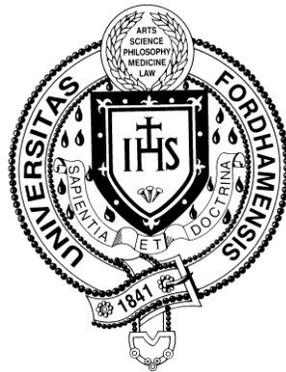


FORDHAM ENVIRONMENTAL LAW REVIEW



INNOVATIVE REGULATORY AND FINANCIAL PARAMETERS FOR
ADVANCING CARBON CAPTURE AND STORAGE TECHNOLOGIES

Zen Makuch, Slavina Georgieva & Behdeen Oraee-Mirzamani

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INNOVATIVE REGULATORY AND FINANCIAL PARAMETERS FOR ADVANCING CARBON CAPTURE AND STORAGE TECHNOLOGIES¹

Zen Makuch,² Slavina Georgieva,³ Behdeen Oraee-Mirzamani⁴

ABSTRACT

In the post-industrial age, the realisation of inherent technical innovation potentials requires that stakeholders develop flexible, cooperation-based frameworks if first mover opportunities and advantages are to be realised. In the Paris Agreement⁵ implementation context, carbon

¹ This article forms part of our ongoing IC4S Carbon Capture and Storage at Imperial College London research initiative. This article reflects our experience in conducting research within the CCS stakeholder community the results of which positively influenced the publication of analysis in a Summary Note from the European Commission entitled “Guidance Document 4, Article 19 Financial Security and Article 20 Financial Contribution”. It also led to revisions to the first publicly available draft of “Guidance Document 4, Article 19 Financial Security (“FS”) and Article 20 Financial Contribution” (“GD4”). Accordingly, in line with this research, the Summary Note clarifies that it is within the flexible discretion and, therefore, the legal jurisdiction of Member States to determine the options for establishing the level of financial security to be required of a CCS site operator (Article 19 of the CCS Directive) as well as the need for additional post-monitoring cost coverage (Article 20 of the CCS Directive). Further to these research-based interventions, the Summary Note clarifies that the proxy 25% bottom line contingency suggested in the first draft of GD4 should be overlooked in favour of a more site-specific risk analysis. Accordingly, GD 4 was amended in this regard. Finally, the Summary Note accepts the role that public government insurance may play in the absence of commercial insurance particularly for “first mover” sites. In this regard, the desire to reflect the cost of FS is noted in a new column for the Annex to GD 4 analysing the cost of FS Options. All of these changes by way of the Summary Note and the revised final draft GD4 are, of course, welcomed as they make it more likely that CCS will be taken up by EU Member States in accordance with their Paris Agreement commitments.

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⁵ *What is the Paris Agreement*, UNITED NATION CLIMATE CHANGE [UNCC] (2020), <https://unfccc.int/process-and-meetings/the-paris-agreement/what-is-the-paris-agreement>, (At COP 21 in Paris, on 12 December 2015, Parties to the UNFCCC reached a landmark agreement to combat climate

capture and storage technologies have emerged as a complementary adjunct to climate change mitigation and a diversified energy mix. However, developing the technology is not without technical and financial risks. The challenge for key stakeholders, primarily (but not exclusively) government and industry counterparts is to develop mutually reinforcing strategies, regulations and policies for testing and commercialising Carbon Capture and Storage (“CCS”) technologies and networks, as that will be determinative of their fate.

In the Paris Agreement implementation period, the UK, for example, has indicated a commitment to bold greenhouse gas reductions (57% by 2030), and investment in CCS, as part of the ambitious emissions reductions targets set forth by the European Union, the deployment of which is meant to count for 20% of the greenhouse gas emissions captured by 2030. This has subsequently resulted in plans for several pilot CCS plants on UK soil. The up-scaling of CCS to the demonstration level, however, is dependent not only on the presence of sufficient interest and funding – an ongoing issue in the UK both pre- and post-Brexit – but also on the existence of appropriate regulatory conditions and options for additional private financing by industrial stakeholders. Furthermore, it is important to note that the up-scaling of projects from pilot to demonstration, and further on to a commercial-scale, is materializing in the context of a global financial crisis and a dip in investment trust in high-risk ventures.

The development of CCS projects in individual states, is not only influenced by national regulatory regimes, policy developments, and fluctuations in financial markets, but is also dependent upon the legislative signals given from supra-national bodies and binding international

change and to accelerate and intensify the actions and investments needed for a sustainable low carbon future. The Paris Agreement builds upon the Convention and – for the first time – brings all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects, with enhanced support to assist developing countries to do so. As such, it charts a new course in the global climate effort.).

agreements. In Europe, the CCS Directive's approach to long term environmental and related financial risk has led to the current state of regulatory and financial uncertainty, thereby, giving rise to potentially uninsurable liabilities which dis-incentivise private sector investment in CCS technology. This is in contrast with legislation in competing states including the United States, Norway, Canada and Australia.

There is every indication that the paramount issue standing in the way of CCS is uncertainty over regulated financial security requirements for site operators and the nature and attribution of liability arising from leakage. This uncertainty could be addressed by a combination of insurance for storage sites and a robust permitting process, which would minimize the likelihood of leakage to virtually zero. There are, therefore, excellent reasons for national and international law and policymakers to seriously consider a more careful and tailored legislative and policy mix, so that regulatory oversight is in balance with innovative financial, insurance and liability mechanisms. In addition to exploring this subject matter, the article offers a number of recommendations for flexible, stakeholder partner-based advancement of CCS technology potentials in climate change and related environmental regulation.

Keywords: Carbon Capture and Storage, CCS Risks, Long Term Liability, CCS Insurance, CCS Directive.

INTRODUCTION⁶

The inherent capacity to innovate is no longer enough to succeed in complex post-industrial societies. The resolution of innovation-related economic and regulatory risk is also of fundamental importance because we exist in a stakeholder milieu in which neither regulators nor economic actors have effective,

⁶ The authors would like to thank Niall MacDowell, Paul Fennell, Alex Walker, Tim Cockerill (University of Leeds), Rob Gross and other colleagues in the Imperial College Centre for Energy Policy and Technology ("ICCEPT") and the Centre for Environmental Policy ("CEP") for their comments on this article and/or their academic support.

unilateral technology implementation capabilities.⁷ As such, implementing innovation now requires the flexible cooperation of key stakeholders.

The UK is a European Union Member State known for its commercial pragmatism and strong commitment to the mitigation of climate change. This article informs Carbon Capture and Storage (“CCS”) stakeholders and other readers about the legal and financial context within which CCS technology currently stands. It does so principally on a comparative basis by reference to several jurisdictions around the world that are implementing CCS or have experience with CO₂ injection for enhanced oil recovery from reservoirs. Countries with a well-developed CCS regulatory approach are given particular attention. Finally, the article offers options that would allow for the construction of a best-fit regulatory scenario which adequately addresses liability and risk issues for CCS using the UK as a case study in view of its continuing interest in this technology in a Paris Agreement context.

The Paris Agreement calls for countries to keep global surface temperature increases to well below 2° Celsius. Since the implementation period which commenced in 2016, comparatively little has happened in respect of emissions reductions noting the imperative nature of this potentially existential planetary challenge. Rather than a reduction, the Carbon Tracker projects a temperature rise to 3° – 3.4° *even if* current policies are implemented.⁸ An important overlooked source of GHG emissions is industry, whose projected share of emissions in a business-as-usual scenario may well rise to 52% of overall emissions by 2050.⁹ Furthermore, to this point, while electrification may provide a solution to our transport and heating-based GHG emissions, this is not the case for industrial

⁷ See Bellona Found., *Moving CCS forward in Europe*, ENGO Network on CCS, BELLONA FOUND. 2 (May, 2013), http://content.ccrasa.com/library_1/5083%20-%20Moving%20CCS%20forward%20in%20Europe.pdf. (It is arguable that the failure of the first round of the NER300 Programme - which would have allowed the sale of emissions allowances under the EU Emissions Trading Scheme in order to finance CCS demonstration projects – to yield even a single CCS project serves as testimony to the failure of Member States to work with industry in order to develop such projects.)

⁸ See Climate Analytics and New Climate Institute, *2100 Warming Projections*, CLIMATEACTIONTRACKER.ORG, <https://climateactiontracker.org/global/temperatures/> (last updated Sept. 23, 2020).

⁹ Jan-Justus Andreas et al., *An Industry’s Guide to Climate Action*, BELLONA FOUNDATION (Nov. 26, 2018), <https://network.bellona.org/content/uploads/sites/3/2018/11/Industry-Report-final.pdf>.

“process emissions” (those related to raw material inputs not fossil fuel burning). In Europe, de-carbonising cement, chemicals and steel industries would require five times the renewable energy currently being produced, seemingly an impossible task. This is one key reason why negative emissions technologies [e.g., for the purposes of this article, variously CCS, CC and Utilisation (“CCU”) and CC Utilisation and Storage/Sequestration (“CCUS”)] are fundamental to Paris Agreement compliance.

In a Paris Agreement implementation context, the ambitious emissions reduction targets set forth by the European Union, coupled with the commitment to Carbon Capture and Storage (“CCS”) technology deployment, are meant to result in 15% of greenhouse gas (“GHG”) emissions captured through this technology by 2030 (with a subsequent steady rise from then onwards).¹⁰ The UK has similarly indicated a commitment to bold GHG reductions and investment in CCS which has resulted in plans for several pilot carbon capture plants on UK soil.¹¹ The up-scaling of CCS beyond the demonstration level, however, is dependent not only on the presence of sufficient interest and funding (from EU-level and UK if not all governments with an interest in CCS), but also on the existence of appropriate regulatory conditions and options for additional private financing by industrial stakeholders.¹²

Innovative financial and regulatory risk management solutions and incentives become all the more important when we recognise the commitments already being undertaken to design and

¹⁰ Council Directive 2009/31, On the Geological Storage of Carbon Dioxide, 2009 O.J. (L 140) 114 (EC).

¹¹ Dep’t of Energy and Climate Change, *CCS Roadmap*, GOV.UK (May 2012), https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/48317/4899-the-ccs-roadmap.pdf; *see also Global Status of CCS Report*, Glob. CCS Inst., <https://www.globalccsinstitute.com/resources/global-status-report/> (last visited Mar. 12, 2020) (stating that there are now 51 large-scale CCS facilities globally. These include 19 in operation, four under construction, and 28 in various stages of development. Of all the facilities in operation, 17 are in the industrial sector and 2 in power).

