Déjà vu all over again

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Carbon dioxide removals (CDR) and legal liability

Abstract
As efforts to scale up the carbon dioxide removals (CDR) sector continue to expand, the question of liability for failed storage or 'reversals' comes to the fore. There are a range of possibilities and views as to who should be liable if reversals do occur. As well as a need to better understanding both the permanence associated CDR methods and the risks which could impinge upon them, we seek to deepen understandings of and the means to address, the risk of storage failure through legal approaches and structures. We review the comparable carbon market scenario that preceded entry into force of the Kyoto Protocol, the current voluntary carbon market (VCM), and what implications scaling up the CDR sector may have. We canvass a range of legal approaches, structures, and reason that liability for on-going storage integrity should remain with the party that carries out the CDR project.

Keywords:

Paris Agreement – carbon dioxide removals – scaling up – liability – storage failure – leakage – trading market units – net zero

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1. Introduction

Legal rule making and scholarship will play a substantial part in discussions concerning carbon dioxide removals[1] (CDR), which are themselves an increasingly prominent part of climate conversations.[2] Meeting the climate change targets of the Paris Agreement requires removing gigatonnes of carbon dioxide (CO_2) from the atmosphere annually. Absent legal regimes to properly regulate the new CDR sector, to incentivize deployment and ensure safe development, both the effectiveness and legitimacy of CDR will be cast into doubt. This paper contributes to those discussions with a focus on the issue of liability for failed removals, necessary for the robustness of financing CDR. Liability – the condition of being answerable in law for a particular circumstance – is a central feature of regime design. As Bodansky notes in his survey of international environmental treaties, well designed systems of liability allocation "increase compliance and effectiveness".[3] An attentiveness at the design stage to parties' capacity to comply, their ability to understand and evaluate the risks attendant to a course of conduct, "improves the prospects for [regimes] effectiveness."[4] As policy makers around the world turn their attention to regulating and incentivising CDR, it is timely to consider how best legal design can contribute to the development of this new sector.

Although CDR constitute a diverse and highly nascent set of approaches, in technocratic discourses – scientific, political, policy and academic – it is widely recognised that in addition to deep emission reductions, the removal of CO_2 from the atmosphere will be *necessary* if intergovernmental mitigation objectives are to be achieved.[5] All IPCC scenarios for avoiding 1.5°C and 2.0°C warming have a significant role for CDR, with median pathways modelling for 5.4 gigatonnes of CO_2 per annum ($GtCO_2$ p.a.) removals by 2030, and 13 $GtCO_2$ p.a. 2050. Furthermore, whilst these scenarios ~~frame~~ characterise the period to 2050 as one dominated by emissions reductions with some removals, the post-2050 period will be dominated by sustained removals. However just as existing decades of global mitigation efforts (not excluding the Paris Agreement) have failed to reverse emission trends with atmospheric GHG concentrations now above their pre-pandemic levels,[6] and coal use exceeding previous peaks,[7] progress on developing the formative removals sector is already

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[1] Defined by the Intergovernmental Panel on Climate Change (IPCC) as: "Human activities capturing CO2 from the atmosphere and storing it durably in geological, land or ocean reservoirs, or in products. This includes human enhancement of natural removal processes, but excludes natural uptake not caused directly by human activities." R van Diemen. et al. IPCC, 2022: Annex I: Glossary. in IPCC, 2022: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (eds. PR Shukla et al.) (Cambridge University Press, 2022).

[2] For example, the UK Government's Net Zero Strategy: Build Back Greener (London, 2021), pp. 28, 184-197 sets an ambition to develop markets and incentives for engineered GGR technologies to enable deployment of at least 5 MtCO2e pa of engineered GGR removals by 2030, potentially scaling to 75-81 MtCO2e pa by 2050.

[3] D Bodansky, *The Art and Craft of International Environmental Law* (Harvard University Press 2010), 264.

[4] Ibid, 265.

[5] For instance, IPCC Sixth Assessment Report: K Riahi et al, 2022: Mitigation pathways compatible with long-term goals. In IPCC, 2022*: Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley, (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA. doi: 10.1017/9781009157926.005

[6] P Friedlingstein and others, 'Global Carbon Budget 2022' (2022) 14 Earth System Science Data 4811.

[7] L Hook, 'Global Coal Use Set to Reach Fresh Record' *Financial Times* (16 December 2022).

lagging. If the ambitious scale out of removals is to be achieved, there will be a significant burden on law to ensure that this new sector is sufficiently robust – in terms of environmental performance, social robustness, investability etc – to bear that weight.

At present most removals methods are neither technically nor commercially viable,[8] operating at very small scale, if at all.[9] There are however significant efforts to address these shortcomings and others, ranging from their social robustness to legal frameworks.[10] The CO_2RE multidisciplinary research project, from which this paper emanates, is one such attempt. Here we address the discrete but pivotal issue of liability for storage failure.[11] The specific issue of liability for storage failure has already received some significant policy attention, with differing approaches apparent. In the adjacent context of carbon capture and storage, the European Union Directive on geological storage of carbon dioxide[12] places obligations on the operator of the storage facility to notify the competent authority, take corrective measures,[13] and surrender EU ETS allowances as said facilities are covered by the EU ETS.[14] In its recently published Proposal on the certification of removals, the European Commission adopts a ~~similar~~ parallel approach to liability, "to avoid double regulation".[15] Addressing similar issues, a recent UK Government report (the BEIS Report, also known as the 'Task and Finish' group)[16] takes a different approach in relation to CDR[17] recommending that:

> If a non-permanent CO2 store leaks earlier than expected, the leaked CO2 will have to be "re-removed" in the future. Provision for this future re-removal should made at the outset. *Liability for the provision of this "re-removal" capability should sit with the initial off-setter.*[18]

This recommendation would entail that, in making provision for a market to promote the scaling up of the CDR sector, contractual risk for replacing amounts of GHG that might leak from a storage facility should rest with the *party purchasing the related removal units*, to offset its emissions. This approach, which diverges with the above EU approach, but also decades of international experience including the Clean Development Mechanism,[19] would likely be problematic.[20] This paper canvasses various alternatives, including the BEIS option, in Section 7. All the same, an important point that the BEIS Report highlights is the need for

[8] The Royal Society and Royal Academy of Engineering, Greenhouse gas removal report, (September 2018).
[9] SM Smith et al, The State of Carbon Dioxide Removal (Oxford, 2023)
[10] See L Štrubelj, 'Waste, Fertilising Product, or Something Else? EU Regulation of Biochar' [2022] Journal of Environmental Law; C Kaupa, 'Scrutinizing Net Zero: The Legal Problems of Counting Greenhouse Gas Emissions, Removals and Offsets Together' (2022) 31 Review of European, Comparative & International Environmental Law 447; and J Macinante and NS Ghaleigh, 'Regulating Removals: Bundling to Achieve Fungibility in GGR Removal Units' (2022) 16 Carbon & Climate Law Review 3.
[11] 'Storage failure' might be defined for these purposes to encompass any leaks, or unintended release of the stored GHGs, or in fact deliberate release of stored GHGs from the storage facility, at any time prior to expiry of the full period of storage held out to the purchaser at the time the removal unit is transacted. This may also be provided for legislatively in relation to the operation of the CDR sector and/or any CDR market.
[12] Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide and amending Council Directive 85/337/EEC, European Parliament and Council Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC, 2008/1/EC and Regulation (EC) No 1013/2006 (Text with EEA relevance). *OJ L 140, 5.6.2009, p. 114–135.*
[13] Ibid, Article 16.
[14] Annex I of the EU ETS Directive; see Recital 30 of the CCS Directive.
[15] European Commission, Proposal for a Regulation of the European Parliament and of the Council establishing a Union certification framework for carbon removals COM (2022) 672 final, Preamble, ¶14.
[16] UK Government, Department for Business, Energy and Industrial Strategy, Monitoring, Reporting and Verification of Greenhouse Gas Removals - Task and Finish Group Report, 19 October 2021, <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1026994/mrv-ggrs-task-report.pdf>
[17] Greenhouse gas removal (GGR) is distinct from carbon dioxide removal (CDR) in terms of the range of gases it addresses. Other processes such as carbon capture and storage (CCS) and negative emissions technology (NET) are related to GGR but not coterminous with it. CDR is used herein, unless a quoted source uses another formulation.
[18] n.16 (BEIS Report) 5. Emphasis added.
[19] Considered in Section 4 below.
[20] For instance, the practical difficulty in connecting the leaked GHGs to particular removal units, given the possibility that the removal units may be traded any number of times before being retired for offsetting purposes. We discuss this issue at greater length in Section 7 below.

further work to understand better both the level of storage durability and the possibility of reversal in relation to all potential GHG stores.

For removals markets to grow and help foster development of this new industrial sector, lawyers will have their role to play alongside the geologists, soil scientists, economists, social scientists, and others.[21] This process has already commenced. In a recent case, it was claimed by Friends of the Earth and others that removals were objectionable owing to their uncertain, 'theoretical', nature. This challenge was rejected, the Court accepting that climate policies which extend well into the future are not simply a matter of empirical measurement but may also depend "upon modelling future circumstances [which] involves a number of judgmental assumptions, variables, interactions and uncertainty."[22] Other challenges will doubtless be forthcoming. The key legal questions we address herein focus on the question of liability. 'Who is liable when a CDR project goes wrong?', and 'what are they liable for and to whom?' Without reliable and tractable solutions to these questions, CDR will fail to be investable, and fail to perform a role in avoiding catastrophic climate change.

