* [2017] FCA 1340.

property policy. Because clean-up costs are not included in the coverage of property liability policies, the need for EIL policies arose to have such coverage also provided. Clean-up costs are not to be considered within the category of damages, hence the definition[61] which is usually found in CLG policies is rather limiting.[62]

By law, marine policies are not required to have environmental pollution liability coverage, but it is established practice that a contractual obligation exists to have EIL insurance in place. It is also worth mentioning that, usually, EIL policies are reinsured in the London market under English law. From the above, it follows that the reinsured will be obligated to hand over the conduct of settlement to reinsurers and get their prior consent.

Seaworthiness is a cornerstone element of marine insurance contracts in that it is an implied warranty as per section 39 of the Marine Insurance Act 1906 (MIA 1906). The ship needs to be seaworthy, i.e. reasonably fit in all respects to encounter the ordinary perils of the sea at any stage of the maritime adventure, and the insurer is not liable if the insured sends the ship to sea in an unseaworthy state. Protection and Indemnity (P&I) insurance covers third party liability of the shipowner for pollution damage causing harm to the marine environment.

In addition to the several types of insurance available to respond to pay for losses stemming from oil spills, insurance may be provided for mitigation costs.[63] Though, in the domestic London market it has already proved necessary to adopt specific policies for environmental issues so as to provide insurance for mitigation and remediation costs, as well as to address the problem that policies traditionally only cover sudden fortuities and not gradual environmental damage. Because the extent of property damage during an oil spill is often unclear, in many cases the coverage sought is the one provided for under an "all-risk" policy whereby, once a policyholder shows that it has suffered a loss, the burden of proof shifts to the insurer to show that the loss is not covered. Equally, a "named peril" policy might be opted for; although it would only provide coverage for perils expressly listed. Both types of policies may contain exclusions to coverage. The likely claims to arise usually involve issues related to the basic elements of first-party coverage, i.e. (1)

[61] Historically, CGL policies would typically promise to provide coverage for all sums which the insured shall become legally obligated to pay as damages because of property damage to which this insurance applies, caused by an occurrence.

[62] *Tatham, Bromage & Co v Burr (The Engineer)* [1898] A.C. 382; *Hall Brothers Steamship Co Ltd v Young* [1939] 1 K.B. 748.

[63] E.g., companies may purchase equipment, such as booms, in an effort to protect property from contamination; see Kellner L. Insurance Coverage Issues for Third-Party Businesses and Municipalities with Losses Due to the Oil Rig Explosion in the Gulf of Mexico. Insurance Coverage Alert, Dickstein Shapiro LLP. 2010.

issues relating to covered property, (2) issues relating to the existence of a sustained physical loss or damage, and (3) the fact that there has to be a claim resulting from a covered peril.

4.2. Specific Insurance Issues

Specific, i.e., special insurance aspects pertain to the insurability of the incident *per se* as well as to the kind of damages sustained, on the environmental side, and to the question of whether such liability should be capped or not. In addition, financial and insurance instruments are used to cover liability risks and, as such, often cover both first-party damage and liability.

An important feature to decide on the insurability or not is the data and information available to insurers on the likelihood of an event occurring and the damage to stem from such a risk. If data and prior information is missing to allow quantifying and qualifying the risk, insurers will use risk assessment models to map the likelihood of the risk occurring. That apart, insurers will need to have capacity to insure such risks, even if they are deemed as insurable.[64]

Existing insurance coverage for physical damage and liability exposures does not adequately cover all risks involved. These risks may involve construction, physical damage, removal of wreckage, control of the well, and liability. Casualty coverage will be added to property damage coverage to handle clean-up and third-party liability, and one limit will often be used for the whole insurance policy thereby creating a challenge for the compensation of third-party liability. Liability caps may also prove dysfunctional because they may not allow for the allocation of the true sum of the damage caused by operators in case of a major incident from CCUS. However, caps in liability sums allow a better and more pragmatic operation of the market. Whilst policymakers can rely on the combination of insurance and self-insurance as the most important instrument to cover all risk entailed in related risks, they need to realize the limitations imposed in terms of available insurance coverage at the same time.[65]