¹² *See* Worley Parsons, *Strategic Analysis of the Global Status of Carbon Capture and Storage –Report Three: Country Studies: The European Union*, GLOBAL CCS INSTITUTE (Mar. 31, 2009), <https://www.globalccsinstitute.com/archive/hub/publications/8517/strategic-analysis-global-status-ccs-country-study-european-union.pdf> (It is noteworthy that any given Member state has the legal right not to allow CCS sites within its territory. If a sufficient number of Member States do not take up the opportunity to implement CCS then the 2030 target may not be met *ab initio*).

build CCS projects. As Figure 1 (below) demonstrates, there are some 51 large scale CCS Facilities spanning 4 continents around the world with focal points in North America, Europe China and the Middle East. In total, 260 million tonnes of anthropogenic CO₂ has been safely stored to date.¹³

Figure 1: Distribution of Large-Scale CCS Facilities (operation or construction)¹⁴



Though this is somewhat encouraging, if we take a climate policy progressive jurisdiction such as the EU as an example, then we observe that total GHG emissions have only been reducing at an average of 50 Mt CO₂-eq. per year since 1990 (the 1992 UN Climate Convention baseline year). In order to achieve its stated goal of climate neutrality by 2050, annual emissions reductions will need to increase to 130 Mt CO₂-eq. The European Commission's strategic compliance scenarios foresee an important role for CCS and CCU with 80-298 Mt of captured CO₂ to be stored underground and 201-307 Mt to be utilised in synthetic fuels and materials respectively. For these projections to occur - noting that Europe's two large scale CCS facilities capture 1.55 Mtpa CO₂ for offshore storage – our storage and re-use capabilities must expand by a factor of 181-391 by the target carbon neutral date of 2050.¹⁵

In order to achieve this, industry action and policy and regulation are beginning to show signs of progress. Accordingly:

¹³ *Global Status of CCS Report*, *supra* note 11.

¹⁴ The Global CCS Institute lists these CCS facilities which include capture, transport and storage of CO₂ at a scale of 800,000 tonnes annually for a coal-based power plant or at least 400,000 tonnes of CO₂ annually for other emissions-intensive industrial facilities (including natural gas-based power generation). *see Facilities Database*, GLOB. CCS INST. (2019), <https://co2re.co/FacilityData>.

¹⁵ In-depth analysis in support of the Commission Communication COM (2018) 773, 2018 O.J. (C 773) 1.

- Norway is constructing a large-scale cement plant and a waste to energy incinerator with both featuring carbon capture capabilities that will result in additional ship and pipeline infrastructure for storage several kilometres offshore. This is part of a long-term plan to expand carbon storage infrastructure in a transnational context.
- Sweden's cement and steel sectors will both implement CCS capabilities and infrastructure in alignment with its carbon neutral plan for 2045.
- The UK is planning to implement six large scale CCS projects in accordance with its 2030 Clean Growth Strategy which will implement CCS at scale during this period.
- The USA has increased tax incentives for carbon storage (rather than release) from \$10 to \$50 t/CO₂ as of 2018.
- In the Netherlands, the port of Rotterdam will be the locus of CO₂ pipeline and storage infrastructure given its central position for energy intensive industry. Accordingly, it plans to manage storage of several million tonnes of CO₂ per year by 2030.¹⁶

Noting these major project installations and infrastructure and the imperative to meet Paris Conventions GHG reduction targets, the time is now to evolve regulatory and financial risk management strategies and incentives for advancing nascent CCS and CCU initiatives.

As it stands, CCS projects fall under the jurisdiction of international law (the OSPAR¹⁷ and London Dumping¹⁸ Conventions). Interestingly, further to Article 6 of the 1996 Protocol to the London Dumping Convention, a 2009 amendment to the Protocol exempts the export of CO₂ for storage from the prohibition on exports of wastes and other matter to other countries for dumping or incineration at sea. However, only six of the required minima of thirty-four nations have ratified the amendment. It would be useful to explore how ratifying parties might work together to permanently advance their CO₂ storage ambitions along the lines of the 2009 amendment. This should be discussed with the contracting parties to the Convention so as not to unnecessarily inhibit efforts to develop storage infrastructure at

¹⁶ Andreas, *supra* note 9.

¹⁷ Convention for the Protection of the Marine Environment of the North-East Atlantic, Sept. 22, 1992, 2354 U.N.T.S. 67.

¹⁸ Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, *opened for signature* Dec. 29, 1972, 1046 U.N.T.S. 120 (entered into force Aug. 30, 1975).

sea. Thankfully, a Resolution for Provisional Application of the 2009 CCS Export Amendment now allows countries to collaborate in relation to the exportation and importation of CO₂ for offshore geological storage.¹⁹

In Europe, CCS projects are also regulated through provisions of the EU CCS²⁰, Emissions Trading (“ET”)²¹ and Environmental Liability (“EL”)²² Directives. Furthermore, the up-scaling of projects from pilot to demonstration, and then on to a commercial-scale, is materializing in the context of continuing global financial uncertainty, the COVID-19 pandemic and a dip in investment trust in high-risk ventures. Still, the EU CCS Directive’s approach to long term environmental and related financial risk has led to the current state of regulatory and financial uncertainty, thereby, giving rise to potentially uninsurable liabilities which dis-incentivise private sector investment in CCS technology.

As we shall see, competing jurisdictions outside the EU, such as Norway, the USA, Canada and Australia have overcome this issue through innovative and flexible funding mechanisms and liability provisions. Even within the EU, the Member States of Germany and the Netherlands have made adaptations to their national laws which have allowed for the transposition of the EU CCS Directive in a way that does not impede investment in, and deployment of CCS demonstration projects in the near future.

The next section of this article analyses the legal framework, which has emerged in European law, for the purpose of addressing liability for CCS projects. This is followed by an analysis of how the current policy scheme might affect the competitiveness of EU CCS projects in regards to their international counterparts and whether a risk-sharing regulatory approach is appropriate for CCS technologies. Finally, we focus on the possible scenarios - sets of regulatory and financing options - which may be

¹⁹ Tim Dixon, *Positive Result on the London Protocol's CCS Export Amendment*, IEAGHG.ORG (Oct. 22, 2019), <https://ieaghg.org/ccs-resources/blog/positive-result-on-the-london-protocol-s-ccs-export-amendment>.

²⁰ Council Directive 2009/31, On the Geological Storage of Carbon Dioxide, 2009 O.J. (L 140) 114 (EC).

²¹ Council Directive 2003/87, Establishing a Scheme for Greenhouse Gas Emission Allowance Trading within the Community and Amending Council Directive 96/61/EC, 2003 O.J. (L 275) 32 (EC).

²² Council Directive 2004/35, On Environmental Liability with Regard to the Prevention and Remedying of Environmental Damage, 2004 O.J. (L 143) 56, 75 (CE).

advanced in order to coordinate CCS deployment in a manner that complies with EU law and enables fair and robust competition with projects in other jurisdictions. These options will also be of value to any nation with an interest in CCS.

I. THE CCS DIRECTIVE, RELATED DIRECTIVES AND GUIDANCE DOCUMENT 4 (“GD4”) 23

A. *The CCS Directive*

In this section we examine the legislative architecture (and official guidance) around long term liability for CCS storage sites. We find that there is a large number of risk management powers, exclusively available to governmental Competent Authorities (CAs) at the same time that there are substantial financial and environmental liability risks placed on storage site operators. It is submitted that this apparent imbalance justifies corrective national legislative measures, for example by utilising a “cooperation” or “partnership”-based approach to long term liability management, as between site operators and regulators.

The CCS Directive provides a significant number of risk management opportunities for UK regulators, while, at the same time, placing significant costs on storage operators. For example, regulators can choose not to approve storage sites with risky geological profiles or to seek strict permit conditions so that human error will be reduced, in respect of technical compliance. Additionally, among the regulatory risk management opportunities available to governments, is the right of authorities to require the following:

- That no storage site which may leak or create undue environmental or health risks shall be permitted;
- That no storage site shall be permitted without requisite levels of financial security²⁴ and technical excellence;
- That a storage site shall not operate without a permit and observance of all permit conditions;
- That a storage site must feature effective monitoring and reporting requirements to the regulatory authority;

²³ Directorate-General for Climate Action, *Implementation of Directive 2009/31/EC on the Geological Storage of Carbon Dioxide-Guidance Document Four*, No. 070307/2009 of 15 June 2012, art. 19-20, 2009 O.J. (C 5) 1, 41.

²⁴*Id.* at 3 (“Financial Security”, as used in the CCS Directive, defined).

- That the regulator must be notified immediately of leakages or irregularities at the site;
- That a storage site will be closed for breach of permit conditions;
- That the storage site operator will comply with strict closure and aftercare requirements;
- That all environmental and related financial liabilities may be placed on the storage site operator;
- That there shall be proportionate penalties for regulatory infractions; and,
- That emission allowances be purchased to cover leakage events.

The sheer weight and nature of risk management opportunities, available to the regulator, combined with the commensurate risk management standards, procedures and financial and related liability requirement placed upon the storage site operators, suggests that a “cooperation” or “partnership” approach to risk management and related long term and financial liability for leakage is necessary. The following analysis illustrates the significant consequences which storage site operators face in maintaining compliance with the CCS Directive. It also comments on the flexibility available to national authorities in devising long term liability and related financial instruments for advancing CCS within the UK’s legislative framework. This “flexibility” analysis should reassure regulators that there are significant opportunities available to regulators to incentivise CCS investment, and subsequent technological and regulatory success, when determining the long term liability and financial provisions that are to be applied to storage site operators through the transposition of the CCS Directive.

Analysis of the CCS Directive articles which address direct liability for operators.

Article 17: Closure and Aftercare

- “A storage site shall be closed:
- a. if the relevant conditions stated in the permit are met;
 - b. at the substantiated request of the operator, after authorisation of the competent authority;
 - c. if the competent authority so decides after the withdrawal of a storage permit pursuant to Article 11(3).”

In essence, once a site is deemed closed, liabilities pass to the state (excluding monitoring and corrective measures). The time limit before such passage could be long (decades), unless appropriate needed legislative certainty is provided. A site can, therefore, be shut if the operator or authority wants to close it, or if its life has expired. There is a large liability placed on the operator, if the site were to close earlier than expected, as set-up and operational costs might not be fully covered. Nothing in this Article prevents the sharing of risk between the operator and other parties including the Competent Authority. The same observation applies to the regulation of long-term liability and financial instruments.

Article 18: Transfer of Responsibility

Where a storage site has been closed pursuant to points (a) or (b) of Article 17(1), all legal obligations relating to monitoring and corrective measures pursuant to the requirements laid down in this Directive, the surrender of allowances in the event of leakages pursuant to Directive 2003/87/EC and preventive and remedial action pursuant to Articles 5(1) and 6(1) of Directive 2004/35/EC, shall be transferred to the competent authority on its own initiative or upon request from the operator.²⁵

An operator needs approval to close the site, whilst rigs and pumps are still installed. The Competent Authority can decide to release the operator before 20 years is up, if they are satisfied the gas is safe; this is an opportunity for the operator to obtain earlier handover, particularly if the site geology is suitable. If the geological conditions are suitable for earlier handover, this would release the operator of liabilities, and reduce insurance or bond costs. Therefore, bonds or insurance need to be negotiated on this basis. This article does not prevent a more flexible approach to addressing long term liability measures, nor does it preclude the use of incentives, in addressing financial and practical burdens of long-term site liability.