This paper aims to contribute to understandings of CDR by examining ways to address the risk of storage failure through legal approaches and structures. The focus on storage failure is not to disregard the many other environmental impacts and issues, potentially including land use planning considerations, surface and groundwater pollution, noise and odour, to which development of the new CDR sector may give rise. However, CDR essentially comprises two fundamental elements: removal of CO_2; and the safe, long-term storage of the removed CO_2. If one of those fundamental elements – safe, long-term storage – is fraught with legal uncertainty concerning failure risk, CDR will not be scaled sufficiently or expeditiously. Thus, this paper seeks to address the issue of storage failure risk, first, by analysing what is at stake when discussing and allocating legal liability. Here we draw on both analogous legal regimes, and also the conceptual legal literature. We then draw upon parallel circumstances that existed in the nascent carbon emissions trading market pre-Kyoto Protocol and how those circumstances evolved from bilateral, commercially negotiated risk allocation, to compliance with the rules of the institutional framework put in place (section 4). It then considers how the voluntary carbon market, that has developed in parallel to that institutional framework and continues to expand, currently addresses the liability questions (section 5), before looking at the implications of the development of a CDR market in the context of the Paris Agreement (section 6). The paper considers legal approaches and structures that might be applied to address risk allocation for CO_2 storage failing or leaking (sections 7), and then draws conclusions (section 8).

Our title draws on the famous malapropism by Yogi Berra. The fundamental questions which are raised by CDR storage failure are in the main far from novel, even though the technologies may be. For at least two decades lawyers have worked with technical experts and government officials in the construction of carbon markets working on cognate problems and developing structures which mediate between the overlapping needs for environmental security, economic and social robustness, and legal effectiveness. Going back yet further, legal scholars have addressed what is at stake in the task of allocating liability. In revisiting these issues in the current context of CDR, policymakers would do well to draw upon past hard won conclusions rather than reinventing wheels. First however, we introduce CDR technologies and the issue of liability, before explicating key analytical elements of the concept of liability.

2. CDR technologies and the risk of leakage

[21] Some lawyers have already started down this path, see L Štrubelj, 'Waste, Fertilising Product, or Something Else? EU Regulation of Biochar' [2022] Journal of Environmental Law.
[22] Friends of the Earth v BEIS [2022] EWHC 1841 (Admin), per Holgate J at ¶77.

As a preliminary matter, it should be noted that CDR are not a 'suite' of technologies, much less a single technology. They are neither coherently clustered, nor share some more- or less-loosely interconnected properties. Rather they are a highly diverse set of approaches, methods and technologies, each with their own chains of technologies, activities, actors, and methods of storage.[23] Consider briefly three examples: afforestation (growing new trees and improving the management of existing forests), bioenergy with carbon capture and storage/BECCS (using biomass for energy, capturing and sequestering the CO_2 emissions, and enhanced rock weathering (EW) (incorporating crushed silicate rocks which capture CO_2 into soils).[24] Each is carried out by different agents (respectively foresters; power generators and geological engineers; and mine operators and landowners), using different carbon stores (biological; lithospheric; and mineral), and have widely divergent storage permanence characteristics. While forest storage can be measured in multiple decades and perhaps centuries, BECCS would sequester CO_2 for millions of years.[25] Significantly for ~~scaling~~ the purposes of the sector's future growth, each has a different technology readiness level (TRL).[26] TRL is a widely used metric to assess and compare the maturity of technologies. At the lowest level of maturation, TRL1 means that the 'basic principles are observed and reported' whilst at the other, TRL 9 equates to 'flight proven' technologies which have gone through debugging after launch. Well understood commercial activities such as afforestation at TRL9, are differently placed from EW (TRL3-4, meaning studies are needed for 'proof of concept')[27], and BECCS (TRL5-6, that is, further testing is required to increase fidelity significantly).[28] Each of these land-based removal approaches is considerably better developed at present than most engineered or ocean-based removals.[29] What all removals *do* share is a joint reliance on both natural resources *and* human ingenuity/technology. As such, the neologism 'nature-based solutions'[30] is questionable.[31]

Concerning definitional matters, it is worth briefly unpacking the IPCC's description of CDR, namely:

> Human activities capturing CO2 from the atmosphere and storing it durably in geological, land or ocean reservoirs, or in products. This includes human enhancement of natural removal processes, but excludes natural uptake not caused directly by human activities.

This has three salient features. Firstly, the fact of "capturing CO2 from the atmosphere" distinguishes CDR from carbon capture and storage (CCS) as in the latter case the carbon is extracted not from the atmosphere but from stores within fossil fuels. Secondly, 'durable storage' excludes from CDR uses of captured CO2 that are then converted into fuels which are then combusted, distinguishing carbon capture, usage and storage (CCUS) from CDR. Thirdly, CDR requires additionality, the need for removals to be beyond the results that would have occurred in the absence of the specific human intervention.

A further common denominator across removal approaches is the risk of storage failure or 'reversal'. In the case of forestation this may arise from drought dieback, wildfires, or disease; for CCS-based methods, this will follow from the physical leakage of CO_2 from the storage

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[23] n.9 (Smith) provides a conspectus at CDR methods at p18. For detailed scientific overviews, see JC Minx and others, 'Negative Emissions—Part 1: Research Landscape and Synthesis' (2018) 13 Environmental Research Letters 063001; and S Fuss and others, 'Negative Emissions—Part 2: Costs, Potentials and Side Effects' (2018) 13 Environmental Research Letters 063002.
[24] For fuller details of these and other GGR methods, see Royal Society chapter 2 at n.8, and Minx and Fuss ibid.
[25] The nature and consequences of differential GGR storage characteristics is discussed in Macinante and Ghaleigh, (n.10), at Part 4.
[26] JC Mankins, 'Technology Readiness Assessments: A Retrospective' (2009) 65 Acta Astronautica 1216.
[27] n.8 (TRS) chapter 2.
[28] See Drax, https://www.drax.com/about-us/our-projects/bioenergy-carbon-capture-use-and-storage-beccs/; and Forum for the Future, BECCS Done Well (2022) at: https://www.forumforthefuture.org/Handlers/Download.ashx?IDMF=99511f06-6d45-4225-8699-f2f722dba465
[29] n.9 (Smith) 18-9.
[30] For example: E Cohen-Shacham et al eds, *Nature-based Solutions to address global societal challenges* (IUCN 2016).
[31] R Bellamy and S Osaka, 'Unnatural Climate Solutions?' (2020) 10 Nature Climate Change 98.

site;[32] and so on. Whilst other disciplines seek to address this question of permanence or durability for their own perspectives, this paper does so within the four corners of recent decades of legal experience, pertaining in particular to the regulation of carbon markets. In so doing we make a contribution to the literature on the 'scaling' of CDR. It is generally accepted that if net zero by 2050 is to be achieved in advanced economies, removals will have to account for about one quarter of present annual emissions.[33] Aside from traditional CDR (afforestation, reforestation, and the management of existing forestry) the 'removals industry' is at present nearly non-existent.[34] To meet net zero, an industry roughly the size of the present power sector will need to be built, from the lowest possible base, in under three decades. The UK aims to develop at least 5MtCO_2/year of engineered removals by 2030. [35] There has never been an industrial sector constructed on such a time scale. To do this, policymakers are having recourse to pricing mechanisms, involving tradable credits based on the outcomes achieved by privately operated removal projects.[36] Pricing mechanisms are applied in various different formats, not only trading markets but also such as financial assurances or insurance, in a variety of environmental regulatory contexts, including natural resource management, waste management, mine site rehabilitation, and radioactive waste disposal; although generally more commercial, rather than regulatory, schemes such as debt-for-nature swaps could even be considered types of pricing mechanism. Demand for the project credits will be driven by regulatory obligations on CO_2 emitters, thus similar in framing to emissions trading markets such as the EUETS and UKETS, although a 'voluntary market' has developed through legal entities taking on non-mandated commitments to offset their respective carbon footprints.[37]

3. A Conspectus on Liability Rules

In its most straightforward terms, liability means the condition of being answerable in law for a particular circumstance. Liability rules are simply those standards which impose liability on a party. Our question is, 'what liability rules should govern CDR storage failure when incentivized by tradable units?'. There are of course other questions which arise from CDR such as civil liability for damage arising from CDR activities, administrative liability for the breach of licensing conditions, or that following the polluter-pays principle, à la the Environmental Liability Directive.[38] But these though are not our question. We address storage failure in part because of its normative character. This is a question currently in development and without rules to answer it. What should the new regime look like is a current policy challenge and will be in other jurisdictions grappling with removals. In this it contrasts with other areas of law implicated by CDR project development. Any CDR project developer would have to consider some combination of planning law, air/water/land pollution control, and many others, all of which are well-regulated and -understood bodies of law. Quite what

[32] RS Haszeldine and NS Ghaleigh, 'Geological Factors for Legislation to Enable Regulate of Carbon Dioxide Deep in the Deep Subsurface' in I Havercroft, R Macrory and RB Stewart (eds), *Carbon Capture and Storage: Legal and Regulatory Issues* (Hart Publishing 2018), VI and VIII.
[33] n.8 (TRS) 8.
[34] n.9 (Smith) ch6.
[35] n.2 (UK NZS).
[36] See, for example: European Commission Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL establishing a Union certification framework for carbon removals <https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13172-Certification-of-carbon-removals-EU-rules_en>; The UK carbon capture, usage and storage (CCUS) deployment pathway: an action plan, November 2018, BEIS: <https://www.gov.uk/government/publications/the-uk-carbon-capture-usage-and-storage-ccus-deployment-pathway-an-action-plan>, at 31-34 Creating market mechanisms for CCUS.
[37] As a general observation, voluntary carbon market projects more and more often seem to address co-benefits such as biodiversity and environmental enhancement, and/or social benefits such as provision of better energy and water sources for less-developed communities in the global South. Readers can determine whether such activities are driven by corporate altruism or public relations.

[38] Directive 2004/35/EC on environmental liability with regard to the prevention and remedying of environmental damage, OJ L 143, 30/04/2004 P.0056-0075.

liability rules should govern CDR storage failure is none of those things and as such particularly worthy of attention.

