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Governance of Carbon Dioxide Removal: Practitioners' Perspectives on Fairness and Equity

Felix Dörpmund[1] , Christoph Brändle[2], Antonia Holland-Cunz[3] and Lukas Tank[3]

[1]Physical Geography, Ludwig Maximilian University Munich, Munich, Germany, [2]School of Management, Technical University of Munich, Munich, Germany and [3]Environmental Philosophy and Ethics, Christian-Albrechts-Universität zu Kiel, Kiel, Germany
Corresponding author: Felix Dörpmund; Email: doerpmund@cdtm.com

Abstract

Targeted policy and governance instruments are essential for developing a carbon dioxide removal (CDR) sector aligned with climate change mitigation scenarios. As a result, a large share of the scientific literature on CDR concentrates on these aspects. However, current CDR deployment and development are mainly driven by private organisations. While their role in CDR governance is generally acknowledged, important context regarding their perspectives, motivations and decision-making processes is lacking. This study addresses this gap by conducting seventy-nine interviews with senior representatives from organisations engaged in the early CDR market, including technology suppliers, credit purchasers, and financiers. We explore their views on key components of fair and equitable CDR systems. Our analysis reveals varying priorities across interviewed actors, including strong regulatory frameworks, market transparency, accountability, funding mechanisms and (climate) justice, emphasising historical responsibility, revenue distribution and community engagement. Additionally, we identify conflicting perspectives on the involvement of oil and gas sectors and the balance between rapid scale-up and thorough, inclusive processes. This research offers critical insights into the role of private organisations in shaping the governance of the emerging CDR sector, highlighting the complex interplay of market dynamics and ethical considerations.

Keywords: carbon dioxide removal; climate justice; governance

Introduction

In their global climate change mitigation projects under different climate change mitigation scenarios, the IPCC regularly counts on carbon dioxide removal (CDR) to achieve net zero GHG emissions and counterbalance hard-to-abate emissions.[1] As it stands, CDR is still in its nascent phase with ongoing research and development efforts and first commercial deployments.[2] This includes established approaches, such as afforestation, and novel methods, like direct air capture with carbon storage (DACCS).

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[1] M Babiker and others, "Cross-Sectoral Perspectives (Chapter 12)" in AR Shukla and others (eds) (Cambridge University Press 2022): 1261–3.

[2] Powis and others, "Quantifying global carbon dioxide removal deployment" (2023) Environmental Research Letters; GF Nemet and others, "Negative Emissions – Part 3: Innovation and Upscaling" (2018) Environmental Research Letters.

Policy and public governance levers are key elements for a concerted effort to reach the necessary scales. As a result, a large part of the scientific literature addresses the question of of what the governance of CDR should entail.[3] This includes, among others, the question of how the goverance of CDR should be developed from an equity and fairness perspective. Honegger et al. (2021)[4] draw an essential connection between governance and fair distributions of efforts and loads. Healey et al. (2021)[5] also address this, pointing out that CDR could be an opportunity to work towards more social equity through adequate governance measures. Pozo et al. (2020)[6] propose a fair and equitable allocation of CDR responsibility quotas based on accumulated historical emissions. Sovacool et al. (2023)[7] use expert interviews to provide context for expanding CDR efforts to the global south and highlight concerns on equity and fairness to differing degrees according to the CDR method.

More broadly, climate ethicists consider different ethical implications of CDR from a philosophical perspective. The discussion commenced with whether CDR should indeed be conducted and what potential impact of these novel technologies may be normatively relevant, including the possibility of unforeseen adverse effects.[8] This debate established the foundation for guiding principles for CDR development and research[9] and the development of principles for CDR governance.[10] Furthermore, the discourse addresses several normative issues that emerge in the context of CDR in greater depth. These include the question of CDR's permissible or justified extent and the distribution of benefits and burdens resulting from CDR.[11] These issues should be reflected in the future practical implementation and governance of CDR.

Private organisations have introduced the lion's share of activity in CDR so far.[12] A small set of large actors, including companies like Microsoft, include CDR in their net-zero

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[3] M Honegger and others, "The ABC of Governance Principles for Carbon Dioxide Removal Policy" (2022) 4 Frontiers in Climate; MJ Mace and others, "Large-Scale Carbon Dioxide Removal to Meet the 1.5°C Limit: Key Governance Gaps, Challenges and Priority Responses" (2021) 12 Global Policy 67; B Maher and J Symons, "The International Politics of Carbon Dioxide Removal: Pathways to Cooperative Global Governance" (2022) 22 Global Environmental Politics 44.