The transfer of responsibility, from the operator to the Competent Authority, adds further risk reduction measures to the arsenal of Competent Authority requirements. It should be noted, however, that there is a need to define the handover timeline, with a preferred specified handover period, as this would create regulatory and insurance-related certainty. One such approach would be for regulators to define a band of time from the storage site closure date to 20-30 years afterwards when liability would

²⁵ *Id.*

then pass on to Competent Authorities. Furthermore, there could be a chosen date within that time band which is deemed “an average” date for achieving liability transfer. Of course, that date would not be fixed and will depend on the specifics of each CCS project. However, it would serve as a marker for both the CCS and insurance industries.

Article 19: Financial Security (“FS”)

“Member States shall ensure proof that adequate financial security is presented by the potential operator as part of the application for a storage permit.” Use of cash, securities, bonds, insurances or loan facilities can be used to give security. Operator must show they can afford to run the site (including after closure for at least 20 years minimum). Article does not preclude use of incentives to assist operators in addressing long term liability costs. Language offers great flexibility; an equivalent alternative to financial security is permissible as part of the permit application.²⁶ “Member States shall ensure that the operator makes a financial contribution available to the competent authority before the transfer of responsibility pursuant to Article 18 has taken place.”²⁷

The monitoring period is 20 years. Costs to the authority need to be itemised, so that the operator can allow for them at tender. If CCS activities are successful, then the minimum financial contribution in respect of monitoring is all that will have to be paid in relation to the post-closure period. This article does not interfere with a flexible approach to liability and financial instrument regulation.

Article 28: Penalties

“Member States shall lay down the rules on penalties applicable to infringements of the national provisions adopted pursuant to this Directive and take all measures necessary to ensure that they are implemented.”²⁸

²⁶ *See id.* at 16, (Further to some of our original research presented to the European Commission, an explicit paragraph was added to the Final GD4 (Section 2.1, page 1), seeking that at Member State level, a balance be struck between regulatory oversight and pricing risk such that nations are not “overpricing the risks in relation to these obligations for early movers”. In much the same vein, new language was added to GD4 advising Member states to adopt a “middle ground” when conducting a site-specific risk profile).
Article 20: Financial Contributions

²⁷ *Id.*

²⁸ *Id.*

This standard penalty provision is not logically connected to the design of risk management and liability mechanisms as penalties are considered to apply solely to breach of Directive provisions. Liability matters are addressed under the Environmental Liability Directive. The operator must, nevertheless, ensure that there is full compliance with CCS Directive requirements, as penalties are likely to occur for permit breaches and failure to submit monitoring report data. Non-compliance with these risk management-related measures can be punished by the Competent Authority. This Article does not contradict a more flexible approach to risk management and liability sharing beyond the operator, provided that penalties are proportional to liabilities.

Article 34 Amendment of Directive 2004/35/EC

“In Annex III to Directive (2004/35/EC) (The Environmental Liability Directive), the following paragraph shall be added: ‘14. The operation of storage sites pursuant to Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of CO₂ (‘); Article 4.1 This (Environmental Liability) Directive shall not cover environmental damage or an imminent threat of such damage caused by ... b. a natural phenomenon of exceptional, inevitable and irresistible character.’”²⁹

Operators have obligations in respect of the prevention and remediation of environmental damage, associated with such sites. Financial security measures are also to be undertaken by storage site operators further to Article 14. A flexible interpretation of Article 14 allows for use of ceilings on financial instruments as well as exclusion of liability on behalf of operators, where they are not at fault or are otherwise not negligent. It is also important to note that a CCS operator will not be liable for environmental damage or the imminent threat of damage in relation to a natural phenomenon of exceptional, inevitable and irresistible character.

From the preceding analysis, we can establish that, as a minimum, CCS Directive Articles 16, 17, 18, 19, 20, 28 and 34 all provide Competent Authorities with liability management powers. The following Articles (in Table 2) achieve the same with risk management functions, thus adding to overall liability management powers for Competent Authorities.

²⁹ *Id.*

In regards to risk management, the Directive articles which address this issue are the following:

Article 4: Selection of Storage Sites

“Member States shall retain the right to determine the areas from which storage sites may be selected pursuant to the requirements of this Directive.”³⁰ It is both possible and advisable for Member States to consult with technical experts and other stakeholders when determining site selection. A partnership approach to the site-selection process could induce joint involvement in shared liability.

Article 11: Changes. Review, Update and Withdrawal of Storage Permits

1. The operator shall inform the competent authority of any changes planned in the operation of the storage site, including changes concerning the operator.³¹
2. Member States shall ensure that no substantial change is implemented without a new or updated storage permit issued in accordance with this Directive. Annex II, point 13, first indent of Directive 85/337/EEC shall apply in such cases.³²
3. The competent authority shall review and where necessary update or, as a last resort, withdraw the storage permit: (a) if it has been notified or made aware of any leakages or significant irregularities pursuant to Article 16(1); (b) if the reports submitted pursuant to Article 14 or the environmental inspections carried out pursuant to Article 15 show non-compliance with permit conditions or risks of leakages or significant irregularities; (c) if it is aware of any other failure by the operator to meet the permit conditions; (d) if it appears necessary on the basis of the latest scientific findings and technological progress; or (e) without prejudice to points (a) to (d), five years after issuing the permit and every 10 years thereafter.³³
4. After a permit has been withdrawn pursuant to paragraph 3, the competent authority shall either issue a new storage permit or close the storage site pursuant to Article 17(1)(c).

³⁰ *Id.*

³¹ *Id.*

³² *Id.*

³³ *Id.*

Until a new storage permit has been issued, the competent authority shall temporarily take over all legal obligations relating to acceptance criteria where the competent authority decides to continue CO₂ injections, monitoring and corrective measures pursuant to the requirements laid down in this Directive, the surrender of allowances in cases of leakage pursuant to Directive 2003/87/EC and preventive and remedial action pursuant to Articles 5(1) and 6(1) of Directive 2004/35/EC.³⁴

In respect of commercial scale storage sites, it is worth recalling that geological storage will extend over long periods of time. Therefore, the CCS Directive spells out framework requirements to ensure the long-term stewardship of storage sites. The Directive, thus, provides for the possibility for sites to be transferred to Member State control in the long term. However, that can only occur once the Competent Authority has been assured that no leakage is likely to occur (the operator retains responsibility for a site whilst it presents a significant risk of leakage). Under the CCS Directive, a storage site shall be transferred (legal liabilities included) to the state when:

- All available evidence indicates that the CO₂ will be completely contained for the indefinite future;
- A minimum period before transfer to be determined by the Competent Authority has elapsed;
- A financial contribution for the post-transfer period covering at least the costs for monitoring for 30 years has been made and;
- The site has been sealed and the injection facilities have been removed. As this is the second key decision in the lifecycle of a storage site (the first being the decision to permit the site for use), a Commission review is foreseen at this stage too.

There is a perception within EU regulatory circles (see CCS Directive, Article 18) that potential storage site operator liabilities and financial obligations end within approximately 20 years post storage site closure (given as a minimum period). However, the nature of Directive Article 18.1-2 language is such that the conditions 1(a) “complete and permanent storage” may not be proven by that time; (b) the 20-year period is a minimum; and 2(c) site evolution “towards a situation of long-term stability” may not be proven by that time. As such, this imprecise Directive language

³⁴ *Id.*

offers regulators an open door to deny the transfer of responsibility from the storage site operator to the Competent Authority at the 20-year threshold. In such circumstances, it has previously been demonstrated, that regulators do not accept such a transfer of responsibility in analogous environmental law fields (in Canada and the United States) pertaining to waste management facilities and contaminated land sites. Notably, transfers can be indefinitely stalled by Competent Authorities through requests for more monitoring data for example. This issue ought to be considered by industry when discussing and agreeing permit conditions with particularly risk averse governments.

B. Environmental Liability Directive

The CCS Directive itself does not address the specific mechanics of liability. Hence, we must look to the Environmental Liability Directive and the Emissions Trading Scheme Directive as the CCS Directive delegates this matter to them.

Further to Article 34 of the CCS Directive, the Environmental Liability Directive brings storage site operations within the liability framework of the European Union. As such, operators of CCS sites have obligations in respect of the prevention and remediation of environmental damage associated with such sites. This applies to all relevant “environmental damage” and corresponding duties of prevention (Article 5) and remediation/mitigation (Article 6) under the Environmental Liability Directive. Financial security measures are also to be undertaken by storage site operators further to Article 14 of the Environmental Liability Directive. A flexible interpretation of Article 14 allows for the use of ceilings on financial instruments. It also allows for the exclusion of liability on behalf of operators, where they are not at fault, are otherwise not negligent or a *force majeure* exception is available.

C. Emissions Trading Directive

If we move on to the Emissions Trading Directive, by virtue of the inclusion of geological storage sites under Annex I of the Emissions Trading Directive, installations will be required to surrender allowances for any emissions from the site (including leakage) as calculated pursuant to the Monitoring and Reporting Guidelines for CCS. The amount of the Financial Security (“FS”) for this obligation can be based on the potential total tons of emissions, including due to leakage(s), multiplied by the market cost of purchasing an equivalent amount of allowances. This

calculation will require (1) estimates for the total tons of emissions that may be released, including due to leakage(s), (2) the timing of emissions, and (3) costs of allowances when releases occur.

It is worth noting that Commission GD4, which is discussed in more detail in the next section, has excised language from its draft version, that specifically did not recommend the determination of FS (for the surrender of allowances due to leakages) by multiplying the estimated amount of funds by the probability that the scenario occurs. Now, a “realistic and appropriate middle ground scenario taking into account all available evidence of the site-specific risk profile is used” as recommended. In addition, GD4 contains a method for the “calculation of the potential leakage amount based on a probability distribution of the amount of leakage from the storage complex” when “there is a proposed use of probability distribution for determining the size of a leak (not the probability that it will occur)”. It also gives regulators the choice of selecting a risk percentile for the size of the leakage to be used instead as an estimate, instead of an inflexible 25% default contingency for FS. Furthermore, there is specific mention of the fact that FS amounts may now be updated “in case of leakage or significant irregularities, or where the monitoring plan is updated pursuant to Annex II of the CCS Directive”. Further to our original research, which underlined the purpose of site-specific risk assessment, GD4 now emphasises that risk profiles differ by the type and upkeep of a storage site and that financial contributions by operators ought to reflect that. Taken as a whole, these amendments grant more flexibility for the development and implementation of a risk estimation curve that can be co-delivered by government and industry cooperating on a site-specific basis.

GD4 observations aside, there is unavoidable uncertainty about the future price of EU Allowances (“EUA”) at the time of any potential leakage. There is no cap on the EUA price; the penalty for excess emissions (100 Euros per tonne) does not relieve the operator of the need to provide allowances to cover the emissions and is not therefore a cap on EUA prices.

The need to hedge against such risk becomes important when it is likely that liability for allowances would entail greater costs over time, as carbon prices rise. Furthermore, the assumption of long-term emissions credits liability would mean that allowances which are bought in the future, as a compensatory measure for loss of CO₂ stored, would be with a significantly higher price range than those bought today, which would only

further defer investments. Therefore, as such, a liability of this kind is not insurable and presents an incalculable risk to potential storage site operators.