As a preliminary matter, this question must first address the meaning of 'liability' developed by Calabresi and Melamed.[39] In their formulation, entitlements can be protected by either 'liability rules' or 'property rules'. (A third category, 'inalienability rules', is also mooted whereby the state entirely prohibits the transfer of an entitlement. These apply to so-called 'moralisms', akin to public international law's peremptory norms.) In the event of infringement, the former will protect said entitlement only by money damages, the latter by enjoinment. In the former case a person would have the right to infringe the entitlement so long as they pay for the infringement (liability rules), while in the latter no infringement is permissible without the consent of the right holder (property rules). In their scheme – developed let us not forget in the heat of the law and economics movement of the 1970s, and as a riposte to Coasean approaches[40] – the choice between entitlements (such as 'liability rules' or 'property rules') is determined as much (if not more so) by distributional concerns, as by considerations of efficiency or wealth maximisation:

> '[t]he state not only has to decide whom to entitle [but must also] the manner in which entitlements are protected and whether an individual is allowed to sell or trade the entitlement.'[41]

Accordingly, where negotiations between the parties are feasible, 'property rules' apply; where transaction costs make negotiations unfeasible, it is 'liability rules'. If liability rules are not merely determined by economic calculations, but also normative or ethical considerations, the questions arises, what those considerations might be? In their analysis of environmental liabilities and Scots land law, Mackie and Combe explore this question in the context of the EU Environmental Liability Directive (and therefore the 'polluter pays principle') and the jurisprudence of the Court of Justice of the European Union.[42] What is notable in their survey is the balancing of economic and equitable concerns by the Court. Citing AG Kokott in *Futura Immobiliare Srl Hotel Futura v Comune di Casoria*[43] they note that *in addition* to its efficiency-focused economic dimension, '[t]he "polluter pays" principle also has the aim of fair allocation of the costs of environmental pollution. The costs are not imposed on others, in particular the public, or simply ignored, but assigned to the person who is responsible for the pollution.' Further authorities support the notion that costs are imposed on parties responsible for the harm, on the bases of logic and fairness, not merely efficiency.[44]

It is striking that these approaches – across the case law and scholarship – cohere so closely with the Calabresian rubric that Coasean efficient allocation of resources is only desirable if it is consistent with socially endorsed distributional objectives.[45] It is also striking how closely they align to functional explanations of liability. The most obvious of these is that liability exists to punish the wrongdoer. It is for this reason that liability insurance was deemed to be against public policy in nineteenth century England as the insurer, not the respondent bore the cost. *Retribution* is however far from the only rationale for liability. It is certainly a present and continuing consideration, but is balanced by considerations of *correction*: 'making good' "the relational imbalance created by the tortfeasor's wrongful act by requiring the

[39] G Calabresi and A Douglas Melamed, 'Property Rules, Liability Rules, and Inalienability: One View of the Cathedral' (1972) 85 Harvard Law Review 1089.
[40] See generally, NS Ghaleigh, 'Economics and International Climate Change Law' in Kevin R Gray, Cinnamon P Carlarne and Richard Tarasofsky (eds), *The Oxford Handbook of International Climate Change Law* (Oxford University Press 2016).
[41] n.39 (Ghaleigh), 1092.
[42] C Mackie and MM Combe, 'Charges on Land for Environmental Liabilities: A Matter of "Priority" For Scotland' (2019) 31 Journal of Environmental Law 83.
[43] [2009] ECR I-6995, Opinion of AG Kokott, [32].
[44] n.41 (Mackie) 96-97.
[45] JB Attanasio, 'The Principle of Aggregate Autonomy and the Calabresian Approach to Products Liability' (1988) 74 Virginia Law Review 677.

wrongdoer…to pay for his harmful acts."[46] The *normative* explanation of liability, that it "sets a standard ~~a standard~~ of behaviour which regulates how people ought to conduct themselves in relation to one another"[47] is a more compelling one, striking "the right balance between the need to encourage people to be enterprising and to take risks (e.g., start up a business, build a railway) and the need to discourage careless and unreasonable behaviour. It is thus economically efficient (balances costs against benefits) and deters conduct which is socially (as well as economically) undesirable." [48]

What though is an appropriate standard of conduct and what are the factors that guide us to allocate it fairly? We argue that information, and in particular informational asymmetries, provide a just and common-sense basis for the allocation of liability. In a simplified two-party setting, asymmetric information will be present when firms have their own levels of risk and have private information about their own circumstances. This asymmetry does not allow the less well-informed firm to tailor its actions to actual circumstances. By imposing liability on the better-informed firm, their advantageous position is balanced out. We explore this in greater detail in section 7.

4. Déjà vu? A look back to pre-Kyoto Protocol

From the start of international carbon emissions trading, there was an issue of where liability would reside as between seller and buyer in the case where the underlying emission reduction, avoidance or emission sequestration, failed to eventuate or was defective, or failed to be recognised or was rejected by the relevant governing body. In the early years of carbon emissions trading (1997-2005) – the interregnum *after* the conclusion of the Kyoto Protocol (KP) and its Clean Development Mechanism (CDM) but *before* KP entry into force and CDM operationalisation – early movers negotiating one-off contracts were concerned with the key issue of:

> …defining what was being purchased and drafting documents that captured the concept of legal rights to a physical activity of reducing or sequestering greenhouse gas emissions from an activity in the hope that they would become more clearly defined tradable commodities in the future.[49]

These one-off contracts evolved into templates and parties in the embryonic market looked forward to more formalised arrangements that would underpin the value of the tonnes of GHG emission reduction, avoidance or removal they were transacting. Even after the KP came into being in 1997, it

> …still needed to enter into force and the specific rules and procedures for creating CERs [Certified Emission Reductions] and ERUs [Emission Reduction Units] did not emerge until many years later with the Marrakech Accords in 2001. Parties continued to buy and sell ERs [emission reductions] and future CERs and ERUs under bi-lateral bespoke ERPAs [Emission Reduction Purchase Agreements] and in nearly all cases this involved primary contracts between the project developer/owner and a buyer.[50]

Consequent upon the lengthy and detailed COP negotiations,[51] these agreements eventually evolved to '…include a range of Kyoto-specific terms to assign responsibility between the buyer and seller for meeting international rules … and apportioning risk between the buyer and seller in relation to failure to meet these rules for any reason.'[52] As such, taking the

[46] J Conaghan, 'Civil Liability' in P Cane and J Conaghan (eds), *The New Oxford Companion to Law* (OUP Oxford 2008).
[47] Ibid.
[48] Ibid.
[49] M Wilder and L Fitz-Gerald, 'Chapter 14 Carbon Contracting' in D Freestone and C Streck (eds.) *Legal Aspects of Carbon Trading: Kyoto, Copenhagen and beyond* (Oxford University Press, 2009), 296.
[50] Ibid 298.
[51] J Depledge, *The Organization of Global Negotiations: Constructing the Climate Change Regime* (Earthscan 2005), 150ff.
[52] n.49 (Wilder and Fitz-Gerald) 298.

example of the CDM, once the rules and procedures for creating CERs were in place, the issue for resolution was no longer which party, seller or purchaser, would carry the risk that the commodity failed to eventuate or was defective, or failed to be recognised or was rejected by the relevant governing body. *Rather* the question was whether the parties had properly discharged their respective responsibilities under the international rules as per their ERPA, so that the CDM Executive Board (CDMEB) would issue the commodity for them to transact.[53] In this way, what was a matter of private contractual ordering was resolved by public intervention in the form of the COP decisions establishing a new regulatory construct.

Arising from the Marrakech Accords was an institutional structure that validated and registered project proposals, applying recognised methodologies, followed by the monitoring, reporting and verification of outcomes, and the certification of results enabling issuance of units, that underwrote the CERs. Thereby the existence and validity of the emission reductions, now 'certified', would no longer be at issue, as the CDMEB essentially stood behind them once it was satisfied that all requirements had been met.[54]

Additionally, the CDMEB institutional structure that stood behind the issuance of CERs, provided specifically for instances of failure. For example, from the beginning the CDM rulebook provided that registered project activities would not be affected by the suspension or withdrawal of designation of a designated operational entity (DOE, an accredited independent auditor of projects), unless significant deficiencies were identified in a validation, verification or certification report for which that DOE had been responsible. If a review were to reveal that excess CERs had been issued, then the DOE whose accreditation had been withdrawn or suspended would be obliged to acquire and cancel an amount of reduced tonnes of carbon dioxide equivalent (i.e. by purchasing CERs in the market) to the excess CERs issued.[55] That is, the DOE was required to make good any absence of valid emission reductions arising from their conduct.