[4] M Honegger and others, "Who Is Paying for Carbon Dioxide Removal? Designing Policy Instruments for Mobilizing Negative Emissions Technologies" (2021) 3 Frontiers in Climate.

[5] P Healey and others, "Governing Net Zero Carbon Removals to Avoid Entrenching Inequities" (2021) 3 Frontiers in Climate.

[6] C Pozo and others, "Equity in Allocating Carbon Dioxide Removal Quotas" (2020) Nature Climate Change 640.

[7] BK Sovacool, "Expanding Carbon Removal to the Global South: Thematic Concerns on Systems, Justice, and Climate Governance" (2023) Energy and Climate Change 100103.

[8] D Lenzi, "The ethics of negative emissions" (2018) Global Sustainability; D Lenzi, "On the permissibility (or otherwise) of negative emissions" (2021) Ethics, Policy & Environment 24(2): 123–36; D McLaren, "Considerations of justice in assessment and appraisal of negative emissions technologies" (2012), Paper presented at the Third Trans-disciplinary Summer School on Climate Engineering, Oxford, UK, 20–24 August 2012; L Voget-Kleschin et al. "Reassessing the need for carbon dioxide removal: moral implications of alternative climate target pathways" (2024) Global Sustainability.

[9] M Boettcher and others, "The formative phase of German carbon dioxide removal policy: Positioning between precaution, pragmatism and innovation." (2023) Energy Research & Social Science 98: 103018.; SM Gardiner and A Fragnière, "The Tollgate Principles for the Governance of Geoengineering: Moving Beyond the Oxford Principles to an Ethically More Robust Approach." (2018) Ethics, Policy & Environment 21(2): 143–74; DR Morrow and others, "Principles for thinking about carbon dioxide removal in just climate policy." (2020) One Earth 3(2): 150–3; S Rayner and others, "The Oxford Principles." (2013) Climatic Change 121: 499–512.

[10] M Honegger and others, "The ABC of governance principles for carbon dioxide removal policy." (2022) Frontiers in Climate 4: 884163.

[11] D Lenzi and others, "Justice in benefitting from carbon removal." (2023) Global Sustainability 6: e22; H Schübel, "Individuals' responsibilities to remove carbon." (2023) Critical review of international social and political philosophy: 1–21.

[12] S Fuss and others, "Chapter 4: The Voluntary Carbon Market, The State of Carbon Dioxide Removal – 2nd Edition."

commitments and sourcing from the above-mentioned novel methods. Here, Reinhard et al. (2023) highlight that the current CDR governance framework lacks the necessary incentives for private organisations to develop a CDR industry that is "technically rigorous, environmentally conscious, and socially responsible." To accelerate the deployment of CDR, governments have just started providing incentive structures, for example, in the cases of the Inflation Reduction Act in the United States of America or the European Innovation Fund.[13] These structures are meant to foster research and development and activate private-sector finance while balancing equity and responsibility questions. To establish a political incentive structure that can effectively facilitate the development of such a CDR industry, Battersby et al. (2022) emphasise the importance of acknowledging the critical role of values, motivations, and decision-making processes held by CDR corporations. This study leverages semi-structured interviews to provide essential context on the role of private organisations in CDR governance, which the current scholarly discourse lacks.

Methodology

We conduct seventy-nine interviews with participants in the early CDR market, including investors, suppliers and purchasers, to provide that much-needed context. The interviewees (complete list in the appendix) were identified by consulting public announcements of corporations, as well as relevant registries of ecosystem actors, such as accelerators, incubators and online communities. The interviews were conducted starting in July 2023 and concluded in September 2024. The geographical distribution of the participants is concentrated in regions that can be described as "Global North" countries. We acknowledge that this presents a limitation in the perspectives reflected in this study. The share of different stakeholders in the pool of participants is slightly skewed towards CDR suppliers, with them representing around 45% of the interviews conducted. Given their roles with a commercial interest in the CDR sector, the participants should not be seen as neutral or academic experts, especially not on justice and equity. They should be regarded as representatives who might argue for measures supporting their respective roles. In the recruitment, we did not screen the participants for prior involvement with the oil and gas sector.

