

# Carbon removal and the empirics of climate delay

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## 1. Introduction

In a short period of time, the climate conversation has shifted towards a new master narrative centred around net zero. From countries and municipalities to various private actors, climate targets that aspire to drop emissions to net zero now pervade climate governance at all levels. As of February 2024, nearly 90% of national emissions are covered by such pledges - for corporations, over 50% of the world's largest 2,000 publicly listed companies by revenue have achieved, pledged or proposed net zero strategies.<sup>1</sup>

This new narrative articulates the inevitable conclusion of climate science: if temperatures are to be stabilised, emissions need to drop all the way to zero. But in some cases this will be difficult or even impossible to accomplish, and the 'net' suggests there will be 'residual' emissions that cannot be avoided. This is where carbon dioxide removal (CDR) comes in, as a set of methods to compensate for any residual emissions. Such carbon removal methods range from afforestation/reforestation, bioenergy with carbon capture and storage (BECCS) and biochar, to direct air carbon capture and storage (DACCS), enhanced weathering and ocean fertilisation (Minx et al., 2018).

The net zero conversation is not the only context in which CDR is discussed - it also enters the picture as a way to reverse temperatures if agreed-upon targets are eventually breached. Yet it is in relation to net zero pledges that removal has so far been most actively discussed. In part this is due to the intense controversies that pervade the net zero debate. While net zero emerged from what might appear as a straightforward application of carbon budgeting science, its adoption by various public and private actors has proven highly controversial (Fankhauser et al., 2022). A growing number of reports and analyses by scholars, NGOs and climate think tanks conclude that net zero pledges differ immensely in terms of their scope, transparency and implied climate ambition. Some amount to little more than greenwashing, while others depict a clearer commitment to scaling up emission reductions (Day et al., 2022; Li et al., 2022; Oxfam, 2021).

The envisioned, often large-scale use of CDR implied in these ambitions has raised numerous concerns about the unsustainable claims on water, land and other resources they

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<sup>1</sup> <https://zerotracker.net/>

would entail (Bluwstein and Cavanagh, 2023; Dooley et al., 2022; Dooley and Kartha, 2018), and the various risks and uncertainties that surround questions of carbon storage security and permanence (The Royal Society, 2022). One of the most central questions is the issue of climate delay or mitigation deterrence (MD) (McLaren, 2016), i.e. the concern that (anticipated) deployment of CDR will lead to a lower or delayed effort to reduce emissions (Markusson et al., 2018).

MD remains the subject of academic debate, including over diverse stances on terminology, with alternatives including 'moral hazard' and 'mitigation delay' (Carton et al., 2023; Jebari et al., 2021; McLaren et al., 2021). So far, this debate has mostly taken place at an abstract, conceptual level, with few studies employing contextualised empirical methods or exploring the specific mechanisms and processes by which MD operates in practice (Carton et al., 2023). The ambition with this special issue is therefore to explore how MD plays out empirically, across a variety of contexts and cases.

The papers in this special issue address the overall phenomenon of CDR (Brad and Schneider, 2023; Von Rothkirch et al., 2024) as well as specific removal technologies, including biochar (Hougaard, 2024; Price et al. 2024), afforestation/reforestation (Stanley, 2024), and direct air carbon capture and storage (DACCS) (Palm et al., 2024). They probe both the relabelling of long-standing CDR practices, e.g. forestry (Stanley, 2024), and the future-oriented imaginaries of more unproven methods, e.g. DACCS. They investigate dynamics at multiple scales, from the national (Hougaard, 2024; Price et al. 2024; Von Rothkirch et al., 2024) to the regional (Stanley, 2024) and supra-national (Brad and Schneider, 2023). Geographically, all of the papers are focussed on places in Europe. The absence of other areas is one of the main gaps in this special issue.

Taken together, the papers answer the call for more grounded, situated, empirical work on the dynamics of MD and climate delay in the context of net zero policy. They help us think through what MD looks like in practice across a number of different aspects. While previous literature tends to be dominated by decontextualised assessments based on surveys of public or stakeholder perceptions (see Carton et al., 2023 for overview), the papers collected here provide a case-based perspective. As such they help us take seriously the importance of different social, political and economic dynamics and contexts in understanding the contentious role that carbon removal plays in contemporary climate politics.