Furthermore, subsequently, provision in the CDM was made specifically for modalities and procedures for carbon dioxide capture and storage in geological formations as CDM project activities.[56] While it appears no such CDM project was ever registered, the modalities and procedures so far as they relate to non-permanence are an interesting model. For instance, they define 'liability' to mean legal responsibility arising from the CCS project activity or the relevant geological storage site, including all obligations related to the operation of the storage site (e.g. monitoring, remedial measures, etc.), to compensate for or remedy any significant damages, including damage to the environment, such as ecosystem damage, other material damages or personal injury, *with the exception of the obligations relating to non-permanence of the storage* [emphasis added].[57]

In the case of a net reversal of storage as a result of leakage (or 'seepage' in the language of the COP Decision) from the geological storage site of a CCS project activity, the non-permanence provisions place the onus, in the first instance, on the project participants to make up the loss by cancelling certified emission reductions (CERs) from the project,[58] or failing that, by cancelling flexible mechanism units (assigned amount units (AAUs), CERs from

[53] M Krey and H Santen, 'Trying to Catch up with the Executive Board: Regulatory Decision-Making and Its Impact on CDM Performance' in D Freestone and C Streck (eds), *Legal Aspects of Carbon Trading: Kyoto, Copenhagen, and beyond* (Oxford University Press 2009).
[54] Note that other issues of environmental integrity with respect to the CDM remained matters of concern. See C Streck, 'The Governance of the Clean Development Mechanism: The Case for Strength and Stability' (2007) 15 2 Environmental Liability 91.
[55] Decision 3/CMP.1 (FCCC/KP/CMP/2005/8/Add.1) Modalities and procedures for a clean development mechanism as defined in Article 12 of the Kyoto protocol, Annex, D, Accreditation and designation of operational entities, paragraph 22.
[56] Decision 10/CMP.7 (FCCC/KP/CMP/2011/10/Add.2) Modalities and procedures for carbon dioxide capture and storage in geological formations as clean development mechanism project activities, paragraphs 24-28 addressing non-permanence. See generally, Haszeldine and Ghaleigh, (n.31).
[57] n.56 (Decision10/CMP.7), paragraph 1(j).
[58] Ibid. paragraph 24(a).

other than the project, emission reduction units (ERUs), or removal units (RMUs)) from sources other than the project activity.[59]

In the second instance, where the project participants fail to make up the loss, the provisions place the onus on the Kyoto Protocol signatory party (Party) hosting the project, provided that Party 'has accepted the obligation to address a net reversal of storage in such a situation in its letter of approval.'[60] In the third instance, where the host Party has not accepted that obligation, the provisions place the onus on each Annex I Party that has received CERs from the project activity to cancel an amount based on the proportion that they have received in relation to the total loss.[61]

Interestingly, Appendix B to the modalities and procedures sets out additional requirements, including for financial provision by project participants.[62] This should provide cover including for meeting host Party laws and regulations, operational safety, project participant insolvency, redress for affected communities and ecosystems in the event of storage failure, and, in the event of storage failure (that is, leakage of stored GHGs), cover for meeting the obligation to make up the loss, and post-transfer monitoring, as set out above.[63] Finally in relation to this model, it is noted that the timeframe envisaged for the financial cover for monitoring is 'at least 20 years after the end of the last crediting period.'[64] What these various provisions demonstrate is that in the CDM process, considerable energy was expended on the question of the allocation of liability. The COP was mindful of striking an appropriate balance between the competing interests of project developers, host countries, auditors, and Parties, deploying tools of the transfer of liabilities, long-term monitoring, and financial security (i.e., the financial provision by project participants referred to above).

Another reason why the issue of liability as between seller and buyer[65] has receded might be that with implementation of the KP, practically all credits, for instance, certified emission reductions (CERs) under the CDM, were issued in relation to emission *avoidance* or emission *reduction* projects, not sequestration projects.[66] As such, questions of whether or not the emissions had been avoided or reduced would have been determined conclusively prior to certification and issuance by the CDMEB and without the risk of subsequent storage failure. Consequently, there has been little need for questions of liability to be resolved over subsequent leakage related to sequestered emissions.[67]

Notwithstanding this, it has been claimed that '…leakage has largely been ignored in CDM Project Design Documents, although it is explicitly listed as a calculation necessary for validation.'[68] Although the point was made in relation to the Marrakech Accords,[69] 'which

[59] Paragraph 24(b).
[60] Paragraph 26(a).
[61] Paragraph 28.
[62] Appendix B, paragraphs 18 and 19.
[63] Ibid.
[64] Paragraph 19(a).
[65] That is, the issue where the underlying emission reduction, avoidance or emission sequester, failed to eventuate or was defective, or failed to be recognised or was rejected by the relevant governing body.
[66] For example, CDM projects by type: Renewables 71%, CH_4 reduction & Cement and Coal mine/bed 15%, Supply Side EE 6%, Demand Side EE 3%, Fuel Switch 2%, HFCs, PFCs, SF and N_2O reduction 2%, Afforestation and Reforestation 0.8%, Transport 0.4%. UNEP Copenhagen Climate Centre, CDM Projects by type, <https://www.cdmpipeline.org/cdm-projects-type.htm#3> accessed 22/06/22.
[67] The UNFCCC provided under the KP for non-permanence in forestry removals through the issue of temporary CERs (tCERs) and long-term CERs (lCERs). However, the need for tCERs to be replaced by permanent credits acted to discourage investors in forestry-based CDM; also the mechanism relied on there being subsequent Commitment Periods; the replacement requirement impacted prices; and there was a lack of fungibility of the units; see: World Bank, BioCarbon Fund Experience: Insights from Afforestation and Reforestation Clean Development Mechanism Projects, 2011, chp.3 Non-permanence <https://web.worldbank.org/archive/website01379/WEB/IMAGES/BIOCAR-3.PDF> accessed 27/06/22.
[68] JP Morgan, Carbon Trading under the Kyoto Protocol: Risks and Opportunities for Investors, Fordham Environmental Law Review, Fall 2006, Vol.18, No.1, 151-184, 180; also F Vöhringer, T Kuosmanen and R Dellink (2006) How to attribute market leakage to CDM projects, Climate Policy, 5:5, 503-516.
[69] Marrakesh Accords (COP7), October 2001, FCCC/CP/2001/13/Add.2; Decision 17/CP.7 Modalities and procedures for a clean development mechanism as defined in Article 21 of the Kyoto protocol, Annex, Appendix B, Project Design Document,

require the project design document to contain, among other things, the "description of formulae used to calculate and to project leakage"',[70] provided it is measurable and attributable to the project, the same requirements could well be applied to physical leakage[71] from CDR projects under a future governance framework. Accordingly, the next section considers the current situation in relation to project-generated credits in the voluntary carbon market, since this is where most carbon credit generating project activity currently takes place.

5. Voluntary Carbon Markets As Sites of Experimentation[72]

Whilst compliance markets for removals and associated credits are still in development, the voluntary carbon markets (VCM) have taken a lead, with the World Bank noting recent demand for project-based credits in carbon markets.[73]

> Under most forecast scenarios, growth is expected to be driven by the increasing number of corporate net zero commitments in combination with an increased supply of new technologies and nature-based solutions.[74]

Data shows that total market value for voluntary carbon market transactions in 2021 reached almost US$2billion.[75] While twenty-nine independent, international or domestic crediting mechanisms operated in 2021, the five independent (voluntary) mechanisms – American Climate Registry; Climate Action Reserve; Gold Standard; Verified Carbon Standard; and Plan Vivo – provided the overwhelming majority of issued credits.[76] The World Bank reported also that, while high demand for credits from removal-based projects combined with limited supply explained the higher prices in this sector, the increased interest was yet to translate into greater project numbers and credit volumes.[77] As the World Bank explains:

> According to Ecosystem Marketplace, in 2021 the traded volume of credits from reduction-based projects in the voluntary carbon market was 21 times higher than the traded volume of credits from removal-based projects. Two factors likely explain the market dominance of reduction-based carbon credits. First, information on removal-based credit transactions may not be available or recorded in the market, as companies are starting to develop these projects themselves ... Second, it is possible that supply of removal-based credits is currently limited due to the long lead times for these projects to produce credits. Companies are also facing difficulties finding carbon credits from medium and long-term removal projects, which guarantee that emissions will be stored for more than 100 years.[78]

This last observation points also to the type of removal projects that are most prevalent. As noted by the State of CDR Report, while current CDR globally amount to 2GtCO_2 pa, practically all of these came from conventional land-based activities, such as afforestation, and land management. Novel methods of CDR accounted for 0.002 GtCO pa (i.e., one

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paragraph 2(i) (ii) Description of formulae used to calculate and to project leakage, defined as: the net change of anthropogenic emissions by sources of greenhouse gases which occurs outside the CDM project activity boundary, and that is measurable and attributable to the CDM project activity.

[70] n.68 (Vöhringer et al.).

[71] Physical leakage is for the most part referred to herein as 'storage failure' (see proposed definition at n.1), and should be distinguished from 'market leakage', which has been defined in the context of CDM as changes in emissions due to changes induced in commercial markets as a result of the project: n.67 (Morgan), 180. The liability issues addressed by this paper do not relate to market leakage, but rather to storage failure (i.e., physical leakage).

[72] Whereas this section addresses the voluntary carbon market and removals within it, it should be noted that the majority of removals operate outwith the VCM – see n.9 (Smith). For present purposes, the VCM is more relevant as it is here that issues of storage reversal liability arise.

[73] The World Bank, "State and Trends of Carbon Pricing 2022" (World Bank, 2020).

[74] Ibid, 41.

[75] <https://www.ecosystemmarketplace.com/publications/state-of-the-voluntary-carbon-markets-2022/> accessed 21/10/22.

[76] n.73 (World Bank), Annex C, Figure 16.

[77] Ibid, 44.