During the semi-structured interviews, the participants were asked about their views on "principles and components of fair and equitable CDR systems" as a concluding question for the interview. The answers to this question and its follow-up questions are subject to this paper. Other questions that were part of the interviews alluded to areas such as risk perceptions, general challenges, hurdles and motivations. These latter questions are covered in another publication separate from this paper.[14] The interviews had a maximum duration of 48 minutes and were conducted using Google Meets.[15] Subsequently, they were transcribed and anonymised using Condens.[16]

The interviewees' answers go beyond the initial scope of the question as outlined above. The answers tend to address governance principles more generally from the perspectives of market participants. We conducted our analysis as follows: First, we examine overarching

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[13] J Boyd and others, "Policy Incentives to Scale Carbon Dioxide Removal: Analysis and Recommendations" (2024); F Schenuit and others, "Carbon Dioxide Removal Policy in the Making: Assessing Developments in 9 OECD Cases" (2021) Frontiers in Climate.

[14] Dörpmund (2025): Motivations and challenges for carbon dioxide removal development: empirical evidence from market practitioners. Environmental Research Letters, <https://doi.org/10.1088/1748-9326/adcad4>.

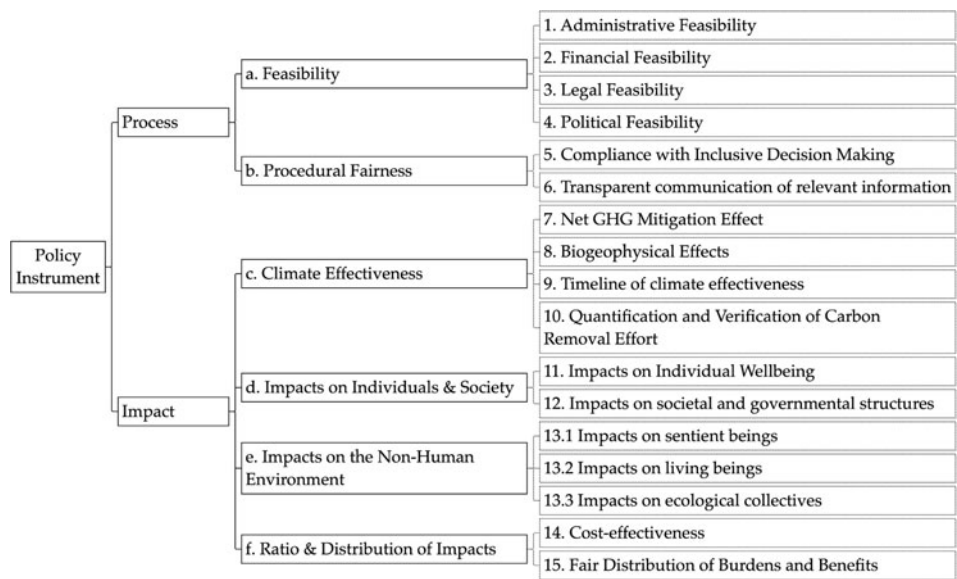[15] Google (2025): Google Meets.

[16] Condens (2025): Condens.

Figure 1. Framework for assessing CDR policy instruments, reproduced from Holland-Cunz and Baatz (2025).

elements of the interviewees' perspectives to inductively construct a baseline on their perspectives by inductive coding. Then, we cluster these elements along the CDR policy instrument assessment framework by Holland-Cunz and Baatz (2025).[17] In this setting, we also describe how different actors weigh the framework elements as a function of how frequently they mention the topic. We use example statements extracted from the interviews to illustrate the positions of individual stakeholders. We stress that these statements are used for illustrative purposes only and shall not be seen as representative of the breadth of perspectives brought forward by the participants. Second, we examine the interviewed actors' apparent differences and conflicting opinions. These results are situated in the relevant contemporary governance discussions surrounding CDR specifically and climate ethics and justice topics more generally.