CCUS's evolution constitutes an imperative to establish and fix a new liability limit for environmental pollution liability insurance. Given the vulnerability of future CCUS hazards' insurability, such a new liability limit will need to be supported by the availability of insurance

[64] Michael Faure, 'Liability and Compensation for Damage Resulting from CO_2 Storage Sites' (2016) 40 (2015-2016) (2) Wm. & Mary Envtl. L. & Pol'y Rev. 387, 389-474; 437-438.
[65] Faure M, Wang H. *The Use of Financial Market Instruments to Cover Liability Following a Major Offshore Accident* In: Faure M. *Civil Liability and Financial Security for Offshore Oil and Gas Activities* (CUP 2017) 236.

coverage on adequate terms and conditions in the global commercial insurance market. Provisions for financial responsibility and liability during post-closure care and long-term stewardship of CCUS projects must balance global and local risks with the climate benefit of CCUS deployment. This imposes a need to develop institutional structures to manage CCUS risks long-term in order to guarantee resources to cover public monitoring and potential remediation costs are available and to avoid the possibility of CCUS projects becoming an unfunded public mandate.[66]

It follows that predictability can play a role in determining whether a risk is insurable and to what extent, but a lack of predictability can potentially be addressed by charging an additional risk premium.[67] Also, the insurer must be able to show that they have the required capital capacity to cover the risk when the latter occurs. [68] A solution to the above requirement of capacity can be established through mechanisms deployed by insurers, such as co-insurance, or reinsurance, or pooling by insurers so as to share the risk. [69]

Many of the operational risks in the CCUS storage process can be addressed through existing risk mitigation and risk transfer options that are familiar to the insurance and oil and gas industries. For specific risks, such as CO_2 leakage, a large number of the operational risks in the CCUS storage process can be addressed through existing risk transfer options familiar to industry, and through a government cap for the CO_2 leakage risk to conclude towards a viable insurance risk management approach. Hence insurers, under tightly defined criteria, could cover at least a subset of the total liability on an annually renewable basis, and the insured will have to declare the volume of stored CO_2 to be insured up front. Other CCUS related risks could use some structured financial products used as insurance alternatives.[70]

At present, only two companies (Zurich and Swiss Re) are launching bespoke products to cover CCS-related risks. Hence, another solution to provide cover for such risks could be self-insurance, i.e., a mechanism whereby the risk is borne by the market players themselves or via the creation of captives, i.e., insurance created by the industry.[71]

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[66] Wilson E, Klass A, Bergan S. 'Assessing a Liability Regime for Carbon Capture and Storage' (2009) 1(1) Energy Procedia 4575.
[67] 'Liability and Compensation for Damage Resulting from CO_2 Storage Sites' (n 64) 389-474, 437-438.
[68] ibid, 389-474, 437-438.
[69] ibid, 389-474, 437-438.
[70] ClimateWise. Managing Liabilities of European Carbon Capture and Storage. 2012
[4] Furre A, Eiken O, Havard
[71] Liang, Xi and Voysey, Andrew, 'Managing Liabilities of European Carbon Capture and Storage: A Climatewise Report on Developing Commercially Viable Insurance Solutions' (2012, *Climatewise*)

Currently, insurance products applicable to a CCUS practitioner include general liability, property damage (first party), business interruption, builders risk, physical damage, environmental/pollution liability, professional liability, control of well, tax, and regulatory insurance. Property insurance for CCUS projects from commercial insurers is generally available, and liability insurance for carbon capture and transportation will not be difficult to obtain. The core of the liability insurance will be indemnification for financial harm as a result of an insured peril. In relation to CCUS, insured perils would be property damage and bodily injury as a result of CCUS operations with exclusions on pollution coverage; however, as CCUS projects develop, faster broadening of coverage and price reduction is anticipated as competition amongst insurers will increase. Proof of this is that CCUS liability insurance is increasingly available to assist in the large-scale development of a necessary and potentially profitable industry.[72]

4.3. Cyber-Insurance Coverage for CCUS Risks

Cyber-insurance has a broad definition and, although it was originally defined as insurance for damages to "physical" computer equipment, nowadays it represents a risk mitigation tool for IT/cyber-related losses, covering damages or losses from information / IT systems and networks. It is suggested that cyber-insurance promotes the implementation of good security measures;[73] however, innovations in cyberspace introduce new types of losses and act as barriers to effective coverage. At present, cyber insurance does not dominate the overall non-life insurance market,[74] but it is one of the fastest-growing new lines of insurance business and cybersecurity is recognized as one of the top global risks.[75] Meanwhile, more and more traditional insurance contracts exclude

<https://www.cisl.cam.ac.uk/system/files/documents/climatewise-ccs-report-nov-2012-full-report.pdf> accessed 28 July 2022.