[78] Ibid.

thousandth of the total), mainly for BECCS, and biochar.[79] Furthermore, only one of the independent crediting mechanisms (American Carbon Registry) covered carbon capture and storage/utilisation, and only one (Plan Vivo) covered blue carbon – that is, the carbon captured by oceans and coastal ecosystems, while all five covered agriculture and forestry:

> Forest and land use credits are closing the gap on renewable energy credits in terms of credit issuance. Carbon credit issuances from forestry and land-use projects increased 159% over the past year, accounting for more than a third of total credit issuances in 2021… Although most of these credits come from projects to avoid emissions from deforestation and land use conversion, projects to remove atmospheric emissions (such as afforestation, carbon sequestration in agriculture, and improved forest management) contributed to a fifth of this growth.[80]

For removals projects registered under these voluntary standards, several independent crediting mechanisms, (e.g., Gold Standard Foundation, VERRA, and so on), have adopted a similar position on reversal liability to that of the Executive Board in relation to the CDM. In other words, the risk of storage failure is addressed by parties meeting the requirements of the standard. Thus, so long as the project is registered, the outcomes monitored and reported, and the results verified, and all other requirements of the standard met, units of the standard will be issued. For instance, one of these bodies, the Gold Standard Foundation, specifically addresses reversal risks in relation to forestry projects, which must retain a buffer amount of 20% against the risk of losses from fire, or pest infestation.[81] However, as the requirements of the standards bodies, over time, will be subject to review and revision, so the parties would need to address this risk allocation between themselves, as part of their contract negotiation.[82]

Additionally, it is important to note here that there is a considerable body of criticism levelled at the voluntary carbon market, on one hand, in terms of the quality and integrity of the project outcomes for which credits/offsets are issued, while on the other, in terms of the claims made by credit/offset purchasers and the purposes for which they acquire the credits/offsets.[83] Another charge is that strong recent demand in and related expansion of the project-based carbon credit market is already having undesirable impacts in terms of competing land-uses, for instance, with more and more land being converted to forestry, in preference to agricultural purposes in parts of the UK.[84] Further, in a high profile investigation, concerning the Verra standard, The Guardian newspaper drew *inter alia* on evaluations of REDD+ effectiveness[85] to conclude that upwards of 90% of offsets are "largely worthless and could make global heating worse." It claimed that said offsets do not represent genuine carbon reductions and in many cases violate the human rights of indigenous and local communities.[86]

These examples point to the need for clearer rules establishing minimum standards to be satisfied in order that projects generate high quality emission reduction or avoidance or

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[79] n.9 (Smith), 1.1.
[80] n.73 (World Bank) 44.
[81] 'Our rules for forestry projects explicitly ensure projects don't cut down trees to make room for new plantations. And to ensure permanence, Gold Standard requires a fixed 20% contribution for a pooled compliance buffer, which, unlike other standards, remains untouched even after the crediting period of the project, further reducing the risk of reversal and non-permanence.': <https://www.goldstandard.org/our-story/sector-land-use-activities-nature-based-solutions> accessed 21/10/22.
[82] For an analysis of risk allocation between commercial parties, albeit in the CCS context, see D Lawrence, 'Carbon Capture and Storage: Commercial Arrangements for Managing Liability Risks' in I Havercroft, R Macrory and RB Stewart (eds), *Carbon Capture and Storage: Legal and Regulatory Issues* (Hart Publishing 2018).
[83] For instance, recent research shows the climate action taken by the eight biggest European airlines lacked transparency and integrity, with some airlines even making the false claim that customers can fly carbon neutral: <https://carbonmarketwatch.org/publications/flights-of-fancy-preventing-european-airlines-from-making-far-fetched-climate-claims/> accessed 21/10/22.
[84] <https://www.landcommission.gov.scot/news-events/events/the-carbon-rush-understanding-the-role-of-carbon-offsetting-and-investing-in-the-land-market> accessed 21/10/22.
[85] A Guizar-Coutiño and others, 'A Global Evaluation of the Effectiveness of Voluntary REDD+ Projects at Reducing Deforestation and Degradation in the Moist Tropics' (2022) 36 Conservation Biology e13970.
[86] P Greenfield, 'Revealed: More than 90% of Rainforest Carbon Offsets by Biggest Certifier Are Worthless, Analysis Shows' *The Guardian* (18 January 2023), accessed 1 February 2023.

sequestration outcomes, a task the recently formed Integrity Council for the Voluntary Carbon Market (ICVCM)[87] is attempting to take on by developing Core Carbon Principles and an Assessment Framework[88] for the voluntary market. At the same time, corporate and financial regulators are beginning to take steps in relation to the various claims made by corporate entities.[89] For the moment, however, their legal approaches seem confined to the regulatory areas of false advertising, or misleading a deceptive conduct, which in the context of carbon offsetting or net zero claims would need evidence of particularly egregious behaviour, one imagines, in order to support regulatory intervention.

It needs also to be pointed out that not all the fault in the project-based carbon credit market lies with the voluntary market. Regulated project-based carbon credit markets exist and evidence is coming to light of design flaws in these schemes which mean credits are being over-issued, or issued in respect of no climate benefits at all, for which private offset purchasers or taxpayers (through the role of their government) are paying.[90] The liability implications of these flawed schemes are various: the climate benefits are compromised or non-existent, potentially creating problems for the private entities that have relied on the integrity of the scheme either in terms of their own compliance or in making public claims that prove now to be baseless; the public has been given a false impression of improvements in GHG profiles of the relevant jurisdiction; taxpayer funds are wasted, not only those of current taxpayers funding non-existent climate benefits, but also the future taxpayers who will need to fund the inevitably more costly emission reductions and removals required at a later time; and for the participants that have derived financial benefit as a result of the flawed schemes, the question needs to be asked to what extent they have been complicit, being aware that the financial benefit flowing to them was as a result of the flaw in the scheme design, but turning a blind eye and continuing regardless. As the next section highlights, unless shortcomings evident in both the voluntary project-based carbon credit market and regulatory project-based credit markets can be addressed, these and other liability issues will only be exacerbated in the scaling up of CDR sector.

6. Implications of development of a CDR market

Scaling up of the CDR sector will mean development of a wider range of methods to remove CO_2 from the atmosphere and to store them geologically or biologically for significant periods. Each of these methods will have different characteristics in relation to matters such as the timing in which they achieve removals; volume and rate of removal; cost; method, location and permanence of storage; environmental and social benefits or impacts; risk factors; and means of measurement and verification of outcomes.[91] For example, the cost of direct air capture and carbon storage (DACCS) is currently estimated in the range US$25-1000/t$CO_2$, whereas afforestation and reforestation (AF) is in the range US$0-240/t$CO_2$. While in relation to permanence of storage, DACCS geological storage has high permanency

[87] See: <https://icvcm.org>
[88] Ibid.
[89] <https://www.sec.gov/files/33-11042-fact-sheet.pdf> accessed 22/10/22: Securities and Exchange Commission proposed rule amendments that would require a domestic or foreign registrant (issuer) to include certain climate-related information in its registration statements and periodic reports; <https://ec.europa.eu/environment/eussd/smgp/initiative_on_green_claims.htm> accessed 23/10/22.
[90] See: B Haya et al., 'Managing Uncertainty in Carbon Offsets: Insights from California's Standardized Approach' (2020) 20 Climate Policy 1112; G Badgley et al, Systematic over-crediting in California's forest carbon offsets program, Global Change Biology 2022;28:1433–1445; R Merzian et al., Questionable integrity: Non-additionality in the Emissions Reduction Fund's Avoided Deforestation method, The Australia Institute/Australian Conservation Foundation, September 2021, https://ACF-Aust-Institute_integrity-avoided_deforestation_report_FINAL_WEB.pdf accessed 23/10/22; Andrew Macintosh, Don Butler, Dean Ansell, Marie Waschka, The Emissions Reduction Fund (ERF): Problems and Solutions, 6 April 2022, Australian National University, <https://law.anu.edu.au/sites/all/files/erf_-_problems_and_solutions_final_6_april_2022.pdf>, subsequently submitted as part of Australian federal government review of Australian carbon credit unit (ACCU) integrity: <https://consult.dcceew.gov.au/independent-review-of-accu>
[91] See generally Fuss n.23.

(millennia), whereas for AF, saturation and vulnerability to disturbance are risks and storage would average decades up to a century.[92]

As such, not only will the independent crediting mechanisms be reviewing and revising their voluntary standards to account for projects seeking to register new methods, but any government scheme or crediting mechanism (e.g., introducing CDR to the ETS, or establishing a separate CDR market) to scale up the CDR sector will need to account for the range of characteristics of the different methods.

In particular, any such mechanism will need to account for the range of storage periods (that is, permanence) of the different methods, variety of storage media and the risks associated with them. One well developed analogue is the regulation of CCS at the EU level in which, in pursuit of the objective of permanent storage, risk assessment and monitoring etc, links with the EU's trading scheme in important ways. As regards environmental protection, monitoring is linked to that required by the Emissions Trading Scheme (ETS) such that 'liability for climate damage as a result of leakages is covered by the inclusion of storage sites in Directive 2003/87/EC, which requires surrender of emissions trading allowances for any leaked emissions'.[93] This is a rigorous level of monitoring, supplemented by the requirement that operators provide financial security (i.e. to provide for 30 years of monitoring).[94] However, after closure of the storage site, liability transfers from the operator to the state (or 'competent authority' in the language of the Directive) after no less than 20 years.[95] This transfer of responsibility takes place after a process of 'history matching' whereby the monitored CO_2 is demonstrated to have behaved in a manner consistent with the operator's ex ante modelling and there is no detectable leakage, and the CO_2 is moving towards long-term stabilization. Nevertheless, it is worth noting also that while the financial security might be in the form of a performance bond or other form of financial surety;[96] must cover costs if the authority undertakes duties under the licence criteria when and if the operator does not do so, and such duties if the licence is revoked (Art. 19(3)); and must be effective for the duration of operation (Art. 19), it is released once transfer of responsibility takes place (Art. 18).[97]

It is likely also that CDR will feature more prominently in the pipeline of projects generating mitigation outcomes for international transfer under cooperative approaches between Paris Agreement parties (Article 6.2) and generating emission reductions under the mechanism supporting sustainable development (Article 6.4). Decisions taken at the third session of the Conference of Parties serving as the meeting of the Parties to the Paris Agreement in Glasgow[98] include the risk of non-permanence of mitigation outcomes or emission reductions.