Actor perspectives on the governance of CDR systems

Holland-Cunz & Baatz (2025) propose a framework for assessing policy instruments governing CDR. Fifteen criteria define standards for governing CDR (see Figure 1). They are structured around six dimensions of interest that are derived from the fundamental questions of what makes a CDR policy feasible (what can be done) and desirable (what should be done according to specific shared values):

A. Feasibility: How feasible is the process of formulating, adopting, implementing, evaluating, and refining a policy instrument?
B. Procedural Fairness: How fair is the process of formulating, adopting, implementing, evaluating, and refining a policy instrument?
C. Climate Effectiveness: How effective is a policy instrument in terms of its intended climate impact?

D. Impacts on Individuals and Society: How does a policy instrument impact individuals and society beyond its intended climate effect?

E. Impacts on Non-Human Entities: How does a policy instrument impact non-human entities beyond its intended climate effect?

F. Ratio & Distribution of Impacts: What is the ratio of inputs (resources) and outputs (impacts) of a policy instrument, and is the distribution equitable?

What makes this framework particularly suitable for the following analysis of the interviews is that it is currently the only assessment framework for the particular topic of "CDR policy instruments," which is closely connected to CDR governance. There are, of course, other frameworks for assessing CDR options[18] or climate policies in general.[19] However, assessment frameworks for climate policies in general are unhelpfully broad for the analysis undertaken in this paper. And assessment frameworks for CDR options, but crucially not CDR policy instruments, contain elements that are unhelpful when assessing the latter or lack policy instrument-specific elements. For example, assessment frameworks for CDR options usually include criteria on the technological feasibility of CDR options (e.g. Baatz et al. 2025). While technological features are relevant for the feasibility assessment of CDR options it doesn't make sense for the feasibility assessment of policy instruments like taxes, regulations or subsidies. Their feasibility, however, depends, among others, on administrative resources that may not be as relevant for the assessment of CDR options. By applying the Holland-Cunz & Baatz (2025) framework we do not deny that this framework overlaps in some aspects with other frameworks within the discussion or that other frameworks could also be employed to analyse the interviews featured in this paper. We do think, however, that because of its specificity the Holland-Cunz & Baatz (2025) framework is the most suitable one for this task.

What also makes the framework particularly valuable for analysis is that it explicitly highlights the value judgments that underlie our ideas about the desirability[20] of CDR. Analysing the interviews against the theoretical background in the form of the assessment framework can serve the following purposes. First, it enhances the analysis of the interviews by using the framework to structure statements according to the values that the interviewees explicitly or implicitly mentioned. Structuring the statements in this way makes it possible to identify which values regarding CDR governance are widely shared, which are highly controversial, or which may not be relevant enough to be mentioned, and where linkages, synergies and trade-offs between dimensions may arise. Secondly, the interviews serve as an iterative reality test of the framework, where dimensions and criteria can be tested for relevance and comprehensiveness. Moreover, practitioners' insights into which criteria and dimensions are considered more relevant can contribute to future research on trade-offs between them. Given the framework's novelty, it has yet to

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[18] See, for example, C Baatz et al. "A Holistic Assessment Framework for Marine Carbon Dioxide Removal Options." (2025) 20 Environmental Research Letters, 054047. <https://doi.org/10.1088/1748-9326/adc93f>; J Förster et al. "Framework for Assessing the Feasibility of Carbon Dioxide Removal Options Within the National Context of Germany." (2022) 4 Frontiers in Climate, 758628.; F Gulde et al. "Frameworks to Assess Climate Change Responses – A Systematic Analysis to Enhance Frameworks for Carbon Dioxide Removal." (2025) Environmental Research Letters.

[19] See, for example, C Baatz "Climate Adaptation Finance and Justice. A Criteria-Based Assessment of Policy Instruments." (2018) **40**(1) Analyse & Kritik 73–106; P Konidari and D Mavrakis. "A Multi-Criteria Evaluation Method for Climate Change Mitigation Policy Instruments." (2007) 35(12) Energy Policy 6235–57; Ş Scrieciu et al. (2011). MCA4climate: A Practical Framework for Planning Pro-Development Climate Policy, United Nations Environment Programme.

[20] For a detailed discussion of the concepts of feasibility and desirability see L Tank et al. "Distinguish between Feasibility and Desirability when Assessing Climate Response Options." (2025) 4, 34 npj Climate Action. <https://doi.org/10.1038/s44168-025-00237-2>.

undergo practical application or critical examination. Its potential limitations stem from its development being rooted exclusively in German and European contexts, which may limit its broader applicability.