It is worth noting that, in terms of financial risk derived from liability, the purchase of emissions credits serves as a climate change mitigation and prevention strategy in itself. Arguably, damage in terms of failed climate change mitigation is already covered in respect of the types of damage listed in the EU Environmental Liability Directive (2004/35/EC) (including, but not limited to species loss, marine ecosystem damage, fundamental changes in land use, damage to land, damage to water, etc.). These types of damage occur as a result of anthropogenic climate change as well, which is why CO₂ as a pollutant has already been determined to be remediated under climate change mitigation measures. Accordingly, if capture operators are legally required to buy emissions credits and storage operators are also bound to cover liability for the same leakage event, there is an apparent double-payment by the operator. This problem of double-counting liability should be addressed by counterbalanced regulatory solutions that push forward CCS technology investment.

D. Implementation of Directive 2009/31/EC on the Geological Storage of Carbon Dioxide, European Commission Guidance Document 4

Further to the prompting behind our original research and inputs to the European Commission Inter-Service and stakeholder consultations around financial instruments and liability for CCS, GD4 has met expectations that it would enhance flexibility for regulators to design and implement innovative solutions to long term liability and shows a greatly relaxed language, as to the financial options available to Member States. There is much at stake in this regard, as the absence of such solutions could likely cause prospective firms that are interested in CCS storage to withdraw said interest. As it stands, GD4 broadly encourages Member States to secure the payment of the Financial Contribution (“FC”) through the instruments and procedures described for FS. It recommends options that are simple, established, and low risk. Accordingly, complex financial arrangements are to be avoided as falling outside the core competencies of Competent Authorities; they are arrangements that appear to flout financial principles (e.g., more certainty and higher return) and may contain hidden risks. The intent of FS and FC is to protect taxpayers and these programmes are not intended to be used for financial speculation.

GD4 pays particular attention to the flexibilities of interpretation around Articles 19 and 20. With regard to Article 19, the following considerations are suggested in GD4:

- FS should be periodically adjusted to take account of changes to the assessed risk of leakage and the estimated costs of the obligations to be addressed. This gives flexibility to operators if they are able to establish low risk (or declining risk).
- FS instruments can include funds, financial institution guarantees, insurance, and first party and related party guarantees irrevocable trust funds, escrow, letter of credit, or surety bonds. Operators may also offer EUAs as equivalent to FS but their acceptance depends on the Member State assessment that the EUAs provide sufficient certainty, amount, liquidity and duration as well as the assurance that the same EUAs are not held as FS for any other purposes at the same time. The determination of FS by multiplying the estimated amount of funds for a corrective measures scenario, by the probability that the scenario will occur, is not recommended (due to the fact that if the likelihood of requiring certain corrective measures is considered to be very low, such an expected value calculation, will result in an amount of FS that will be inadequate in the actual event of such FS being needed) unless the calculation of the potential leakage amount is based on a probability distribution.
- Member State and national Competent Authorities may use specific types of allowable FS mechanisms that might be derived from existing laws and regulations about FS instruments that are acceptable for closure and post-closure care of waste landfills, for wastes from extractive industries, decommissioning of offshore structures, trans-frontier movements of hazardous wastes, environmental liabilities under Directive 2004/35/EC (“ELD”) and other relevant national programmes.
- Determining an appropriate amount of FS for surrender of allowances ought to be based upon a “realistic and appropriate middle ground scenario taking account of all available evidence of the site-specific risk profile” and a “calculation of the potential leakage amount based on a probability distribution of the amount of leakage from the storage complex”.

Article 20 shares the intent (of Article 19) that the post-transfer costs, of at least the monitoring obligation for a period of 30 years, need to be fully covered by the operator and that necessary funds be readily available to the CA. However, GD4 gives further interpretation to some mechanisms which can be used to finance this long-term liability:

- It should not be assumed that the idea of a prepaid insurance policy for financial assurance of geological sequestration site closure and post closure monitoring would necessarily also extend to an additional 30 years of monitoring after the transfer of responsibility.
- The CCS Directive does not require that the FC cover the full estimated amount of the costs which the CA will incur for the post-transfer obligations. However, there is no restriction on setting the amount of the FC at a value that might represent the full costs of those obligations.
- With respect to determining the amount of FC, Member State may allow the use of expected value techniques for estimating FC amounts for contingent obligations in addition to using more deterministic approaches to estimating the FC for monitoring. In other words, when calculating an amount for FC, the probability of each type of contingent event may be factored into the cost estimates.
- Member States with multiple storage sites can pool the risks of contingent obligations to some degree. Where the Member State intends for the operator's FC to cover the CA's full costs, then the expected value approach should not be used.
- Elements related to the history of storing CO₂ also may be relevant in determining the post-transfer obligations of the CA. In particular, the occurrence of leakages or significant irregularities, detection of significant adverse effects and assessment of the effectiveness of corrective measures taken may affect estimates of the probability, duration, scale and scope, intensity and timing of post-transfer obligations.

In discussing CCS long-term liabilities, GD4 authors have demonstrated the knowledge that a risk-sharing approach, such as commercial insurance or risk pooling, would be preferable. Specifically, they have acknowledged that obligations, which appear least likely to arise, namely, corrective measures due to leakages and surrender of allowances due to leakages, are also those which would impose the largest cost burden (this being the

case, particularly, for the surrender of allowances). Thus, they recommend that, for a well-developed technology, with a large number of relatively homogeneous sites and a long empirical history, some kind of risk-sharing approach be established; insurance is given as an example. They also do mention, however, that the lack of experience with CCS and other factors creates a high degree of uncertainty in estimating probabilities and magnitudes of leakages. Interestingly, following our original research, the revisions that appear in GD4, have resulted in a ‘softening’ of the language regarding the sufficiency of existing data. As such, GD4 could be interpreted as being more open to the contribution of expertise (regarding the estimation of high-risk low-probability events such as leakages) from industrial stakeholders.

By way of a counterbalance, GD4 does recognise that an overly cautious approach would penalise the technology in its early years, by requiring more security than the actual risk warrants. GD4 authors recommend that Member States steer between these extremes, in particular by evaluating risk during the site characterisation phase. They perceive that the information, thus gathered, may serve as a sufficient basis for a financial security regime to be constructed specifically for CO₂ leakages - a regime which would take reasonable account of the limited risk of the more extreme events, whilst not distorting the costs of CCS or exposing the taxpayer.

Overall, the revised language in GD4 is more flexible regarding the financing options available to Member States. The revision now explicitly adopts that allowance be made for public/Member State insurance. The opinions put forth by its authors are encouraging, especially with regards to demonstration phase projects, where certain allowances will be made. For example, Member States are granted the opportunity to provide public insurance, in the absence of commercial insurance, by accepting transfer of risk in relation to surrender of allowances, in exchange for a non-refundable premium. This is a useful option, as it helps to resolve the inherent risk that attends otherwise uninsurable activities and events. Should that insurance be provided in conditions that are more favourable than those of the market, this may come under State Aids obligations and the Commission must be notified. The same requirement applies to post-demonstration phase fully commercial sites.

It must be noted, however, that Member States are cautioned that methods for meeting the FS must be found, even

when there are few CCS projects on the ground. Member States are allowed to pool FS arrangements for first mover sites, in order to increase the number of projects participating in the insurance scheme and finance any liability in excess of the pool by establishing a method for profit and loss sharing. This option is sensible, provided that risk pooling is adjusted for individual site characteristics – including both technical and financial risks. Care would also need to be taken in ensuring that profit and loss sharing calculations do not involve cross-subsidisation as between firms.

Other risk-sharing arrangements may be possible, as GD4 is not exhaustive on this point. Therefore, this ought to encourage Member States to appropriate a flexible approach to leakage liability, particularly in the deployment of demonstration projects. This attitude may well encourage investment in CCS technology rollout, as well as mandate data gathering for important statistical measures, as to the exact risk parameters associated with long-term storage of CO₂. Once complete, this data will enable authorities to draft permitting and regulatory measures, which are appropriate to the full-scale commercial rollout of CCS.

Overall, a pragmatic view of European Commission CCS GD4 would be one where the required security and additional contingency measures are assessed on a site-by-site basis. A distinction ought to be made between liabilities in the demonstration and commercialisation phases, as demonstration projects will be facing first-of-a-kind issues. If a Member State has issued a permit to the operator, it should assume that there is very low risk of that site leaking (issues of past oil well, related access to info, and other site characteristics will have been made public, etc.). The operator and the Competent Authority ought to, therefore, agree to a shared risk profile, perhaps through an insurance mechanism, which would allow risk exposure to be capped for the operator.

E. Review of the CCS Directive

The first European Commission Report on the review of Directive 2009/31/EC on the geological storage of carbon dioxide, does not provide a significant change to the state of the legislation as is, but rather elucidates some of the thinking around CCS development, indicating the preferred methods of market

incentivisation, without disbaring any of the flexible options discussed in this article.³⁵

Overall, the report concludes that the Directive is “fit for purpose and sets up the necessary regulatory framework to ensure the safe capture, transport and storage of carbon dioxide while allowing the Member States sufficient flexibility.”³⁶ Furthermore, it considers transposition measures to be complete, for all but one Member State, and is advancing with conformity checks. The safety provisions and legal certainty emanating from the CCS Directive and GD4 are, therefore, seen as providing sufficient signals to investors and any changes to the Directive, at this stage, are discouraged, in order to not de-stabilize the efforts made so far.

However, despite the overall favourable review, there is an acknowledgment by EU policymakers that the development of CCS in Europe has been lacking, with a dearth of practical knowledge impacting the ability to review available legislation in a thorough manner. For example, there is a need to identify whether and what existing transport and potential storage infrastructure is suitable for reuse including by reference to existing natural gas infrastructure and facilities and information sharing thereupon. It would be of considerable utility for the EU and her Member States to build these research components into existing research funding programmes. A similar observation applies to other sub-surface geological formations noting that the costs of acquisition, exploration and related data acquisition can amount to €6 (\$8) - €20 (\$25) per tonne of CO₂.³⁷ When this information is made available then regulators should consider how to transfer or licence such infrastructure for CO₂ transport and storage purposes *vis-a-vis* incumbent owners/rights holders while ensuring that said regulators have the legal competence to regulate offshore facilities. It is interesting to note that, in comparative terms, the United States and Canada should also look to address the offshore regulation of CCS as they have yet to do so.³⁸ This is particularly the case for the

³⁵ *Report from the Commission to the European Parliament and the Council on the Implementation of Directive 2009/31/EC on the Geological Storage of Carbon Dioxide*, COM (2014) 099 Final (Feb. 25, 2014).

³⁶ *Id.*

³⁷ ZEP, *The Costs of CO₂ Capture, Transport and Storage: Post-demonstration CCS in the EU*, GLOB. CCS INST. (July 20, 2011), <https://www.globalccsinstitute.com/resources/publications-reports-research/the-costs-of-co2-capture-transport-and-storage-post-demonstration-ccs-in-the-eu/>.

³⁸ See R. W. Webb & Gerrard, M.B., *Overcoming Impediments to Offshore CO₂ Storage: Legal Issues in the United States and Canada*, 49,

United States as the Department of Energy's Energy Technology Laboratory announced \$18 million for four offshore projects.