For instance, in their initial report, Parties need to describe how each cooperative approach ensures environmental integrity, including '…By minimizing the risk of non-permanence of mitigation across several NDC periods and how, when reversals of emission reductions or removals occur, the cooperative approach will ensure that these are addressed in full;'[99] and as part of their biennial transparency reports, include information on how the cooperative approach ensures environmental integrity, including '…By minimizing the risk of non-

[92] Ibid.
[93] n.12 (CCS Directive), Recital 30.
[94] Ibid, Art.19.
[95] Ibid, Art.18.
[96] For instance, in UK transposition of the CCS Directive, financial security is defined as a charge over a bank account or property, a deposit of money, a performance bond of guarantee, an insurance policy or a letter of credit: The Storage of Carbon Dioxide (Licensing etc.) Regulations 2010/2221, reg. 1(c).
[97] n.12 (CCS Directive).
[98] Report of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement on its third session, held in Glasgow from 31 October to 13 November 2021, FCCC/PA/CMA/2021/10/Add.1.
[99] Decision 2/CMA.3 Guidance on cooperative approaches referred to in Article 6, paragraph 2, of the Paris Agreement, IV. Reporting, A. Initial report, paragraph 18(h)(iii).

permanence of mitigation across several NDC periods and when reversals of emission removals occur, ensuring that these are addressed in full;'[100]

Similarly, activities under Article 6.4 shall be designed, inter alia, to '(ii) Minimize the risk of non-permanence of emission reductions over multiple NDC implementation periods and, where reversals occur, ensure that these are addressed in full'[101] and '(iii) Minimize the risk of leakage and adjust for any remaining leakage in the calculation of emission reductions or removals'.[102] Mechanism methodologies should '…avoid leakage, where applicable…'[103] and '… shall include relevant assumptions, parameters, data sources and key factors and take into account uncertainty, leakage…'[104]

While the guidance on cooperative approaches and the rules, modalities and procedures for the sustainable development mechanism, insofar as they address non-permanence of removals, appear minimal, at least policymakers have taken the issue into account. As the BEIS Report notes, both the level of permanence and the probability of reversal in relation to all potential GHG stores require better understanding.[105] Inevitably, this will bring the issue of liability for storage failure, and leakages, to the forefront. Provision has been made for the transition of CDM projects and CERs to the mechanism under Article 6.4;[106] it is not inconceivable that the 6.4 Supervisory Committee might, in future, adopt modalities and procedures modelled after Decision 10/CMP.7,[107] or something similar, in relation to Article 6.4 projects.

7. Allocating Liability for Reversals: An Analysis of Options

As noted above, in the early years of carbon emission trading, pre-KP and the CDM entering into force, early-movers negotiated one-off contracts that evolved from contractually allocating liability for failure of or defective emission reductions, avoidance or sequestration, to allocating responsibility for each party to comply with the rules and procedures of the institutional structure, once the KP entered into force. Compliance with the rules and procedures ensured issuance of a valid, tradable commodity in the form of a CER for each tonne of GHG emission reduced, avoided or sequestered.

In the present context of a nascent and developing CDR market, this section examines five different legal approaches or structures[108] that could be considered by national policymakers and regulators for allocating liability in relation to the risk and consequences of storage failure. In a sense, the five are really only two, based on the history canvassed in preceding sections of this paper – the first three relate to a choice between the counterparties to a transaction, that is, the pre-KP scenario, being either the removal project developer/seller, or the offsetter/purchaser of the removal units; while the latter two are variations on the post-KP scenario, in which there is an institutional structure for allocating the risk responsibility (that

[100] Ibid., Reporting, C. Regular information, paragraph 22 (b)(iii).
[101] Decision 3/CMA.3 Rules, modalities and procedures for the mechanism established by Article 6, paragraph 4, of the Paris Agreement, V. Article 6, paragraph 4, activity cycle, A. Activity design, paragraph 31 (d)(ii).
[102] Ibid, paragraph 31 (d)(iii).
[103] Ibid., activity cycle, B. Methodologies, paragraph 33.
[104] Ibid, paragraph 34.
[105] n.16 (BEIS Report).
[106] Report of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement on its fourth session, held in Sharm el-Sheikh from 6 to 18 November 2022, FCCC/PA/CMA/2022/L.14, Draft decision -/CMA.4, Rules, modalities and procedures for the mechanism established by Article 6, paragraph 4, of the Paris Agreement, Annex I, II. Processes for implementing chapter XI.B (Use of certified emission reductions towards first or first updated nationally determined contributions) of the rules, modalities and procedures for the mechanism established by Article 6, paragraph 4, of the Paris Agreement.
[107] See section 4, supra.
[108] The descriptions listed are the 'plain vanilla' versions of the options. Any of the options described might be supplemented by other elements, schemes or supporting policies such as insurance, buffer arrangements, and so on.

is, the legal liability to redress the consequences of a CDR storage failure resulting in emission of stored CO_2). All the same, the five are as follows:

(i) purchaser/offsetter needs to replace the removal units (as proposed in the BEIS Report);

(ii) project owner/seller has obligation to maintain storage (and, if necessary, replace removal units);

(iii) again, this is a choice between the counterparties to a transaction, that is, the pre-KP scenario, being either the removal project developer/seller, or the offsetter/purchaser of the removal units, but subject to the variation that, based on analysis carried out to achieve a deeper understanding of each CDR method in terms of permanence of storage it provides and the risk factors that may affect it, allowing discounted pricing according to risk, to arrive at a scale of removal units priced according to storage permanence (defined time periods) and the risk that the storage might fail or leak before the defined period expires;

(iv) the government provides an institutional structure (e.g., along the lines of that provided by the CDMEB for CERs), so that once a removal unit is issued it is treated as valid and in the event of storage leakage or failure, replacement of related removal units is underwritten by the government (i.e., taxpayers);

(v) as part of a different institutional structure model, introducing a standard for bundling CDR projects so that bundles of projects that meet the standard can issue standardised removal units – a bundle would be managed by a 'bundle management company' which would have the long-term legal responsibility for the storage permanence of the standardised units issued by it.[109]

Before considering these different approaches and indicating a preferred approach, it is important to reiterate that our purpose here is, in the first instance, to consider 'who is liable when a CDR project goes wrong?' Consideration is given to the further questions 'what are they liable for and to whom?' as part of this exercise. Notwithstanding the important further question 'how do they then address or provide for this liability?', for the purposes of this paper, while noting them, we do not include analysis of possible mechanisms such as requiring entities to hold financial assurances to enable liabilities to be discharged, or insurance; or industry funds, or other collective funding schemes. This is a relevant matter for further research, the precursor to which is the principal question we seek to address here. We do so, in relation to the five different approaches listed above, by considering the legal relationship from which the liability may arise, then evaluating which party to that relationship is best placed, and most incentivised, to rectify the failure should it occur. Readers should bear in mind the discussion at section 2 above, and in particular the Calabresian notion that while efficiency is *a* consideration in the design of liability regimes, it is not the only one. Questions of equity, fairness, and other normative objectives should also apply, not least Conaghan's approach of balancing enterprise with harm deterrence. In this process of allocating liability, information and which parties have it, is a key determinant.

First and Second options

For the reasons following, as a general rule, it is considered the second option would be a better approach to allocating liability than the first option. Hence as between the two, the

[109] This proposal is elaborated in: Macinante and Ghaleigh, n.10 supra.

approach taken in the European Union Directive on geological storage of carbon dioxide[110] is preferred to that in the BEIS Report.[111]

To elaborate, the BEIS Report recommendation might be considered further. It provides that if a non-permanent CO_2 store leaks earlier than expected, the leaked CO_2 will have to be 're-removed' in the future. Provision for this future re-removal should made at the outset.[112] Liability for the provision of this "re-removal" capability should sit with the initial off-setter.

A first step might be to look at the reasoning for this recommendation. The Report states:

> If, for example, CO2 is removed from the atmosphere in 2030 via a mechanism that is understood to store CO2 in a non-permanent sink, and this store unexpectedly reverses, e.g., re-releases the CO2 to the atmosphere in, for example, 2060, this CO2 will need to once again be removed from the atmosphere. Given that this will not be a "new emission", but rather a delayed emission, understanding with whom the liability sits for this "delayed emission" will be key, as will the ability to trace back and enforce the liability against the relevant emitter. If, for example, liability is considered to revert to the original 2030 emitter, how might they be held responsible? Conversely, if the liability is considered to sit with a 2060 emitter, the same questions arise, noting that this may significantly impact the price at which the original removal service was provided. Further work is required to better understand both the level of permanence that might be associated with a given store, and also the probability of an early release owing to, e.g., fire.[113]

The question it is directed to is, irrespective of whether on a permanent or non-permanent basis, where does the liability for storing and maintaining the storage reside? Assuming the context is a market for removal units,[114] is liability with the project operator/seller, or with the purchaser/offsetter? Another way of putting this would be to ask what the units traded in that market represent. In other words, what are the buyers paying for?

Having looked back (in section 4 above) to the circumstances of the nascent carbon trading market pre-KP entering into force, the question of allocating liability as between project operator/seller and purchaser/offsetter seems familiar. Perhaps the most obvious difference is that now, in the more heterogeneous context of the Paris Agreement, any institutional structure that might be directed at this issue might be more likely to be on a national government or perhaps bilateral agreement basis, at least in relation to cooperative agreements pursuant to Article 6.2, rather than on an intergovernmental basis, as was the case with the CDMEB, although the Article 6.4 Supervisory Body will perform similar functions.[115]

Therefore, to consider the liability allocation question in the current CDR context, just as counterparties attempted to do in their one-off contracts pre-KP, it may help to begin by defining what they are transacting, that is, by setting out a meaning for CDR methods. Notwithstanding the wide range of characteristics displayed by the different methods (noted earlier), all CDR methods involve two aspects, namely removal of the CO_2 from the

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[110] n.12 (CCS Directive). Noting also that the EU CCS regime amended the Environmental Liability Directive such that a duty was imposed on operators (and in default the competent national authority) to take preventative or remedial action where environmental damage occurred or was imminent.
[111] n.16 (BEIS Report).
[112] Making provision at the outset for future rectification of storage failure or leakage is fully supported.
[113] n.16 (BEIS Report), 13. This seems based on assumptions of first, an ability to connect the release from the sink/store to the particular removal units traded in the market; second, a taxonomy of "new emission" as opposed to "delayed emission" and the meaning of "permanence" when referring to a store of CO_2; and third, it seems to be assumed that there are no other parties involved, but if the release were to occur before the removal unit has been retired for offsetting purposes, does the liability fall on the current holder, or if it has been traded, do intermediary holders also share that risk? These elements are yet to be resolved.
[114] Although 'credit' can also be used, 'removal unit' is preferred here when referring to the commoditised instrument representing a tonne of GHG removed by a CDR project, to distinguish it from credits under the CDM or other existing schemes.
[115] See for instance, Decision 7/CMA.4, Guidance on the mechanism established by Article 6, paragraph 4, of the Paris Agreement, recitals paragraphs 19, 20.

atmosphere, then safe storage of that CO_2 for a significant period.[116] Thus, when entities set up projects to carry out CDR (that is, undertake a project activity using a CDR method), they are doing so in order to (i) remove CO_2 and (ii) store the removed CO_2. How long that storage is intended to continue will be, in the first instance, a function of the particular CDR method applied.