Additionally, the framework lacks established methods for aggregating its criteria, posing challenges for systematic implementation and evaluation. This also makes the application of the framework to the qualitative interviews at hand challenging. Despite these limitations, it can serve as a helpful tool to categorise and interpret the practitioners' perspectives, mainly because it is especially suited to categorise statements on issues beyond feasibility, particularly fairness and equity.

For the analysis, we cluster the views/statements of the actors as outlined below. We rate the level of focus the actor group assigns to the individual dimension in question as "low" (grey), "mid" (light blue), or "high" (dark blue), depending on the distribution of thematic codes of that actor. For example, more than 60% of purchasers refer to lean and efficient processes and third-party methodological enforcement. At the same time, only 11% of interviewees mention climate justice and equity considerations. As a result, we rate the former as "high" and the latter as "low." This is not to say that the latter dimension is of no interest to the interviewee. Instead, it indicates what is on their mind regarding CDR governance. Further, we stress that individual statements of participants can be challenging to classify. For example, a statement like: "We care about co-benefits for biodiversity" might aim to enhance biodiversity for agricultural productivity, for the sake of flora and fauna, or both. In our analysis, we classify the interviewees' responses to the best of our knowledge using the context in which they are mentioned.

The results (Table 1) reveal distinct perspectives across suppliers, purchasers and investors in the early CDR market, highlighting areas of alignment and divergence. Across the board, the involved actors stress the importance and need for strong third-party regulation and governance. This includes mandated incentives for private organisations to be involved with CDR:

> *It's compliance. I think right now voluntary is allowing the people who already have the means to participate. But I think we need an agreement with teeth, and I think that means compliance.*
>
> — *purchaser*

One of the main reasons for this need for governance is climate effectiveness, the most commonly referred topic. All actors care about a governance system for CDR that ensures proper monitoring, reporting and verification (MRV) of the climate mitigation effects of CDR methods. Two considerations link climate effectiveness to issues of fairness and equity. First, climate effectiveness considers not only how much CO_2 is removed after CDR options are implemented, but also how quickly the options are scaled up (criterion 9). Scaling up CDR options too quickly may conflict with equity requirements. We discuss this point in section 3. Second, when we looked at the statements from the interviews that are systematised under climate effectiveness, terms such as "rely" or "trust infrastructure" point to another dimension, namely procedural fairness. An instrumental value of procedural fairness lies in strengthening societal support for the CDR governance in question. Relying on and trusting in the climate effectiveness of a CDR governance is only possible if the traceability and verification of CDR efforts are procedurally fair, i.e., in a transparent and inclusive way with widely available information.

Interestingly, interviewees didn't bring up the concern about mitigation deterrence/moral hazard, at least not explicitly. The criterion of "climate effectiveness" in the Holland-Cunz & Baatz (2025) framework takes into account the overall climate impact of a governance system, inducing that a governance system that leads to more mitigation deterrence is less climate effective. The theoretical tool chosen for our analysis thus has

Table 1. Thematic cluster of CDR governance topics according to the framework mentioned above. The relative importance of elements colour-coded as low (grey), mid (light blue), and high (dark blue).