In a related development, last year's first annual general meeting of the Gulf of Mexico Offshore Projects reported the joint aim "to develop partnerships which will work on storage assessment, risk assessment and modelling, identifying monitoring technologies for offshore, infrastructure re-purposing (pipelines, platforms, and wells), regulatory considerations, and knowledge dissemination and outreach".³⁹ As such, relevant offshore CCS legislation will need to follow particularly once the demonstration phase for these projects is complete. Rather encouragingly, in May 2019, United States Senator John Cornyn (Republican, Texas) introduced Bill 1675 seeks to promote the research, development and commercialisation of natural gas carbon capture technologies, including through private sector partnerships on demonstration projects.⁴⁰ However, said legislation does not address CCS operations beyond this phase. Further to these initiatives, the low carbon price and the high cost of implementation for Member States remain as significant barriers facing the desired whole-scale deployment of CCS in 2030. Specific examples are made of successful CCS projects outside of the EU, which often provide an added economic benefit (through the use of Enhanced Oil Recovery, a technique that is well-established in the USA).

The acknowledgement of these issues, however, is not seen to require any further legislative intervention on an EU level. The Commission sees Articles 19 and 20 as giving enough scope to Member States, to decide how operators should prove their ability to safely operate and monitor storage sites including up to the transfer of responsibility to the Competent Authority. Furthermore, as there is not enough practical experience, there is deemed to be a lack of experience with Article 18 (i.e., post-closure transfers of site liability to the competent authority), which will have to wait until the next Commission review to be updated, if that is seen as

ENVTL. L. REP., 10634, 10634-10647, (2019) (According to the authors, these jurisdictions regulate offshore CCS through a patchwork of laws rather than a specifically designed offshore CCS framework. This will make the advancement of offshore CCS in places such as the Cascadia Basin - a large offshore basalt rock formation with considerable storage potential - a challenging proposition.).

³⁹ Tim Dixon, *Gulf of Mexico Offshore Projects First Annual Meeting*, IEAGHG.ORG (Feb. 13, 2019), <https://ieaghg.org/ccs-resources/blog/gulf-of-mexico-offshore-projects-first-annual-meeting>.

⁴⁰ Nick Snow, *US Senate Bill Would Boost Carbon Capture Research*, 117, OIL & GAS J., 1, (2019).

necessary. GD4 revision is also deferred to within 5 years' time as we await more practical knowledge.

In essence, the only new feedback from the 2014 Commission review report is to point to the reforms of the EU carbon market and ETS Directive as the major expected drivers for CCS and to demur on the issue of Emission Performance Standards as an unnecessary adjunct to the ETS reform. The legislative framework available (CCS Directive and GD4) will remain in place, unchanged in the near future, and incentivisation of CCS projects will either have to wait for the promised ETS reform, or to take advantage of the flexibility inherent in the Directive and Guidance documents in addressing the heretofore neglected long-term liability issues. If anything, we can see that while the Commission is thinking of the low carbon price as a barrier, there is, so far, a lack of acknowledgement that long-term liability and risk provide equally strong, negative investment signals.

This is further evidenced in the summary opinions that the European Commission has issued on two CCS permit applications. Further to Article 10 [(1) - (2)] of the CCS Directive, the European Commission is given the opportunity to issue non-binding opinions on such draft storage permits. In the case of Block P18A of the Dutch Continental Shelf, a proposal in which the scientific advice indicates effectively no leakage, environmental or health risk, the Commission sought additional legal assurances in respect of:

- Notification of leakage risk (CCS Directive Articles 8 and 9);
- A requirement that the wells in the adjacent P-15-9 reservoir must be CO₂ secure as a condition of their closure (CCS Directive Article 8);
- Specific permit provisions on changes, review, updating and withdrawal of the storage permit (CCS Directive Articles 8 and 9);
- Further information on the financial security for the project which otherwise “appears to be at a very early stage” (CCS Directive Articles 8 and 9);
- Further professional development and technical training of the operator and all staff (CCS Directive Article 8); and,
- The processes, findings and outcome of the Environmental Impact Assessment pursuant to Article 5 of the

(Environmental Impact Assessment) Directive 85/337/EEC.⁴¹

The European Commission reserved its rights to intervene further in the storage application and permitting process as development consent has not been granted at this stage. Similarly, in the case of the UK draft permit for carbon dioxide storage in the depleted Goldeneye gas condensate field on the UK Continental Shelf, the European Commission warned the UK that it had not provided sufficient information in its first draft permit submission (upon which a second submission was subsequently satisfactorily submitted and reviewed). The site features a negligible risk of leakage, environmental or health risk. In its Opinion, the Commission calls attention to a dispute over the post-closure transfer of responsibility of the site with Shell (Petroleum) UK indicating 6 years and the competent authority calling for 20 years in accordance with the Directive. This dispute is also vital to a determination as to whether the legal requirement for adequate financial security has been satisfied. Unsurprisingly, as with the Dutch permit application, the Commission opinion has withheld its approval of the UK draft permit for carbon dioxide storage until such time as an Environment Statement (in relation to an Environmental Impact Assessment), which evaluates the effects of substances other than CO₂ that are present in CO₂ streams, is completed and approved. The same applies to agreement upon and provision of evidence of financial security for the full 20-year post closure monitoring period (CCS Articles 18 and 19).⁴²

In summary, these two storage permit applications offer further evidence of the need to address project proposal risk in the context of CCS Directive barriers to the realisation of CCS as a viable contributor to climate change mitigation in a much-needed

⁴¹ *Relating to the Draft Permit for the Permanent Storage of Carbon Dioxide in Block Section P18-4 of Block Section P18a of the Dutch Continental Shelf, in Accordance with Article 10(1) of Directive 2009/31/EC of 23 April 2009 on the Geological storage of Carbon Dioxide*, COM (2012) 1236 Final (Feb. 28, 2012).

⁴² *On a Draft Permit for the Permanent Storage of Carbon Dioxide in the Depleted Goldeneye Gas Condensate Field Located in Blocks 14/28b, 14/29a, 14/29e, 20/3b, 20/4b and 20/4c on the United Kingdom Continental Shelf, in Accordance with Article 10(1) of Directive 2009/31/EC of 23 April 2009 on the Geological Storage of Carbon Dioxide*, COM (2016) 152 Final (Jan. 20, 2016).

Paris Agreement implementation framework. Pursuant to the second Report on the Implementation of Directive 2009/31/EC (The CCS Directive), we shall see whether the Commission is similarly disposed to CCS as a means of implementing the Paris Agreement when we obtain the Commission opinions on an application for a storage permit that is being reviewed in Italy and an application for the Q16 Maas field further to the Netherlands ROAD project⁴³. This is not known at the time of the third report on the implementation of the Directive (October, 2019). On a more optimistic note, according to the Commission “a considerable number of Member States and Norway continue to support or plan to support projects in the near future, through their national programmes or funds, research and demonstration activities on CCS”.⁴⁴ As well, the Dutch CCS Porthos project has submitted two further storage permit applications and sought an amendment to an existing permit while Norway has awarded an exploration permit for CO₂ storage on the Norwegian Continental Shelf.⁴⁵ Another application for an exploration permit has been filed in Andalucía, Spain.⁴⁶ As further evidence of efforts to develop CCS activities there are two main networks, the North Sea Basin Task Force and the Baltic Sea Region CCS Network which together have eight states cooperating in the development of transboundary solutions for the transport and geological storage of CO₂.⁴⁷

F. EU State Aids / Competition Law

There may be those that point to State Aids/competition law restrictions on regulatory solutions for financial instruments, for long term liability regulation, further to the CCS Directive. It is noted that, to date, the UK (pre and post-Brexit) and German governments have taken a favourable position in this regard by adopting a flexible approach to State Aids, and it would appear that the European Commission is similarly disposed by reference to its

⁴³ *Report from the Commission to the European Parliament and the Council on the Implementation of Directive 2009/31/EC on the Geological Storage of Carbon Dioxide*, COM (2017) 37 Final, (Jan. 2, 2017).

⁴⁴ *Report from the Commission to the European Parliament and the Council on the Implementation of Directive 2009/31/EC on the Geological Storage of Carbon Dioxide*, COM (2019) 566 Final (Oct. 31, 2019).

⁴⁵ *Id.*

⁴⁶ *Id.*

⁴⁷ *Id.*

Guidelines on environmental and energy state aid for 2014–2020.⁴⁸ There is also a strong argument to suggest that, in its essence, carbon dioxide storage represents a public good or service, that fulfils a government function of mitigating climate change. By storing carbon, which would otherwise have been inevitably produced in order to satisfy energy demand, storage serves to mitigate climate change and to meet binding emissions reduction targets, which are placed upon governments within an EU and international legal context. Given the additional point that carbon storage may well turn out to be a cost versus revenue neutral activity, some easing of State Aids rules/competition law should apply. This argumentation is supported by the EU Treaty obligation of competition law to not obstruct the performance, in law or in fact, of the particular tasks assigned to services of general economic interest (i.e., arguably, the provision of carbon storage for climate change prevention and mitigation is such a general economic interest).⁴⁹

Thus far, leading Member State governments have taken a sensible approach to State Aid regulation and CCS. For this reason, it is not suggested that a formal procedure be commenced to review and amend the EU General Block Exemption Regulation or Guidelines on environmental and energy state aid for 2014–2020, with the aim of codifying new principles and rules in respect of CCS. This would constitute a drawn out and cumbersome process. Given the history of CCS Directive negotiation, there would be further uncertainty about the result and Member States and non-State interests, which are without direct and active interests and projects in the field of CCS, would still be in a position to influence the outcome in a manner, which may not best serve Member States and private sector actors that wish to advance CCS technology. There is also the observation that, the revision of EU state aids regulation and guidance for CCS should have taken place at a time that was commensurate with the creation of the CCS Directive.

In any event, the signs are that a flexible approach is being taken by CCS implementing states, to the interpretation of State Aids disciplines. As such, it is anticipated that regulators will continue along these lines, as this approach has been further

⁴⁸ *Guidelines on environmental and energy state aid for 2014–2020*, 2014 O.J. (C 200) 01. *see also*, Press Release, *State Aid: Commission Approves UK Support Scheme for Early Study Work on Carbon Capture and Storage Demonstration Projects*, 2013 O.J. (Mar. 20, 2013), https://ec.europa.eu/commission/presscorner/detail/en/IP_13_254.

⁴⁹ The issues raised in this sub-section require more detailed treatment but are beyond the scope of this article.

reinforced in the GD4 document. Specifically, the revisions that appear in the document contain new language, which discusses the possibility for Member States to provide some form of insurance (in the absence of an insurance market for CCS) through a form of risk-transfer. For example, this could appear as a surrender of allowances in exchange for a non-refundable premium. Notably, State Aids/competition law objections would only be invoked if the said insurance is found to have been provided in commercial conditions that are more favourable than those of the current market. Furthermore, in another notable final revision in favour of flexibility of policy/regulatory design, GD4 is not exhaustive as to other types of risk-sharing arrangements, which could be established, including individual risk-sharing arrangements with CCS operators, on a case-by-case basis. The only stipulation provided in the GD4 is that, “Where State aid within the meaning of Article 107(1) of the TFEU (*Treaty for European Union*) is involved in the establishment of the FS, in accordance with Article 108 of the TFEU, that State aid must be notified and authorised by the Commission before it is granted.”⁵⁰ This stipulation is merely a statement of applicable EU law.