[72] Maguire P. 'Conquering Insurance Obstacles for Carbon Sequestration Technologies' (*Power*, 2009) <https://www.powermag.com/conquering-insurance-obstacles-for-carbon-sequestration-technologies/#> accessed 28 July 2022.

[73] Anderson, R. Bohme, R. Clayton, R. Moore, T. 'Security Economics and the Internal Market' (*European Union Agency for Cybersecurity* 2007) <https://www.enisa.europa.eu/publications/archive/economics-sec/> accessed 28 July 2022.

[74] 'UK Cyber Security: The Role of Insurance in Managing and Mitigating the Risk' (*HM Government*, 2015) <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/415354/UK_Cyber_Security_Report_Final.pdf> accessed 28 July 2022.

[75] 'Global Risks 2015 10th edition, Technical Report' (*World Economic Forum*, 2015) < https://www3.weforum.org/docs/WEF_Global_Risks_2015_Report15.pdf> accessed 28 July 2022.

specific losses linked to cybersecurity and, therefore, it is imperative that a separate cyber-insurance market develops to also help industry practitioners and regulators fully understand potential future systemic risks.[76]

The marine insurance market is highly specialized and, because the limits of insurance are usually in the excess of $1 billion, there is no single insurer who covers the entire risk exposure. Because we live in an era where there is an increased use of the Internet of Things (IoT) across the energy sector, this also increases the vulnerability to cyber-attacks. Therefore, it is imperative to address cyber-risk as a key operational risk and implement measures to prevent, detect and respond to cyber-threats in a holistic way. For insurance related to CCUS, and because oil pollution damage can occur and cause gradual damages, oil spill related costs can accrue and make it extremely difficult for companies to draw a line, as not only is it difficult to anticipate the actual losses incurred during oil pollution and other general or cyber-related liability incidents, but to also place caps on such liabilities. Following these incidents, insurers have tended to add crisis management services to their environmental insurance solutions. Regulators have also appeared to step up their enforcement of environmental and other laws. In addition, it was realized that there is a lack of uptake of financial security instruments to cover all damage from the most infrequent and costly offshore accidents. Consequently, extensive and responsive mitigating measures would need to be put in place alongside extensive insurance coverage for cyber-attack risks.

Some property policies expressly exclude cyber coverage and, in such cases, courts have also held that cyber losses are not covered. Accordingly, courts have held that cyber losses are not covered in cases where a policy is silent on whether cyber coverage exists. In *Ward Gen. Ins. Servs., Inc. v Employers Fire Ins. Co.*,[77] the court heavily relied on liability coverage cases interpreting data loss under insuring provisions in CGL policies. For companies without specific cyber-risk insurance coverage, coverage is sought under a CGL policy, whereby typically the claimant will be alleging that the assured negligently permitted hackers to access its computer systems and data. Coverage A of the CGL policy provides coverage for liability owed to a third-party for an occurrence or a wrongful act resulting in bodily injury or property damage, for which the insured is legally obliged to pay damages. Occurrence is usually defined as an accident which

[76] 'Security Economics and the Internal Market' (n 73).
[77] *Ward Gen. Ins. Servs., Inc. v. Employers Fire Ins. Co.*, 114 Cal. App. 4th 548,550, 7 Cal. Rptr. 3d 844, 846 (2003).

does not include intentional acts. *America Online Inc. v St. Paul Mercury Ins. Co.*[78] is one of the leading cases analysing whether cyber losses constituted physical damage. Coverage B of a CGL policy provides coverage for certain cyber-related claims, i.e. for the sums that the insured becomes legally obliged to pay as damages.[79]