Dimension of Interest	Supplier	Purchaser/Marketplace	Investor
Process: Feasibility	As defined by the outlined framework, feasibility was not picked up by the interviewed actors. The framework describes this dimension as the feasibility of the implementation of a policy (governance system, in this case). Rather, all actors presume the feasibility of a CDR governance system by not questioning the feasibility of such.		
Process: Procedual Fairness	Procedural fairness, in the eyes of suppliers, may be reached by establishing transparent governance processes and inclusive decision processes. *[. . .] just like concepts of additionality and ton year accounting And all of this stuff is like its purpose is to push people away and make a group of insiders. And I think that that is not how you win wars. That is not how you engage broadly the population of the world to spend 1.5 to 2% of GDP on this problem [. . .] Like we could hire a bunch of engineers and PhDs and stuff but like you have to find ways to communicate to people such that they can understand it and grasp onto it and engage with it.*	Buyers address the issues of information and intransparency within decision making processes for governance systems. *I think the crux is in the fairness and the giving back to the communities that are actually doing the work. [.] So I think as always, probably great transparency around how the funds are actually being used and who they really benefit from [is missing].*	Investors perceive the need for transparency in the creation of accepted governance structures. *I think one thing that's very, very important is transparency. [.] transparency in the long run will be super important and will also be needed.*
Impact: Climate Effectiveness	Suppliers deeply care about the climate effectiveness of their ventures. Additionally, the importance of verifying and quantifying the mitigation effects of CDR are underlined. *As long as you fulfil these criteria, then you need a system of making sure these criteria are well selected and enforced by the government or other third parties.* *You know, you need to be able to rely on the fact that people are doing what they're doing. So trust is the core of everything here.*	Purchasers stress the importance of verified and quantified carbon removal efforts *I think it's extremely important to have like a full traceability of the removed carbon. So and also to have that removal sort of verified like there is the like a physical traceability of what actually happened because I think it's very hard to to know what happens to it.*	Investors allude to the importance of proper verification and reporting systems for the sake of ensuring actual climate effectiveness of CDR credits *[. . .] yeah, credits that are certified, but making sure that you have a proper verification system and reporting system.* *[. . .] we absolutely have to build a trust infrastructure by which I mean we need certifiers and protocols that have got widespread acceptance as being trustworthy.*
Impact: Impacts in Individuals & Society	Suppliers are very specific about the incorporation of positive impacts of CDR deployment on local communities and individuals. *You know really that co creation, the collaborative process with the community members to make sure that these projects are built in a way that not only avoids negative impacts but also creates positive ones.*	Purchasers talk about including the impact of CDR on individuals and society. *But going forward I think from a climate justice perspective it will just, it will be an increasing part of the decision making. We have. I think as a whole things like job creation in underserved communities where people can point to that.*	Investors talk about the fact that society needs to be taken into account for CDR governance. They stress this less than other elements. *[. . .] it's a lot about the societal focus and what we as society actually then view as kind of like beneficial.*

Table 1. (*Continued*)

Dimension of Interest	Supplier	Purchaser/Marketplace	Investor
	And I think that most of all, community engagement should not be an afterthought, to be one of the first things you think about.	*Listening to the community really making sure that you are trying to prioritise diversity, equity and inclusion, that climate justice is at the forefront of your thinking.*	
Impact: Impacts on the Non-Human Environment	Interviewed suppliers did not specifically talk about the impact of their methods on the non-human environment. They see their businesses and fundamentally solving environmental problems.	Purchasers stress the importance of environmental co-benefits that need to be included in CDR systems. At the same time, they stress the need for commodification, which could disregard co-benefits. *I think Co-benefits are the most overlooked element to like a good CDR purchase in my opinion.*	Investors did not talk about the non-human environment specifically.
Impact: Ratio & Distribution of Impacts	Suppliers stress the importance of community benefit sharing and having polluters pay for CDR *Again, this gets into redistribution of wealth, some kind of baseline fee for every or percentage of every carbon, carbon trade, let's say that goes to the most affected communities or most affected nations of climate change and kind of gives them the ability to adapt more efficiently or to transition to real estate, reduce the cost of capital even for deploying renewable power.* *However, where it's done and where it like where the money goes [sic], I think those regions that are affected the most, which is predominantly going to be the tropics given it's the hottest area and water masses that are there.*	Purchasers focus about the element of adequate distribution of burdens and benefits in global CDR systems. *Weigh the share of like who should be paying for that and whatever, you know, like having polluting industries like the oil and gas and whatever, like pay more and you can like protect effective communities more.* *It requires regulation to ensure fairness, global collaboration to distribute a budget, acknowledging CDR as a tool for climate justice. We can't expect developing countries to supply the same capital for negative emissions as developed nations. A CDR budget must be established, linked to historical climate contributions as the fairest indicator. Financing should follow this principle, not based on the location but historical responsibility.*	Investors mention the inclusion of benefits for specific communities and global participation through fair revenue distribution *And I would wish for those countries to own the technology to, you know, to build the technology, to own the technology and also like to receive the revenues, obviously.* *[. . .] having an equitable revenue distribution across primary and secondary carbon markets [. . .].* *The West has a huge advantage and we overlook a little, we overlook too many capabilities in the rest of the world.*

the capacity to recognize statements about mitigation deterrence/moral hazard. The interviewees simply did not raise this topic.[21]