Hence, the project operator carries out the project, removing CO_2 and storing it. Having monitored and reported outcomes and verified results, the project operator is issued removal units commensurate with the number of tonnes of CO_2 removed *and* on the basis that those tonnes will be stored for a period in accordance with the CDR method applied. It is assumed that the authority issuing the removal units, say, the government scheme administrator, will have a credible basis (the requisite understanding, noted in the BEIS Report) for determining how long the storage component will be, based on the CDR method applied (possibly being further classified in terms of being either 'permanent' or 'temporary'), and that this will be encapsulated by the core features of the removal unit (that is, its specification, registry record, value and other relevant characteristics).[117] Each removal unit, therefore, represents a tonne removed and stored for the period that accords with the method applied. This is what the unit represents, what the project operator holds out to the market when selling the removal unit and what the purchaser is paying for when buying the removal unit.

Notwithstanding the ability of the contract counterparties in any particular case to negotiate a liability allocation as between themselves, there is an argument that the obligation to ensure not just the removal, but also the storage, should stay with the party conducting the project in the first place, because:

- first, the project operator is best placed to address any leakage, both in terms of knowledge of the project and access to the facility;

- second, transferring risk of leakage or storage failure to the buyer of the removal unit or another party would provide a perverse incentive to the project operator not to take responsibility for the integrity of the storage;

- third, the setting up of the project to remove and store CO_2 will be, in most cases, stand alone and independent from any activities that cause emissions.[118] Leaving BECCS to one side, it is difficult to conceive the emissions resulting from a storage leak or failure as not being the new emission of the project, but rather as a delayed emission of the purchaser of the removal unit.[119] In contractual terms, a more accurate framing would be that the project operator has failed to deliver what they have contracted to sell and for which they have been paid: in other words, failure of consideration, for which they could be liable for breach of contract;

- fourth, when the project operator sells the removal units generated under the trading scheme they are selling both removal and storage, so it would be odd if they were able to simply pass on the risk for half (i.e. removal-only) of what they are contracting to provide to the buyer; and

- fifth, if the risk of ineffective or defective storage were to pass from the project operator to the buyer of the removal unit, it would be likely to have a negative impact on demand (as prospective purchasers would be acquiring a potential liability).

[116] n.8 (TRS), 20.
[117] These might even include the type of GHG if other than CO_2 removed, to facilitate accounting for issues such as those considered in: Myles Allen *et al* 2021 Ensuring that offsets and other internationally transferred mitigation outcomes contribute effectively to limiting global warming *Environ. Res. Lett.* **16** 074009.
[118] Bioenergy with carbon capture and storage (BECCS) projects may be a counter-example.
[119] n.16 (BEIS Report).

Another factor, that militates against both the first two options, is time. The definition given to permanence, in relation to one or another CDR method, could stretch to centuries or longer. In the absence of specific legal provisions as to the nature of the entity that might buy or sell removal units, it is reasonable to ask whether either a project owner/seller or a purchaser/offsetter is likely to still exist and be available to replace removal units associated with failed or leaking storage, at the relevant time. For this reason, neither of the first two options, *per se*, may be practicable.

Third option

The third option, as noted, is a variation on the first two. Assuming analysis could provide a sufficiently detailed knowledge and understanding of permanence and the risk of failure or leakage for each different CDR method, so that a scale could be devised to rank each based on anticipated length of storage period and the risk that the storage might fail or leak before the defined period had expired, then removal units could be priced accordingly. Additionally, the anticipated period of storage could be better reflected in the transaction between project owner/seller and the purchaser/offsetter.

However, this variation begs the questions of who would make the relevant determinations (as to period of permanence and risk rating) and who would set the prices? It is likely that only government would be in a position either to fund or, through its own research bodies, carry out the necessary analysis to gain a sufficient knowledge and understanding and thus, would be the provider of the determinations as to period of permanence and risk rating.[120] It is likely also that government would leave it to private ordering, as the efficient way to price the different types of removal unit, based on the determinations of the market.

Even though the value and characteristics of the commodity being transacted would be more clearly defined, and there would need to be an issuance mechanism in place, under this third approach there would still not be a full institutional structure. Just as under the first two approaches, the project owner/seller and the purchaser/offsetter would negotiate as between themselves where the risk would fall. Thus, in comparison to the situation under the KP, it would be more developed than was previously the case pre-KP, but there would still not be protection comparable to that afforded by the rules, modalities and procedures of the CDMEB ~~when it was in place~~.

Furthermore, just as with the first two options, it would still come down to a matter of whether the party that contractually carried the risk of storage failure or leakage would still exists when that failure or leakage occurs – the issue of limited corporate lifetime. It presumes also that there would be a legal obligation, whether regulatory or in the parties' contract, for the storage failure to be rectified (e.g., by replacing the relevant removal units).

Another issue that could arise concerns complexity of the resultant market. A scale of differently priced removal units in the same market would provide good opportunities for arbitrage. Tracking who was using what type of removal units to offset which emissions would necessitate sophisticated registry and trading tracking systems. This is a wholly novel situation which arises from the sheer diversity of removal methods, as compared with the relatively simplicity of emitting activities. A tonne of emitted CO_2 is equivalent to any other tonne of emitted CO_2, whereas any two units of removals may differ on the basis of the method used and therefore characteristics of permanence and so on. The resultant complexity would undermine the operation of the market. If every removal unit needed to be individually

[120] Although credit reference agencies might also be interested in providing such ratings, as it is in their line of business. It is noted also that providing such 'permanence ratings' would automatically introduce an element of risk for the provider in the event of storage failure at odds with the relevant rating.

assessed and compared through a process of due diligence, the costs of transactions would be so high as to make the market sluggish to the point of illiquid.

Fourth option

The fourth option is for a more developed institutional structure than the preceding option, perhaps along similar lines to the CDMEB, but in this instance based on national not international rule-making. As in the case of the CDMEB, it would set out rules and procedures to be followed in order for project outcomes to be certified and have removal units issued in respect thereof. While the removal units issued to projects would have different characteristics (e.g., permanence and risks) as per the scale considered in option three, project outcome certification and issuance of removal units would mean that the rules and procedures had been complied with and that the government would stand behind the integrity of those units.

Thus, in the event that a particular store failed or leaked, the government, as opposed to the project owner/seller or the purchaser/offsetter,[121] would underwrite the risk and acquire removal units in the market to replace those affected by the failure. Again, as with the first option, transferring risk of leakage or early failure of the store to the government as underwriter of the system introduces a perverse incentive for the project operator not to take responsibility for the integrity of the storage. Thus, measures may need to be introduced to counter this incentive, akin to those common in CCS regime.[122]

This option places the management of the risk of storage failure or leakage and related liability on a firmer institutional structural footing, whilst minimising the transfer of any potential risk to the government (and, consequently, future generations of taxpayer).[123] As noted earlier, in the case of the CDMEB, this issue did not arise simply because there was so little in the way of removals and these were mostly forestry-based. In relation to CDR, all the methods for which include storage of some sort, this consideration becomes much more significant. The final option seeks, amongst others, to address this point.

Fifth option

The fifth option proposes introduction of a government implemented institutional structure, but increases the onus of responsibility on the project operator (as compared with the CCS example) to maintain integrity of the CO_2 storage. This derives from a proposal to address the fungibility of removal units generated by different CDR methods and thus, facilitate a more efficient CDR market.[124] The proposal itself draws explicitly on the financial process of securitisation in which various exposures are pooled to form a financial instrument that can be marketed to investors. (A complex area of law previously governed by EU law,[125] at the time of writing the UK government was legislating to replaced retained EU law with a domestic scheme under the Financial Services and Markets Bill.[126])

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[121] Leaving to one side the possibility that there are other parties, e.g., market participants, who may be involved.
[122] For a survey, see I Havercroft, 'Long-Term Liability and CCS' in I Havercroft, R Macrory and RB Stewart (eds), *Carbon Capture and Storage: Emerging Legal and Regulatory Issues* (1 edition, Hart Publishing 2011). The CCS Directive provides for transfer of responsibility to the competent authority provided all obligations concerning monitoring and corrective measures have been taken by the operator (Art.18); also addresses this by obligations on the operator, inter alia, to notify leakage and take corrective measures (Art.16) including surrender of EUETS allowances in respect of leakages (Art.17): see n.12.
[123] Noting, at the same time, that ultimately the risk will default to the government anyway if there are no other potentially liable parties.
[124] n.10 (Macinante and Ghaleigh).
[125] Inter alia, Regulation (EU) 2017/2402 of the European Parliament and of the Council of 12 December 2017 laying down a general framework for securitisation and creating a specific framework for simple, transparent and standardised securitisation, and amending Directives 2009/65/EC, 2009/13.
[126] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1122997/Policy_Note_Securitisation_Regulation_Illustrative_Statutory_Instrument__1_.pdf