G. Summary

Noting the further regulatory and guidance requirements, discussed in Section 2, and taking account of the financial, environmental and human health liabilities surrounding ownership of a storage facility under the CCS, ETS and Environmental Liability Directives, it is submitted that a cooperative or partnership-based approach to long term liabilities is required. This point is further underscored when EU leaders have legislated in a field for which there is no long-term liability insurance, thus depriving industry of traditional Act of God insurance clauses that apply in respect of naturally occurring events, which are beyond the control of industrial operators. In the field of CCS, this is a highly consequential omission and, thus, entails significant additional risk for storage site operators because earthquakes/tectonic plate shifts constitute the most significant type of risk, in relation to long-term CO₂ storage. In the absence of a “cooperation” or “partner-based” approach, with the regulator, these events are uninsurable and hence, all the financial and liability-related risk is placed on the storage site operator.

⁵⁰ Directorate-General for Climate Action, *supra* note 23.

II. COMPETING JURISDICTIONS ARE STRETCHING FIRST MOVER ADVANTAGE

A. *First Mover Advantage through Regulation*

Within the United States, regional and state-level initiatives to address emissions from the power sector have been accompanied by state and regional funding initiatives in innovation and investment for carbon capture and storage. Federal initiatives alone amount to \$11 billion in investment in CCS projects, with a further US-China Clean Energy Research Centre, aimed at joint CCS technology development and implementation. In respect of the most prominent such project funds (FutureGen), the states of Illinois and Texas waived any storage site operator long-term liabilities in respect of leakage for the (currently suspended) FutureGen project sites. Further to this point, in order to ameliorate permanent liability risk upon the private sector the states of Texas, Montana and North Dakota permit the transfer of liability to them. In this regard, it is noted that though federal regulation of CCS does exist in the form of the Environmental Protection Agency's final permitting rule (for injection of CO₂ for long term storage in Class Vi wells)⁵¹ state-level regulation leads the way with more investor-friendly risk reduction mechanisms in the form of liability transfers and fewer and shorter post-injection regulatory requirements. In contrast, Federal Class VI well permitting leaves no room for transfer of liability from the permit holder to the state and has 50-year post-injection site care requirements. This is hardly an endorsement for private sector research and development or related investment in the CCS business. Hence, the area of liability continues to receive significant attention in the United States. Canada follows the same pattern with the federal government maintaining relative regulatory silence while the sub-federal provinces particularly Alberta develop investment and user-friendly approaches to CCS site permitting and liability management along the lines of the State of North Dakota.

Still, according to the United States Environmental Protection Agency, carbon capture and storage is being seen as a key enabling technology in relation to the US energy mix. As such, CCS has been a focal point for significant research and development funding. Electricity sector modelling suggests even faster initial penetration of CCS at commercial scale with carbon capture technology already being deployed at a coal-fired power

⁵¹ Criteria and Standards Applicable to Class III Wells, 40 C.F.R. §146.31-4 (2020).

plant at Boundary Dam, Saskatchewan.⁵² Further to this point, five Class VI CCS storage permits have been issued, four for FutureGen and one for the Archer Daniels Midland (Illinois) Industrial CCS Project. Similarly, the COORETEC and Coal21 Programmes in Germany and Australia reinforce this perspective. Such jurisdictions tend to resonate with the IEA's policy recommendation to address limits to long-term project liability (particularly in the demonstration phase) through project indemnification by government and other industry supportive measures.

In Canada, as part of efforts to make Canada a global leader in carbon capture and storage, the government of Alberta alone has dedicated \$2 billion to CCS projects as a centrepiece of greenhouse gas emissions mitigation through to 2050.⁵³ Alberta's government has estimated that CCS could contribute approximately 70% of the province's CO₂ mitigation efforts and intends to have several projects operational this year. The Weyburn project has been operating for more than a decade and provides an excellent example of how projects can operate across borders and boundaries (the Weyburn operations cover both sides of the US-Canadian border).

In Alberta, the CCS Act amends the Mines and Minerals Act, so that a closure certificate will be issued upon the completion of a CCS Project. Thereafter, the government of Alberta will take on liability for the captured CO₂, assuming all obligations of the party that injected it into the ground (the lessee) including:

- Obligations as an owner and licensee under the Oil and Gas Conservation Act of the wells and facilities covered by the agreement that authorized the injection of the carbon dioxide;
- Obligations as the person responsible for the injected captured carbon dioxide under the Environmental Protection and Enhancement Act;
- Obligations as the operator under Part 6 of the Environmental Protection and Enhancement Act in respect of the land within the location of the agreement used by the lessee in relation to the injection of carbon dioxide; and
- Obligations under the Surface Rights Act.

⁵² U.S. Env'tl. Prot. Agency [EPA], *EPA Analysis of the Lieberman-Warner Climate Security Act of 2008 S. 2191 in 110th Congress*, 2008.

⁵³ *Id.*

In Australia, as part of ongoing efforts to give industry assurances and respective investment in CCS storage sites, a time limit is set on litigation against CCS storage site operators (20 years following project closure) and the federal government has assumed long-term liability for leakage. These provisions are found in the Offshore Petroleum and Greenhouse Gas Storage Act. These time limits should prove to be of comfort to the commercial insurance industry, as it seeks to extend CCS insurance products beyond operational liability during the closure life of storage sites. Naturally, given prevailing regulatory requirements, the need for financial assurances and the potential length of storage, decommissioning and post-closure periods, the insurance industry has yet to develop and offer products or services in this regard. Zurich announced that it was making two CCS insurance products Carbon Capture and Sequestration Liability Insurance and the Geological Sequestration Financial Assurance available in 2009.⁵⁴ However, Royal Dutch Shell's Peterhead Project could not find an underwriter owing to the lack of available underwriting information (absence of claims history, limited number of CCS projects for risk spreading and undefined liabilities).⁵⁵

Finally, The Norwegian Sleipner project is an important precedent, as we build the evidence base for CCS regulation around the world. This is true for two reasons: thus far no significant leakage issues have arisen, and the project has progressed as expected in this regard; and, second, the Sleipner project itself benefitted significantly from a carbon emission tax of €40 t/CO₂. As such, public sector participation in financing the project loomed large in incentivising CCS in this jurisdiction. Interestingly, the Sleipner Project is silent as to the liability of the Demonstration Project Operator, in effect absolving the Project of any long-term liability for leakage and transferring that responsibility to the government.

B. First Mover Advantage through Demonstration Projects

Against the analytical backdrop of the CCS Directive, there exists a legal argument that much of the planning, policy development and implementation-related activities, as well as contracting around Demonstration Phase projects, had already taken place prior to the CCS Directive enforcement date of 25 July

⁵⁴ Zurich, Advertisement on Carbon Capture and Storage Association, CCSASSOCIATION.ORG, <http://www.ccsassociation.org/about-us/our-members/zurich/> (last visited Feb. 4, 2020).

⁵⁵ News desk, *Shell Sees Large Risk Premiums for Carbon Capture and Storage Cover*, INSURANCETIMES (June 12, 2015).

2011. As such, Demonstration Phase projects would not be subject to the full legal requirements of the CCS Directive, at least with respect to long-term liability, as those projects face first-of-a-kind issues and risks. Furthermore, demonstration projects are necessary as a means of informing government policy on CCS, advancing first mover advantage, as well as better understanding the particulars of permit design.

Equally, demonstration phase projects in Norway, Canada, the United States and Australia have not had long term liabilities placed on project operators, owing primarily to the first-of-a-kind research and development-based nature of such work and the good will that project operators have demonstrated, in sharing knowledge designed to advance CCS as a climate change mitigation option.

If Europe is to maintain pace with these competing jurisdictions then, provided that moral hazard-related concerns can be addressed contractually, demonstration phase projects ought to be subject to a government indemnity, in respect of unintentional environmental damage. For demonstration phase projects that have advanced to the commercial storage stage it is appropriate to develop permit conditions for sites along the lines of the cooperative risk management and financial liability instruments advocated in this Article.

C. Liability Case Studies in the Nuclear, Oil and Gas and Waste Management Sectors

This section of the Article examines three mature regulatory regimes that may inform the manner in which liability should be managed in a CCS context. They are: the nuclear industry; landfill site regulation and the management of oil spills at sea. Aside from other self-evident conclusions, what appears from examining these schemes are more sophisticated approaches to risk management and financial liability sharing. By and large, capped liability schemes are a pervasive feature, and greater investment certainty is in place, even though the risk profiles of these sectors are at least as high as those for CCS storage. The nuclear facility example actually features a much higher overall risk profile. What we also see for these activities is a significantly more receptive response from the insurance sector, which is, arguably, one of the lynchpins to the long-term success of the CCS sector.

With respect to the nuclear industry, the risk longevity for radioactive waste is considerable. High-level radioactive waste is

generally material from the core of the nuclear reactor or within nuclear warheads. Most of the radioactive isotopes in high-level waste emit large amounts of radiation and have extremely long half-lives (some longer than 100,000 years) creating long time periods before the waste will settle to safe levels of radioactivity. Therefore, the potential risks can last for 100,000 years. The risks of nuclear and CCS facilities are, in theory, similar in terms of the possibility of leakage. However, the leakage of radioactive materials would be more catastrophic. As well, serious risk longevity for radioactive material has a greater duration than for carbon dioxide. Even though the likelihood of leakage is similar between the nuclear and CCS industries, depending upon scale and experience, the impact and consequences will be far greater for a radioactive leak with the liability period for CCS appearing to be trivial by comparison.

In the UK, nuclear liabilities are covered by the Nuclear Installations Act 1965 as amended by the Nuclear Installations (Liability for Damage) Order 2016.⁵⁶ Further to the 2016 revisions of the Act, the limit on liability stands at €700 million for each major installation. Therefore, the operator is liable for claims up to this amount and must insure accordingly. Beyond any available insurance coverage, the current Paris/Brussels system applies, with the government contribution to meet any shortfall in insurance coverage to meet the thresholds of €700 million (Paris claims) to €1,500 million (Brussels claims). Such insurance is available in large part because of these caps set on liability. The majority of this insurance is provided by a pool of UK insurers comprising eight insurance companies and sixteen Lloyds syndicates (Nuclear Risk Insurers). This arrangement does not fall under state aids rules as it is set under an International Convention.

In the United States of America, the Price-Anderson Nuclear Industries Indemnity Act (1957) establishes a no fault insurance-type system in which the first \$121.25 million per reactor is payable by the operator when an accident occurs with a maximum liability cap per reactor per incident of \$450 million.⁵⁷ Therefore, evidence of ability to pay is required as part of an operator's permit conditions. Noting that there are 104 such reactors, \$12.6 billion of the system is industry-funded through private nuclear insurance pools. Any claims between \$121.25

⁵⁶ The Nuclear Installations (Liability for Damage) Order 2016, C. 562 (Eng.), https://www.legislation.gov.uk/ukxi/2016/562/pdfs/ukxi_20160562_en.pdf.