Further, interviewed suppliers heavily emphasise the importance of positive impacts on local communities and individuals, with purchasers following suit. This emphasis also seeps into the distribution of positive and negative effects. Across all actor groups, ensuring a proper distribution of burdens and benefits is a priority. All actors see this as an underpinning of the acceptance of CDR methods. Suppliers allude to climate justice ideas and polluter-pays-principles. Purchasers and investors talk about this in the scope of global carbon markets. Specifically, they discuss the importance of adequate burden sharing across industrialised and developing countries. Outside of the immediate framework at hand, many participants stress the element of transparency about the characteristics of a CDR verification system rather than a transparent process of enacting the governance system. They also focus on the governance structures and processes of the CDR market that will emerge rather than the overarching governance system.

Pragmatism for speed and scale vs. normative ideas and public support

There are diverging opinions regarding the tradeoff between pragmatism in speed and scale as opposed to normative ideas about CDR governance. These tradeoffs reveal the challenge of creating governance structures that accommodate the urgency of scaling CDR solutions and the demand for ethically grounded systems. On the one hand, we see latent needs for, and prioritisation of integration, usage of existing infrastructure, and commodification. On the other hand, we recognise normative ideas that strongly emphasise due processes, equity, and fairness. The issue is that the rapid development of CDR governance sometimes fails to meet the demands of equity and fairness. In contrast, implementing fair CDR governance takes time, which is a problem of fairness relative to the victims of delayed action. Simon Caney (2015)[22] uses the distinction between "burden-sharing justice" and "harm-avoidance justice" to describe the occasionally conflicting demands of climate justice: equitable burden distribution and avoidance of unfairly delayed action need not always go together.

In our interviews, we experience some purchasers and investors who are advocating for integration and reliance on existing infrastructure to streamline scalability, with traceability and verification as foundational to a functional market. For many participants, this goes hand in hand with the call for the commodification of CDR. On the other hand, we have representatives of the same actor group strongly encouraging the inclusion of co-benefits, sometimes citing them as their primary area of inquisition when purchasing credits. For them, social justice and giving back to underserved communities are at the forefront of their evaluation and selection criteria, with a strong focus on co-benefits, such as soil enhancement or community uplift.

Commodification could potentially yield higher development speed and adoption rates. It might trigger new waves of needed capital to bridge the massive gap in financing the first-of-a-kind (FOAK) plants and help reach commercial scale in production facilities. The effects of commodification of carbon emissions have been viewed critically, though, for example, in forestry projects, where commodification is said to have failed to create livelihood co-benefits and other forms of sustainable development (e.g., reducing emissions from deforestation and forest degradation in developing countries. (REDD)).[23]

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[21] DE Callies (2023). The Ethics of Geoengineering. In G Pellegrino & M Di Paola, Handbook of the Philosophy of Climate Change. Springer. pp. 919–37.

[22] Simon Caney, "Two kinds of climate justice: avoiding harm and sharing burdens." (2015) Political Theory Without Borders: 18–45.

[23] Tracey Osborne, "Tradeoffs in Carbon Commodification: A Political Ecology of Common Property Forest Governance" (2015) Geoforum 64.

For CDR as a potential ingredient for a just transition, Nawaz et al. (2024) recently argued that commodified carbon markets might not allow for prioritising climate justice elements. We see this trade-off as a potential field for much tension as the build-out of CDR continues to accelerate:

> *So, we've intentionally chosen certain projects because of the Co-benefits that they have [.]*
> *purchaser*

> *Our objective ultimately is to move towards greater commodification of the market. So that it can become a scalable market because the more bespoke everything is fragmented, the less scale we can realise.*
> *purchaser*

Another issue that is closely related to the previous one is the inclusion of the oil and gas sector. While leveraging their infrastructure and capital might be crucial to accelerate CDR implementation,[24] scholars argue that this risks undermining justice in the CDR system and reinforcing existing inequalities.[25] Across all actor groups, participants emphasised the importance of addressing this conflict and meaningfully incorporating climate justice. In the eyes of this study's participants, failing to address this inherent climate justice conundrum will lead to a loss of trust in the integrity of the CDR sector. This integrity is seen as the bedrock for a functioning CDR sector.