In this introduction, we summarise and discuss what we can learn about MD from this special issue. We first outline processes of MD identified across the papers. We then discuss different background conditions that make deterrence more likely. Finally, some possible ways to reduce MD risks are addressed, before we conclude and suggest some avenues for further research. Throughout we reflect on gaps and weaknesses in the literature as a way to identify priorities for future research.

## 2. Processes of MD

The papers in this special issue point towards three main processes through which MD operates, namely different ways of 1) *envisioning CDR*, 2) *rendering CDR knowable*, and 3) *offsetting with CDR*.

(1) Several of the papers show how MD is discernible in the way *carbon removal is envisioned* by different actors, that is, how they imagine, frame or otherwise position removal in ways that are often compatible with established carbon-intensive practices. By employing concepts like ‘socio-technical imaginaries’ (Brad and Schneider, 2023; Hougaard, 2024; Palm et al., 2024) and ‘expectations’ (Von Rothkirch et al., 2024) these papers examine how future CDR potential is described and alternative mitigation options (e.g. more fundamental economic changes) are marginalised or ignored (Brad and Schneider, 2023; Palm et al., 2024). As several of the papers highlight, this may lead to what McLaren (2020) terms ‘substitution and failure’, i.e. when some emissions are left unabated with reference to planned carbon removal, but in the end those removals fail to materialise. Some papers also discuss how such imaginaries are ‘enacted’ or ‘performed’ in specific contexts and thereby gain influence in, for instance, EU policy making (Brad and Schneider, 2023) or selected industries (Hougaard, 2024; Price et al. 2024).

*Brad & Schneider (2023)*, for example, study EU climate policy development and identify risks of MD in the kind of future visions that shape policy and permeate the lobbying activities of economic actors. They show how a green growth imaginary guides EU climate policy in the direction of new business opportunities for ‘carbon farming’. The related notion of a ‘circular [carbon] economy’ facilitates flexibility (and ambiguity) between geological CDR, ecosystem-based CDR, and emissions reductions, and prevents a more ambitious and stringent discussion on residual emissions. The lobbying is mainly driven by agribusiness and the biomass industry, with interests in sustained business opportunities and legitimacy. The result, the authors argue, are net reduction goals that fail to fully separate removals and reductions. This creates a degree of flexibility that for instance allows removals from the Land Use, Land-Use Change and Forestry (LULUCF) sector to be used to counter emissions from transport or other sectors under the Effort Sharing Regulation: a potential form of MD.

Similarly, *Palm et al. (2024)* explore how the socio-technical imaginaries of dominant interests in the petrochemical sector are reflective of dynamics of deterrence and delay. They show how fossil-based plastic production is reframed as part of a circular carbon imaginary (an imaginary also discussed by Brad and Schneider, 2023) while CDR – specifically DACCS - is described as a means to provide carbon for petrochemical production, substituting the original fossil feedstock. In the process, CDR is conflated with, and reimagined as carbon capture and utilisation (CCU), giving increased legitimacy to carbon capture technology. Palm et al. (2024) also highlight the important role that selective silencing plays in this. The circular carbon imaginary downplays both the problem and uncertainties with CDR (and plastic recycling), and the feasibility of alternative, low risk, short term strategies involving reduced production. The result is that continued fossil-based production, a continued dependence on carbon, and the dominant position of incumbent corporations are re-legitimised, while lower-carbon alternatives or opportunities for reduced production and consumption are left out.

*Hougaard (2024)* shows how socio-technical imaginaries about biochar are enacted in Denmark, by a range of actors, and across a set of fora. This enables a surprisingly large role for biochar in Danish climate policy, and in turn allows for the continuation of current forms of highly industrialised and animal-heavy agricultural production. But, the author argues, biochar faces drastic upscaling challenges and multiple uncertainties, and there is

significant risk that it ultimately fails to live up to expectations. Such failure would mean that biochar justifies the current agricultural system with a promise of compensation that may in the end never happen, leading to higher emissions than anticipated.