⁵⁷ 42 U.S. C. § 2210 (2006).

million and \$450 million would be covered by the federal government. Thus far, a secondary insurance payout under this Act has not been required. By corollary, if CCS Directive transposition in the UK had resulted in a cap on liability, then the serious absence of insurance (e.g., Royal Dutch Shell's Peterhead Project) for CCS storage site liability may well have been remedied. It would also have, arguably, incentivised private sector participation in carbon capture and storage.

In respect of waste management and liability, landfill sites represent a potentially useful comparison with CCS storage sites, on the basis that both facilities entail risk of leakage during the site life and well beyond it. Both sites feature risks that arise beneath the Earth's surface (and as such are conventionally out of view) and both risks may be large. In respect of liability, insurance cover is needed for the long duration of the closure-related sealing and inspection period for landfill (possibly 20-30 years). This is expected to cover public and employee liability, from methane leaks to injuries, and to indemnify the operator or the authority from any continuing liability. The fact that such insurance exists is a key reason why the private sector is involved in the landfill business.⁵⁸ Arguably, a state role in advancing public goods and services such as waste management, environmental protection and, by analogy, climate change mitigation is justified if not mandated by law in the public interest.⁵⁹

With respect to oil and gas spills at sea, they are comparable to Carbon Capture and Storage's financial and regulatory aspects in the sense that, in both cases, an international pool fund may be appropriate in case of incidents, such as leakage or structural failure of seagoing vessels. Accordingly, funds could be drawn down to cover the cost of damages. The consequences of the failure of both cases (i.e. oil and gas spills and CCS) are broadly similar. When such vessels fail or leak, oil and gas get released into water and the atmosphere. The failure of CCS infrastructure has analogous consequences. If there is a leak in deep geological formations, the

⁵⁸ Interestingly, waste management sector public fund schemes exist at country level in order to address post-closure costs. DuPage County Illinois set up a \$232 million public fund in order to cover potential post-closure costs for nine landfills. *see* Concerned Citizens of Cattaraugus County, Inc., *Municipal Liability for Pollution*, CONCERNEDCITIZENS.HOMESTEAD (Apr. 1, 2008), http://concernedcitizens.homestead.com/municipal_liability.html.

⁵⁹ Borden Ladner Gervais, *Canada: The Non-Polluter Pays: Municipal Liability For Cleaning Up Migrating Contamination*, Mondaq (Dec. 11, 2012), <https://www.mondaq.com/canada/Environment/210938/The-Non-Polluter-Pays-Municipal-Liability-For-Cleaning-Up-Migrating-Contamination?>

captured CO₂ is released into the atmosphere and in case there is a leak in the ocean, the captured CO₂ is released into the hydrosphere with similar risks to the environment as those of oil and gas spills.

Further to the 1992 Convention on Liability and Compensation for Oil Pollution Damage, an international fund for compensation for pollution damage named “The International Oil Pollution Compensation Fund 1992” pays the costs and damages resulting from an accident, of course, providing that the Fund cannot prove that the accident was intentional or occurred as a result of negligence and misconduct.

A tanker owner's liability limit, under the Civil Liability Convention, depends on the size of the tanker. The liability limits set out in the Civil Liability Convention, in respect of claims following a spill of persistent oil, are as follows:

- For all tankers with a gross tonnage up to 5,000: 4.51 million Special Drawing Rights (SDR)(approximately \$7 million);
- For tankers with a gross tonnage of between 5,000 and 140,000: 4.51 million SDR plus 631 SDR (approximately \$1,000) for each gross ton in excess of 5,000; and
- For tankers with a gross tonnage of 140,000 and over: 89.77 million SDR (approximately \$140 million).

As with the nuclear liability analogy, the existence of a cap on liability, in addition to insurance, is not coincidental. Both elements form the minimum basis for private sector participation in these sectors. By analogy, CCS regulation should facilitate the existence of these mechanisms if private sector participation is to be both fruitful and competitive with other CCS jurisdictions.

III. OPTIONS AND FORWARD-LOOKING SCENARIOS

D. CCS Regulation in the USA

Due to the relative uncertainty, over potentially isolated significant leakage incidents, commercial insurers are currently shying away from long term liability insurance provisions for CCS, though they are committing to operational insurance (e.g. Zurich Financial Services). Experience dictates that environmental regulators look to insurers for the design of environmental liability legislative provisions. Where long-term liabilities are uninsurable,

then it is of critical importance to create other investment incentives and create mechanisms, which effectively share the risk (and potential liability) beyond the storage operator. Otherwise, industry will be unwilling to internalise the risk and promising initiatives may well fail. There is considerable discussion of USA-style options when moving forward with CCS in Europe, in part because Anglo-American policy and regulatory culture have some similarities by comparison to other jurisdictions, and also because the United States has been a historical leader in environmental regulation.

Furthermore, the US has the longest history of carbon dioxide injection into reservoirs for the purposes of Enhanced Hydrocarbon Recovery (EHR) – a technology whose risk profile closely resembles that of CCS. It is also one of the countries which has best managed to take CCS from R&D into the market. It must be noted that, while the existing US Federal framework currently does not provide for a release or transfer of liability from the operator to other persons, several state legislatures, including those with actual experience of carbon dioxide injection through EHR, have chosen to adopt legislation that provides for transfer of long-term liability to the respective State by various mechanisms. These options include:

- States agreeing to take on the long-term liability by undertaking the CCS project themselves;
- States assuming liability from CCS operators or;
- States providing a mechanism for transfer of liability.

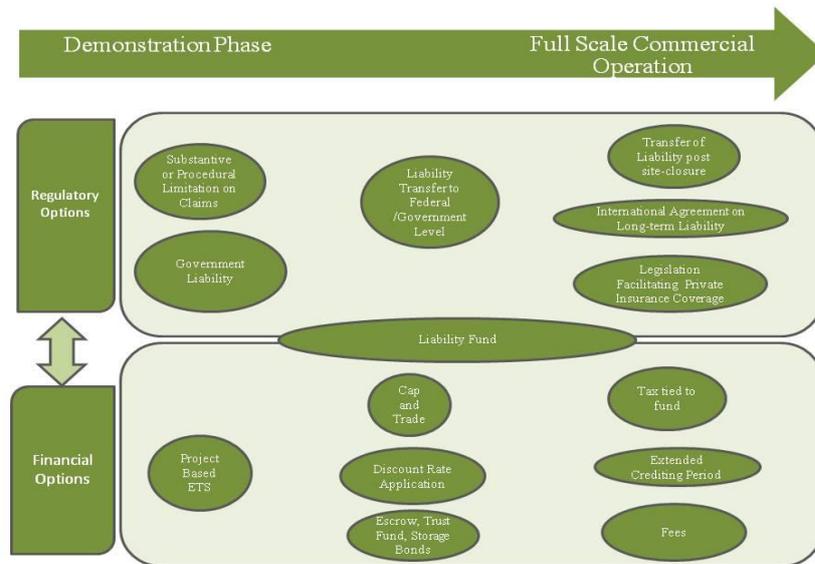
Furthermore, a number of States have begun to establish local regimes for long-term liability transfer. Louisiana, Montana, North Dakota, Oklahoma and Texas have developed a “Certificate of Completion” model, whereby the operator of a geologic sequestration site can transfer title and liability to the State, after demonstrating to the relevant agency that the site is stable for a certain period of time, after the last CO₂ has been injected, and that the site has been closed. The states of Illinois and Texas have also accepted liability for certain CCS pilot projects from the project outset.

E. Regulatory and Financing Options

Broadly speaking, the US approach to CCS is characterized by a reliance on the existing framework for long-term liability and

stewardship, the adoption of substantive or procedural limitations on claims and the creation of funds to support long-term stewardship activities. The said approach also features compensation of parties for various losses or damages incurred after site closure, as well as in some cases the transfer of liability to the federal government after site closure (with certain contingencies). Figure 2 illustrates our professional judgment as to some of the most relevant regulatory and financing options that have been used by individual State legislatures, or have been suggested as sound financing mechanisms from the risk averse US Environmental Protection Agency, which has now taken over the Federal regulation of CCS projects. Included are also the most widely discussed options from the International Energy Agency, as well as those scenarios suggested in the EU Commission Guidance Documents and by our research team.

Figure 2: Our Graphic Representation of Regulatory and Financial Options for Management of CCS Risk



Looking at our Figure 2, we can see that some financing or regulatory options may be more suited to different levels of maturity of CCS technology. When a project is still in its demonstration phase, operators often face first-of-a-kind issues. Thus, a flexible regulatory approach, which is still compliant with the tenets of the EU CCS Directive, can allow for the development of a regulatory framework for CCS in a manner that is integrated with the process of technological evolution and competitive leadership.

A flexible approach from regulators, particularly at the Demonstration phase, can include such measures as the adoption of Substantive or Procedural Claims, government Liability or the creation of a Project Based Emissions Trading Scheme (ETS). Substantive or Procedural Claims would be advantageous in that they would help to ease uncertainties from the business and insurance communities over the extent of potential liabilities and address uncertain or inconsistent government standards. The adoption of 'Liability by the government' can take on many forms, depending on the involvement at certain stages of CCS, i.e. governmental ownership of CO₂, ownership of pipelines or other equipment, or even governmental oversight, financing, and encouragement of CCS activities.

Structuring a regulatory programme in the demonstration phase, so that the government is directly liable for CCS activities, could reduce the complexity of assigning long-term liability for those pilot phase projects. Additionally, for relevant States that have not already done so [China and the European Union have while Canada (federally), the USA (federally) and the Middle East have yet to do so], the creation of a Project-Based ETS can be a part of a trial sectoral approach to GHG mitigation, that would allow for the testing of the way in which ETS credits are best compensated, thereby overcoming the issue of Double-Counting under the EU ETS and Environmental Liability Directives.

The rollout of different regulatory or financial measures, alongside the maturation of CCS, is an approach that would not only allow for the creation of best-fit techno-regulatory regimes, but would also support the parallel testing of such policy/regulatory options as CCS technology develops.

In the transitional phase between demonstration and full-scale deployment, the most appropriate regulatory measures are arguably the gradual Liability Transfer to a federal government level and the integration of CCS into a wider (EU or international) Cap and Trade regime. With the transition of CCS into the demonstration phase, the financial and environmental risks would be much better established, allowing governments and private insurers to better manage the associated potential liabilities. Possible additional financial mechanisms, for regulation at such a phase, include Discount Rate application, Escrow, Trust Funds and Storage Bonds. These types of mechanisms are characterised by the convergence of private fundraising options, under the oversight of a governmentally appointed body. They would enable the effective pooling of resources for leakage compensation and could

potentially be applied to CCS operators (in the event of liability not being transferred to National Authorities). This would help pave the way for the creation of a strong international regulatory framework around CCS.