Most companies today maintain CGL coverage which protects from financial loss, broadly providing defence and indemnity coverage for claims of bodily injury and property damage. But whether a CGL policy will protect businesses from cyberattacks is not always clear. In addition to it depending largely upon the facts of the case, state courts addressing the issue have been inconsistent. While some courts in the US have found that coverage exists,[80] others have denied claims for data breach under CGL policies.[81]

Given this jurisdictional uncertainty and the fact that the standard CGL ISO policy form and many CGL policies have recently been amended to contain exclusions for breaches from cyberattacks, many companies have fittingly turned to specific cyber liability coverage to fill the gaps, including special war risk coverage.

Whether or not a particular cyberattack or data breach is considered an act of war is critical to whether the exclusion applies. The problem is that there is no universal definition of war, let alone agreement on what constitutes an act of war in the cyber context. In addition, insurers always have the burden to prove an exclusion application. The war risk exclusion presents insurers with a particularly formidable evidentiary challenge in the cyber context. Courts have traditionally interpreted the war exclusion narrowly, defining "war" as a physical event involving two sovereigns or quasi-sovereign governmental entities. Thus, without direct involvement by a sovereign state, the war exclusion would generally not bar coverage.[82]

With regards to large or small-scale cyber or war risk attacks, the challenge for insurers will likely be that, as with September 11th, demands will be made on them to provide immediate answers to coverage questions. As *In re September 11 Litigation*[83] demonstrates, the facts that will

[78] *America Online Inc. v. St. Paul Mercury Ins. Co.*, 207 F. Supp. 2d 459, 468-469 (E.D. Va. 2002).
[79] *Recall Total Information Management, Inc. v. Federal Ins. Co.*, 147 Conn. App. 450, 83 A.3d 664 (2014); *Gummow Devilling, supra* note 61, 1-25 at 11-14.
[80] *Travelers Indem. Co. of Am. v. Portal Healthcare Solutions, LLC,* 644 Fed. Appx. 245 (4th Cir. 2016).; *Eyeblaster, Inc. v. Federal Ins. Co*., 613 F.3d 797 (8th Cir. 2010)).
[81] *Recall Total Info. Mgmt. v. Fed. Ins. Co.*, 147 Conn. App. 450 (Conn. App. Ct. 2014
[82] *Pan Am. World Airways, Inc. v. Aetna Cas. & Surety Co*., 505 F.2d 989 (2d Cir. 1974).
[83] *In re Sept. 11 Litig.*, 931 F. Supp. 2d 496, 511 (S.D.N.Y. 2013)

determine coverage under the circumstances will not likely be immediately available, and, for that matter, may not be available for significant periods of time.

As climate change accelerates, insurance for environmental and cyber-incidents from the CCUS is necessary to cover the gradual character of occurrence of environmental harm as far as the environmental liability coverage is concerned, given the feature of "sudden" and "unexpected" loss coverage usually found in property casualty policies and, at the same time, provide adequate coverage for cybersecurity occurrences.

Despite the fact that the globalisation of environmental risk is more intense than ever before, the civil liability regime for marine and oil pollution has extended the scope of compensation obligations to include environmental impairment, yet the usually encountered "sudden" and "unexpected" loss coverage in property casualty policies is not appropriate for environmental pollution coverage, which by its nature usually occurs gradually. Also, the threat and frequency of cyber-risks have provided the need for specific and separate additional coverage for cyber terrorism and cyber risks. This, in turn, has been anticipated to re-establish a "soft" more pragmatic and accessible CCUS related insurance market, medium and long-term.

Insurance solutions include state liability assumed by the host state for the storage of CO_2 transported and the likely results of an incident of pollution and the creation of "CCUS pools" to be formed to provide realistic premiums and low, or none at all, insurance deductibles making the insurance of CCUS impossible to meet financially. The aim is to not have a "hard" insurance market, i.e. a market where – due to the either high deductibles or large risk premiums – the CCUS ships and their operations may effectively be left uninsured. Such an option would threaten the mass production and deployment of CCUS ships and jeopardize climate change mitigation efforts and, thus, the 50% reduction of CO_2 emissions by 2050, as pledged by the shipping community.