(2) Various papers in this special issue show *how carbon removal is rendered knowable* in ways that end up enabling MD. This includes a concern for how knowledge gaps are dealt with in the scientific literature and applied practice, that is, how actors navigate what is and is not known. Both Palm et al. (2024) and Price et al. (2024) stress how scientific uncertainty is inherent in promises of future removals. This introduces the possibility that speculative CDR plans end up crowding out emissions reduction options that are more mature, but costly or unpopular in the short term. In contrast, Stanley (2024) illustrates how increased accuracy (hence reduced uncertainty) in forest carbon measurement and verification leads to the generation of more carbon offsets without actually enhancing carbon sequestration. He argues that the overt focus on measurement might deter or delay emissions reductions, while the increased amount of 'known' carbon legitimises emission increases elsewhere. Likewise, Price et al. (2024) highlight the central role of measurement, reporting and verification in developing CDR offset markets. While the absence of standards and devices for the time being fends off the development of a substantial biochar carbon offset market in the UK, the overly optimistic expectation of future, cheap, verified offsets from biochar may negatively affect efforts to reduce emissions today.

Employing concepts such as 'interpretative flexibility' and 'boundary objects', some authors discuss how specific understandings of CDR and net zero matter for MD. For example, von Rothkirch et al. (2024) explore expectations among stakeholders of the role of CDR in the Swiss policy context. They identify a degree of interpretative flexibility with regard to residual emissions, but also a silence among policy makers regarding this flexibility. This means that assumptions and assessments of how impossible it is to abate particular emissions, and how necessary it is to resort to carbon removal to compensate may go unchallenged, which could result in MD. The authors also find different views among stakeholders about the risks of MD, although (again) there is little discussion about it.

(3) Finally, the papers foreground how a dominant *reliance on offsetting mechanisms* in the pursuit of CDR funding is fuelling MD dynamics (Brad and Schneider, 2023; Price et al. 2024; Stanley, 2024). The paper by Stanley (2024) for example illustrates how the construction of new digital/technological infrastructure facilitates the offsetting market's internal 'drive towards carbon credit maximisation' without necessarily increasing the amount of carbon that is being removed. Brad and Schneider (2023) show how proposed carbon removal policy instruments in the EU, such as the Carbon Removal Certification Framework, allow removal credits to be used to offset emissions that could be avoided, which they identify as a key MD dynamic.

Likewise, Price et al. (2024) identify biochar carbon trading in the UK as a potential form of MD, even though the current lack of verification standards so far makes these markets unfeasible. The authors argue that robust standards for measurement, reporting and verification need to be developed to minimise the risk of MD, but they also raise concerns that biochar carbon trading in itself can contribute to MD by reducing the urgency of wider mitigation actions.

### 3. Political economy as structural background condition

In addition to the three processes identified above, almost all papers point to how economic and political interests contribute to deterring or delaying emission reduction efforts. It is by connecting these interests to the three processes that the contextualised risks of MD become clear: Delay results from how actors produce, shape and promote specific visions of carbon removal - and the role it should play - in line with their interests, thereby reframing the problem of climate change and its preferred (or possible) solutions (Brad and Schneider, 2023; Palm et al., 2024). These actors play an important role in rendering carbon removal knowable (e.g. by developing and employing advanced measurement techniques (Stanley 2024)) and tend to make selective use of carbon removal science, thereby reinforcing some renderings while silencing others (Stanley, 2024; Von Rothkirch et al., 2024). And the continued dominance of offsetting as a central tool in climate politics can only be understood as the outcome of a neoliberal form of governance in which the prioritisation of private interests is a direct rationale, and delay/deterrence a logical outcome (Stanley, 2024).

We can consider these political and economic interests as background conditions or structural mechanisms for MD. The contributors to this special issue draw on a range of theories and literatures including cultural political economy, critical policy studies and economic sociology to bring these conditions into their analysis, illustrating how institutional actors such as industries (Brad and Schneider, 2023; Hougaard, 2024; Palm et al., 2024; Stanley, 2024) and (industry-captured) governments (Brad and Schneider, 2023; Hougaard, 2024; Palm et al., 2024) have vested interests in maintaining the current system of capitalist production and consumption.