By bundling CDR projects, so that the bundle of projects satisfies the requirements of a standard ('Standard'), the bundle would be eligible to issue standardised removal units.[127] The Standard would be

> …a document, established by consensus and approved by a recognised body. It provides rules, guidelines or characteristics for activities or their results so that they can be repeated. The aim is to achieve the greatest degree of order in a given context.[128]

As part of the requirements of the Standard, the bundle would be managed by a bundle management company. This entity would have the long-term legal responsibility for the storage permanence of, and management of risk factors in relation to, the projects in the bundle and thus, for the standardised units issued by it. A core aim of such companies would be to ensure integrity and quality of outcomes, but also to foster a role for a class of professional managers, who would be tasked to ensure CDR projects continued to satisfy those requirements.[129] By bringing the projects in the bundle under the management remit of the bundle management company, not only would the project operators retain responsibility, thus a positive incentive to ensure integrity of storage, but this would apply across all the projects in the bundle, which would benefit from the greater pooled knowledge and resources of the bundle. On the other hand, it might be argued that the bundle management company approach would be subject to the same 'limited corporate lifetime' issue noted in relation to the third option (and consequently, the first two options as well). The bundling standard proposal includes legislative backing that would mean standardised removal units could only be issued by bundle management companies that satisfy the standard. Bundle management companies formed by the individual project companies that constitute the bundle part of that process would assume longer term responsibility for the units issued by the bundle.[130]

The objectives of the proposed Standard would include ensuring uniformity and consistency of outcomes across all bundles/pools of projects; addressing identified risks and shortcomings of individual methods through the bundling approach to facilitate issuance of fungible, high integrity removal units; ensuring a cross-section of methods is represented in each bundle; and ensuring appropriate governance and high-level oversight and management of CDR project development within the jurisdiction (e.g., to avoid imbalances in land uses and/or CDR methods; ensure distribution of CDR projects conforms to objectives of planning laws) and ensure that broader environmental frameworks which govern matters including water quality, contamination, waste and the protection of habitats and species are applied and complied with. In this way, the scientific, technical and environmental matters related to how CDR projects are planned, developed and operationalized might be managed and, to the appropriate extent regulated, in a way that provides for application of technical expertise, quarantined from market influence or impacts. To the contrary, it might be argued that standardised removal units would only aggregate the different project risks across the bundle, although an alternative framing might be that the individual project risks would be spread across the entire bundle. All the same, there is potential for bundled projects to be viewed in the same light as the mortgage-backed securities (MBS) and collateralised debt obligations (CDOs) that featured prominently in the global financial crisis of 2008-2010, notwithstanding that the standard, as proposed, should ensure the bundled projects would bear no resemblance to the subprime mortgages that underpinned those MBS and CDOs.

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[127] The bundling proposed here is similar to the bundling of small-scale CDM projects only in name.
[128] The Securitisation Regulation – Illustrative Statutory Instrument Policy Note (HMG, 2022), <Standardisation - GOV.UK (www.gov.uk)> accessed 06/02/23.
[129] In terms of the length of the project management commitment, there is a clear parallel with the role played by pension fund managers.
[130] J Macinante and NS Ghaleigh, 'Facilitating the Supply Side of a Greenhouse Gas Removal (GGR) Market: Bundling GGR Projects to Standardise Removal Units' [2022] CO2RE Policy Briefing.

This approach would also apply the analysis carried out to achieve a deeper understanding of each CDR method in terms of permanence of storage it provides and the risk factors that may affect it, mentioned in relation to the third option above. However, instead of this feeding into market complexity through a scale of differently priced CDR removal units in the market, this understanding would be built into the Standard for structuring the bundle of projects. Thus, determinations as to period of permanence and risk rating concerning particular CDR methods would be taken into account in structuring the bundles of projects, rather than in a market context in relation to individual projects, where the determinations could be open to challenge or potentially provide a basis for litigation by dissatisfied parties.

8. Conclusion

The CDR sector needs to be scaled up if it is to support mitigation action directed to achieve the objectives of international climate change policy. The failure to do so will "put climate targets at risk".[131] The policy instrument most likely to be implemented to promote such scaling up would be a market in CDR project-based outcomes – see the lead taken by the European Union in this respect[132] – although it is far from a given that integration of removals and emissions markets is the optimal policy option.[133] Since CDR outcomes necessarily entail the storage of the removed CO_2 for significant periods, the question of liability for leakage or storage failure needs to be addressed. Notwithstanding the need for further work to better understand both the level of storage permanence achievable by different CDR methods and the risk factors affecting the probability of failure, legal approaches and structures can facilitate development of a market in CDR project-based outcomes by appropriate allocation of related liability risks. This paper seeks to contribute to this process.

The first point to note is the obvious one that liability is fundamentally a social construct. The allocation of risk and reward in a novel field such as CDR is quintessentially a matter for legal policy making, and one in which lawyers should play a prominent role. It is striking that within the BEIS 'Task and Finish' group that there was only one lawyer out of thirty-four participants, as compared with over a dozen natural scientists. Also well represented were delegates from the landowning and farming sectors. Given this, the determination that liability for re-removals should not sit with project developers but off setters was scarcely surprising. Nonetheless, what is offered here is a reasoned and historically informed analysis of what is at stake in debates surrounding the allocation of liability in this new sector, which policymakers in particular might draw upon.

Early carbon market trading was characterised by contracts attempting to define the commodity being traded and designed to capture the legal rights attaching to the physical activities being carried out. Risk allocation between the counterparties to these contracts – project developer/seller on one hand, the purchaser (who ultimately may have intended to use the commodity to offset their own emissions) on the other – was a matter of negotiation. Eventually, with the entry into force of the KP, the CDMEB provided the rules and procedures for an institutional structure that assured the integrity of the commodity, provided the rules and procedures were followed. Voluntary standards implemented by independent

[131] A Galán-Martín, D Vázquez, S Cobo, N Mac Dowell, JA Caballero, G Guillén-Gosálbez, 2021. Delaying carbon dioxide removal in the European Union puts climate targets at risk. Nat Commun 12, 6490. https://doi.org/10.1038/s41467-021-26680-3

[132] Amendments adopted by the European Parliament on 22 June 2022 on the proposal for a directive of the European Parliament and of the Council amending Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union, Decision (EU) 2015/1814 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and Regulation (EU) 2015/757 (COM(2021)0551 – C9-0318/2021 – 2021/0211(COD)), see new Recitals 13(b), 13(c) (amendments 423, 424) and Amendment 511; Explanatory memorandum of proposal for regulation on Certification of Carbon Removals, p3.

[133] 'CO2RE-NEGEM Workshop – Consideration of Greenhouse Gas Removals (GGR) in Emissions Trading Systems: Principles and Practice', (CO2RE Briefing Paper, 2022).

(NGO) crediting mechanisms in the voluntary carbon market continue to apply essentially the same model.

While clear parallels can be observed between possible CDR market development and earlier project-based carbon market development and its evolution into the institutional structure under the CDMEB, and more recently the voluntary carbon market, there are also clear differences. Projects based on CO_2 removals have been only a small percentage of the total to date and have been confined, for the most part, to forestry and land use.[134] Development of the CDR sector portends a much greater range of CDR methods, each of which will have different characteristics. Differences in method, location and permanence of storage, and risk factors that may impinge upon storage, in particular, will differentiate the CDR market from the carbon market that has preceded it. This differentiation brings the question of liability for leakage or failure of storage to the forefront.

In these circumstances, this paper considers five approaches to addressing allocation of risk of liability for storage that leaks or fails over time. In this context, time is an important consideration, for example, the length of storage, existence of parties, and timing of any leak or storage failure. Another important consideration is that the party undertaking the project to deliver GHG removal and storage is best placed to ensure the on-going integrity of that storage and should be incentivised to do so, rather than being afforded the opportunity to transfer that risk to another party. Informational asymmetries substantially guide us here. When firms (project developers) have better information about their costs, harms, and mitigation options than their counterparties, fairness dictates that liability sits with them as incentivises them to exercise care one the basis of their superior information. In the very long term, government (and so, future generations of taxpayers) may have to pick up the risk in the absence of other potentially liable parties – even long lived bundle management companies. In providing an institutional structure (option five), it is argued that it would be preferable that storage liability remains with the party best placed to maintain its integrity, rather than planning for it to be transferred to government prematurely. The need for government to provide an institutional structure to enable the CDR market to operate, by providing rules and procedures, is clear. The institutional structure does not need also to place the onus on government to ensure integrity of GHG storage, when other more appropriate parties are still available. Existing models, such as the EU CCS Directive and the CDM modalities and procedures (under Decision 10/CMP.7), put in place timeframes of around 20 years after which time transfer of liabilities to the state may be possible if conditions are met.[135] If the responsible entity (such as a bundle management company) still exists, there are sound reasons for extending such timeframes. If there is continuing risk of failed storage, even if minimal, the merits of transferring liability to the state (so as to provide comfort to investors and project operators) needs to be set against the disbenefit of kicking those costs on to future taxpayers. An institutional framework which is informed by design principles of equity, as well as efficiency, could ensure that liability plays a powerful role in that process.

In closing, again it is worth emphasising that the fundamental questions raised by CDR storage failure are far from novel, even though the technologies may be. Lawyers have, with technical experts and government officials from various disciplines, worked for decades in the construction of carbon markets, co-producing solutions to cognate problems and developing structures that mediate between the overlapping needs for environmental security, economic efficiency, social robustness, and legal effectiveness. Policymakers would do well to draw upon past, hard won conclusions, in addressing the current context, rather than reinventing wheels.

[134] See n.9 (Smith)
[135] See, for instance, n.12