Once full-scale deployment is reached, regulatory measures can be enacted via the Transfer of Liability Post Site-Closure to a government body. This would, ideally, occur under the auspices of an International Agreement on Long-term Liability, so as to allow for the creation of best fit options between capture and storage operators around the world, as well as to open up the use of CCS credits under the Clean Development Mechanism (CDM). Nationally, governments could enact Legislation Facilitating Private Insurance Coverage or perhaps mandate a tax tied to a super-fund, similar for that of oil spills. The level of revenue, raised through such schemes, could thereby be set at an adequate level to cover estimated liabilities. Depending on the levy amount, the cost of CCS installation, and the credits given/taxes avoided by CCS operators, would potentially be an incentivising and long-term liability minimising mechanism for the drawing in of CCS investors.

Alternatively, Extended Crediting Periods or Fees also represent financial alternatives that would rely on monitoring results and, thereby, act as a form of security buffer for CCS operators, especially at capture sites.

F. Examples from other Jurisdictions

Some real-world examples, of flexible approaches to CCS regulation, can be seen in the case of Norway, Australia, Canada and the USA. Norway has incentivised CCS by legislating a carbon emissions tax of €40 t/CO₂. CCS is regulated both under the Norwegian Pollution Act and the Petroleum Act. However, at the present time responsibility for leakages is not satisfactorily regulated under Norwegian law.

The long term liability associated with the storage of CO₂ in Australia is for now covered under the Research Development and Demonstration approval provision, under the Victorian Environment Protection Act, which recognises that more comprehensive legislative cover would be necessary in the future, for any commercial geo-sequestration projects. Canadian legislation, on the other hand, has taken the approach of issuing closure certificates under a CCS Act with the government (of the province in question) assuming responsibility for the stored CO₂.

Adopting a flexible regulatory approach, the US EPA, has finalised requirements for CCS through the development of permitting for a new class of storage wells (Class VI), to be used specifically for geological storage of CO₂. The EPA has proposed a default 50-year timeframe for CCS liability with the provision that the acting EPA Director may shorten or lengthen that period, based on risk data gathered during the permitting process. Additionally, this new permitting system will allow for financial guarantees for CCS to be chosen from a variety of different options, which would allow for greater market competition and rapid deployment of lower-cost solutions in the CCS industry.

Within the EU, two legislatures stand out as having a progressive view on CCS regulation while still adhering to the letter of the CCS Directive: Germany and the Netherlands. The government of the Netherlands implemented the CCS Directive by amending the Netherlands Mining Act, which requires that CCS would operate under a Permitting regime (similar to that of the US). Preliminary analysis indicates that liability will lie with the storage license holder, up to the point of the license expiration. If at that point there is a legal successor, or the materials are proven to be definitively left in the subsoil, the liability would be removed from the license holder. Furthermore, it is likely that the Dutch government will set up a fund to deal with unexpected damages at storage sites, perhaps similar to the one for oil spills.⁶⁰

In 2009, the German government mooted a draft Carbon Capture Storage Act on CCS, which allows it to conduct extensive testing of the technology, on the basis of which further requisite implementing legislation will be drafted. Importantly, the draft Act includes the possibility that, after a period of 30 years from the decommissioning of a plant, and thus about 80 years after its start-up, operators may transfer their responsibility to the Federal government (once the operator has established proof of the long-term safety of the storage site).⁶¹ The draft Act has not become into force. However, with the re-emergence of support for CCS by the German government as of 2019 we are likely to see CCS legislation again soon. On another note, the CCS Demonstration Project

⁶⁰ Bellona Foundation, *New Dutch government puts CO₂ capture and storage at forefront in climate plan*, BELLONA.ORG (Oct. 11, 2017), <https://bellona.org/news/ccs/2017-10-24057>. (How that relates to potential damages remains to be seen).

⁶¹ H. Weyer, *Legal framework for CCS in the EU and Germany*, in *Clean Energy Systems in the Subsurface: Production, Storage and Conversion* 21-8, (Michael Z. Hou et. al. eds., (2013).

Network, which is sponsored by the European Commission, has also expressed the belief that long-term CCS liability will be dealt with in the manner of oil spills – with “the state assuming liability after a regulated abandonment process”.

G. Summary and Recommendations

When considering regulatory and financial scenarios for the management of CCS liability, we have discussed a public/private liability fund (which, in essence provides an insurance function in the absence of commercial insurance) as an over-arching mechanism, standing at the interface of government oversight and private finance, and which has the potential to be adapted and expanded alongside the maturation and upscaling of CCS technology. Such a fund could set a threshold of liability for storage site operators, beyond which public liability insurance or indemnification would apply. A CCS fund can be adapted to grow alongside the rate of creation of CCS projects. Additionally, if risk is factored in, it would allow for a fair contribution by each operator and would be a more proportionate method of accounting for the probability of a leak (noting that fund contributions would be individually earmarked to indemnification events that are specific to each fund contributor – such that cross subsidisation of other firms is not possible). Even though it might not be an immediately appealing option to operators, due to concerns about cross-subsidisation of competitors,⁶² the creation of a liability fund of this nature has the potential to be a vital cornerstone for the establishment of a private insurance market for CCS. Public/Private Liability Funds can bolster confidence with regard to the risk profiles of CCS activities and spark the interest of private insurance firms.

Regardless of the position on the establishment of Public/Private liability funds, a government/public indemnification scheme ought to be set up during the demonstration phase of CCS technology rollouts, in order to ensure that there is investment from private sector stakeholders. On the basis of the analysis undertaken thus far, this Article supports the use of a government liability (also known as Indemnification) framework for demonstration projects along the lines of competing CCS jurisdictions. In order to address “moral hazard” arguments, exceptions to governmental liability

⁶² By this we mean that cross subsidisation should be prohibited such that any payments made by one storage site operator should not be used to indemnify adversely affected parties or environmental damage caused through a leak that is the responsibility of another storage site operator.

could be established around concepts of operator fault or negligence (see the Environmental Liability Directive) and a duty to apply best available techniques in the demonstration phase along the lines of the Industrial Emissions Directive.⁶³

Furthermore, demonstration project operators can assure Competent Authorities of their financial stability through Trust Funds, Escrows or Storage Bonds and, thereby, demonstrate their ability to handle operational risk within the required time frame. In cases of operator default, a payment of surety bonds can contribute to a standby trust fund in the amount equal to the face value of the bond and sufficient to cover estimated costs; a performance surety bond guarantees performance of the specific activity or payment of an amount equivalent to the estimated costs into a standby trust fund.

It must be noted that while a range of possible options has been accepted by the authors as workable, there are certain overriding features that should be applied from the date upon which a long-term liability framework is set up for CCS. The first aim should be to create the market conditions in which private insurance products can be offered in the CCS market. This proposition is advanced on the basis that private sector insurers are the world's leading experts in risk management pertaining to environmental technology and will provide the best means for allocating financial risk with the interests of civil society in mind.

Further to these observations, long term liability for CCS storage should be extended to a maximum approximating £50,000,000, having regard to other types of damage and remediation costs in the field of environmental protection law. Claims over £50,000,000 should be absorbed by a public insurance mechanism or other public guaranty. Equally, greater regulatory certainty should be established by specifying a maximum period of time (somewhere between 20 and 30 years is reasonable and can be accommodated without the amendment of the CCS Directive) after which there should be a transfer of responsibility for a closed storage site to competent authorities.

These two measures should be sufficient to create a private sector insurance market for CCS. To incentivise cutting edge CCS technology development and to provide for the best storage sites,

⁶³ Directive 2010/75 of the European Parliament and of the Council of 24 November 2010 on Industrial Emissions, Integrated Pollution Prevention and Control, 2010 O.J. (L 334) 17.

the £50,000,000 threshold should be subject to adjustment depending upon three criteria, namely: storage site characteristics, technical competence of the operator and the financial capacity of the operator to address CCS risk. The threshold amount for each site should be subject to review every five years.

Finally, exemption from the purchase of ETS Directive (or similar State schemes) allowances in proportion to the amount of greenhouse gases stored, is completely justified by the aims of climate change mitigation and surrounding international, EU or other applicable national laws. However, in a European-style or analogous context, the duty to purchase allowances in relation to leakage serves little in terms of policy purpose. This is because the duty of remediation and supporting penalties in respect of the Environmental Liability Directive and the CCS Directive provide Competent Authorities with ample means of punishing and remediating leak-based damage including climate-related damage. This point is made in the knowledge that CO₂ stream providers to CCS storage sites will be legally required to capture CO₂ in the future.

CONCLUSION

Ambitious emissions reduction targets for the near future driven by the Paris Agreement and the suitability of Carbon Capture technology for that purpose, have combined to propel CCS development on a global level as a contributing response to climate change. As carbon capture is “low-hanging fruit” and involves technological and scientific knowledge already available to a wide range of actors in the energy industry, it allows for a relatively low-cost method (compared to the true cost of nuclear or offshore wind power) for industrial stakeholders to contribute to climate change mitigation targets, set forth by governments.

As it stands, CCS legislation is comprised of an overlapping network of international agreements and regional (in the case of the EU) policies. In unison, they form a strong basis for environmental protection from leakage of carbon storage sites, through the use of the precautionary and polluter pays principles. However, these legislative instruments form an uncoordinated legal basis for CCS, with overly stringent financial and liability provisions. At present, this poses a significant barrier to stakeholder investment, technology development and roll-out.

Carbon Capture and Storage will have to unfold in a competitive energy sector and holds within it ramifications for

energy security. Unfortunately, the current overly guarded regulation frameworks that we find, particularly at the EU level, are restrictive to CCS evolution and competition. Therefore, governments are advised to work with industry in providing clear regulatory solutions for a predictable investment framework for CCS. This would allow for the tailoring of legislation and policy, having in mind the international legal basis for CCS, to the specific investment and regulatory climate of a given country. Furthermore, it would take advantage of pre-existing good relationships between policymakers and industry, which can lead to invaluable feedback on the appropriateness and ramifications of regulatory decisions. Ultimately, it is suggested that this would enhance the precision of monitoring activities and allow for a more inclusive approach to risk management measures.

A flexible approach to CCS liability provisions is not necessarily unique or unprecedented. In fact, selective flexibility is being adopted across a range of CCS stakeholders acting in national contexts. Norway, the USA, Canada and Australia have shown an innovative approach to handling liabilities and often make clear distinctions between demonstration and commercial phases of the technology, in terms of the burden of payment for the operator. The European Union itself is moving towards a more amenable interpretation of the CCS Directive as evidenced by the positions put forward in successive Commission Guidance Documents. Furthermore, there is every indication that the paramount issue standing in the way of CCS - the uncertainty over the nature and attribution of liability arising from leakage - could be addressed by a combination of some form of insurance framework for storage sites and a robust permitting process (formulated from governmental best practice policies), which would minimize the likelihood of leakage to virtually zero. Therefore, there are excellent reasons for law and policymakers to seriously consider a more flexible, innovative approach to CCS legislation and policies, by taking into account the issue of long-term liability and other significant legislative barriers to the necessary dissemination of CCS technology in the near future. After all, negative emissions technologies are a necessary component of successful Paris Agreement compliance and our elusive quest to stabilise the world's greenhouse gas emissions.