CCUS is a climate mitigation technology. Even more, the Covid-19 pandemic has indicated an accelerated need for climate change mitigation. The 4th Industrial Revolution (4IR) is accelerated by the increased use of the digital environment and it reinforces the need for the use of technologies such as CCUS. Such technologies will need to be able to process big data safely and rapidly and will play a pivotal role in innovating and maintaining the safety of digital ecosystems. As systems will increasingly rely on such technology, hence increasing vulnerability to hackers, this entails the need for robust cyber risk insurance coverage as systems. Insurance

challenges might include a difficulty to assign liability or machine failure or malfunction, and even business interruption, due to a cyber failure.

Lastly, contrary to the above arguments in favour of deploying CCUS as a means of implementing climate-friendly technologies are the proponents of the argument that CCUS risks should not be insured, and the technology should be abandoned altogether. Their view is based on the critics relating to establishing insurance coverage against leaks into groundwater and the atmosphere as the main rhetoric purports that there is no actual "clean coal" technology like CCUS. Such criticism has led many insurers to develop CCS/CCUS liability insurance coverage for risk from lawsuits or penalties over pollution, business interruption, well control and "geomechanical liability" as interest in CCS and CCUS is growing in the industry as greenhouse gas emissions legislation expands.

5.0 Recommendations and Conclusion

The goal of reducing greenhouse gas emissions to combat climate change offers an opportunity to search for and develop solutions: solutions to address current emissions and that create new approaches for the modern economy to produce less or even no CO_2. A robust liability framework for CO_2 capture, use and storage could undoubtedly represent a positive first step towards addressing a difficult regulatory issue. Ensuring safe deployment of CCUS through minimisation of leakage must remain a priority, to supplement climate change mitigation efforts and get the most benefits from this technology's deployment.

Whilst efforts have been made in international environmental law to confirm that the capture, transportation and storage of CO_2 legally fits within the London Protocol, the Basel Convention remains as an area where clarification is still outstanding. Due to the nature of international law, clarification on CCUS's legality has taken a long time to achieve. It is imperative that future amendments to international environmental law are made with a view to legalize CCUS are made promptly to ensure that this method can effectively be used in the fight against global warming. So too, the European Union should work to further develop its CCUS regulatory frameworks to encourage safe development of clusters, cover utilization of captured carbon and promote the deployment of CCUS technologies pertaining to production and demand, as well as cover any outstanding nuances of industries with little to no alternatives to CCUS in meeting climate neutrality goals.

Both from an insurance and general liability perspectives, liability will need to be capped to further allow insurability to operate. Arguably, there is a level beyond which liability will start to lose its positive effects and simply act as an insurmountable barrier for insurance. Governments may be reluctant to accept amendments which may place a higher burden on public funds, regardless of how unlikely the event of significant leakage actually is. Still, the argument must be emphasized that States retain their freedom to decide whether to allow CCUS on their territory. Insurance plays a pivotal role in ensuring there is a safety mechanism to help deploy CCUS technology and battle climate change.

Insurers and insureds bear in mind that environmental pollution is usually gradually occurring; hence, the "sudden" and "unexpected" loss coverage in property casualty policies is not appropriate for environmental pollution incidents. Both the threat and the frequency of cyber-risks have provided the need for specific and separate additional coverage for cyber terrorism and cyber risks. This in turn has been anticipated to re-establish a "soft" insurance market and help deploy the widespread use of CCUS.

Alternative options to afford covering the CCS risk is through risk-sharing agreements or a pool is a system which allows operators to share each other's losses and whereby the operators unlike in insurance are both insured and insurer, or via the provision of a financial guarantee to the operator by parties such as another company or third party or a financial institution. Governments can also step in to allow the regulatory environment for having guaranteed minimum safety standards for CCS, to then allow the insurance market to respond, or through legislation (at international and national level) or via establishing government compensation programs which would be able to finance CCS-related risks, or via the direct provision of compensation to the victims, as the case is often with *ex post* compensation for natural disasters, however the fact that CCS damage is categorised as manmade, liability law is to be called upon in the first instance.[84]

[84] 'Liability and Compensation for Damage Resulting from CO_2 Storage Sites' (n 64) 389-474, 460-466.