> *And then the final thing I'll say on it just very pragmatically [. . .] that's even if you didn't care about any of these issues, they will be important in terms of societal perception. So, it's really key that people see the CDR space trying to be very forward in terms of its climate justice mindset.*
> *purchaser*

> *So, the perception is that industries like oil and gas can emit as much as they want, and people like [redacted] will just come and suck it up and save the day, which is a terrible perception to have*
> *supplier*

Adequately governing this interplay so as not to lose integrity and thus, public support is seen as one of the key tasks of a given governance system. As a prerequisite, they see an independent governance system and not under the influence of the oil and gas sector. Our participants' perspectives on governing concepts frequently express the need to make polluters pay. Here, the participants allude to the responsibility of countries and companies, accounting for the historical responsibility and context of the accumulated emissions.[26]

> *Who caused the problem need to be the ones to pay for it, which means fossil fuel companies and the US and other Western countries that other developed countries that are responsible for putting so much carbon into the atmosphere*
> *supplier*

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[24] S Asayama, "The Oxymoron of Carbon Dioxide Removal: Escaping Carbon Lock-In and yet Perpetuating the Fossil Status Quo?" (2021) Frontiers in Climate.

[25] S Nawaz and others, "Carbon Removal for a Just Transition" (2024) Climate Policy 1.

[26] For future interviews, it may be interesting to ask stakeholders whether their commitment to making the polluters pay in the context of CDR changes when distinguishing between CDR as a tool to reach net zero emissions and as a tool to reach net negative scenarios. It is conceivable that those who advocate for the Polluters Pays Principle for getting to net zero would not consider it fair for past polluters to pay in a net negative scenario where only subsistence emissions remain. For an introduction to the Polluter Pays Principle in the context of climate justice see S Caney, "Climate Justice' (2021) Stanford Encyclopedia of Philosophy (ed E.N. Zalta).

When touching on potential mechanisms for this to occur, participants again incorporate the idea of CO2 as a tradeable commodity, illustrating the complexity of this discussion:

> *Again, this gets into redistribution of wealth, some kind of baseline fee for every or percentage of every carbon, carbon trade, let's say that goes to the most affected communities or most affected nations of climate change and kind of gives them the ability to adapt more efficiently or to transition to [. . .] renewable power.*

supplier

Concluding remarks

According to global climate change mitigation goals, the volumes of CDR will need to increase significantly over the following decades. The governance of such a CDR system will pose a formidable challenge. Private organisations already actively engaging with this nascent sector are starting to influence the development of such governance. This study gives a glimpse into their perspectives, showing both commonalities and areas of tension.

Despite their varied perspectives, all actors converge on the necessity for robust governance systems characterised by vigorous third-party enforcement, transparency and accountability. These foundational elements are critical to ensuring the climate effectiveness of CDR. Key tensions emerge in the trade-off between the urgency to scale CDR solutions rapidly and the need for equitable, justice-centred governance frameworks. This juxtaposition reflects broader debates in climate justice, including the distinction between burden-sharing and harm-avoidance justice. While rapid commodification and integration with existing infrastructure may accelerate sectoral development, these approaches risk undermining equity, reinforcing historical injustices and compromising public trust. Conversely, though slower, embedding climate justice principles and co-benefits into governance structures strengthens the sector's societal legitimacy. The oxymoron of the involvement of the oil and gas sector underscores this tension. Participants overwhelmingly stress that a successful governance system hinges on its independence. Such a system must navigate these tensions, for example, by prioritising a Polluter Pays Principle and addressing historical emissions. Otherwise, participants see the looming threat of losing public trust in the CDR sector, which ultimately undermines its feasibility.

Moving forward, the scientific community must actively steer these discussions surrounding and enactment of CDR governance. Scholars must also know market participants' evolving priorities and challenges for this. Reconciling these apparent tensions and trade-offs will be neither straightforward nor swift. However, it is imperative to address these issues to build a credible and effective CDR market. As the sector evolves, its long-term success depends on its ability to balance pragmatic development needs with meaningful commitments to fairness and equity – ensuring that CDR contributes to climate mitigation and a just transition.