Several of the papers point to the benefits that incumbents gain when framing CDR as an extension of their existing operations (Brad and Schneider, 2023; Hougaard, 2024; Palm et al., 2024; Stanley, 2024). The petrochemical industry (Palm et al., 2024), plantation forestry (Stanley, 2024), and industrial agriculture (Hougaard, 2024) all use CDR to future-proof their investments and continued existence. Likewise, large landowners use CDR to make more money from their land (Stanley, 2024). Climate progressive governments seek to maintain legitimacy by working towards climate targets and being seen as global leaders (Brad and Schneider, 2023; Hougaard, 2024; Von Rothkirch et al., 2024). CDR also provides new economic opportunities for start-ups and emerging actors, from CDR suppliers trying to sell a product, to market enablers and providers of measurement technologies that seek to benefit from the exchange.

This is not to say that these different actors necessarily intend to deter emissions reductions. As Hougaard (2024) argues for the Danish biochar case, the collective enactment by various actors of CDR as a climate solution mainly contributes to the manifestation of MD as an *emergent effect* (see also Markusson et al., 2018). Similarly, petrochemical companies construct a future for themselves using oil with reference to carbon removal and the imaginary of circular carbon, in spite of the uncertainties and risks involved, which relieves them of the need to set out plans for reduced reliance on oil (Palm et al., 2024). Whether intentional or emergent, across the cases, the promotion of CDR systematically reduces the pressure on achieving emissions reduction, or introduces risks of this happening.

The special issue provides evidence that actors do not fully take MD risks into consideration even in the presence of explicit critiques and warnings. Rothkirch et al. (2024) show that the mantra of ‘we need all the options’, in recognition of MD critique, substitutes for more engaged discussion about the actual risks involved. That co-existence of critique with naïveté and lack of concern is likely insufficient to stop MD from manifesting.

The way political-economic interests envision CDR, help render it knowable, and use it as an offset illustrates that MD is not an easily isolatable phenomenon, but instead branches out and connects various places, industries and stakeholders. The papers in this special issue find MD processes in sites of policy development (Brad and Schneider, 2023; Price et al. 2024; Von Rothkirch et al., 2024), industrial innovation (Hougaard, 2024; Palm et al., 2024), policy-industry entanglements (Brad and Schneider, 2023; Palm et al., 2024) as well as ‘on the ground’ in concrete locations (Stanley, 2024). These sites are connected and overlapping. For example, experiments and measurement activities in farms and forests (Hougaard, 2024; Stanley, 2024) are responses to national level goals (Hougaard, 2024; Von Rothkirch et al., 2024). Policy development in the EU (Brad and Schneider, 2023) orients itself both to member states and to the broader international context (Von Rothkirch et al., 2024). And the use of CDR in offset markets (Price et al. 2024) relies on market actors (Palm et al., 2024) and hinges on carbon calculations and measurements (Stanley, 2024) as well as on actual (or envisioned) CDR projects. These various entanglements indicate that MD is inherently a structural phenomenon that cannot easily be carved out and served up as an isolated piece of ‘evidence’ (Carton et al., 2023).

#### 4. Why contemporary society is prone to delay

Beyond a general commitment to political economy, the articles also engage a number of more specific conditions that enable or help explain MD. Key among these is *the centrality of fossil fuels* to society (Palm et al., 2024). Fossil fuel production enables oil and gas companies to be among the most profitable in the world, giving them a very strong interest in continued use of their assets and further expansion. These corporations have huge influence over policy, as amply documented (Dunlap and Brulle, 2020; Lucas, 2021). Dependence on fossil fuels is also anchored in infrastructure investments, user practices, knowledge regimes, subsidy schemes, etc (IEA, 2023). This dependence and infrastructural lock-in means that those invested in fossil fuels have much to lose, in terms of profits and political power, if emission reduction pathways were to require a fossil fuel phase-out. CDR offers an attractive alternative that maintains current production systems, including, in some cases, by framing emissions as residual or hard-to-abate (Lund et al., 2023).

A second condition is the neoliberal commitment to *market-based climate governance* as the key means of scaling CDR (Price et al 2024). This of course is the logic that underpins offsetting mechanisms. It allows the prioritisation of short-term profitability over ambitious climate mitigation, and implicitly allocates CDR to those that can afford it (Grubert and Talati, 2024). In the absence of restrictive policy measures, this means that some sectors or industries can continue emitting GHGs as long as they purchase sufficient amounts of (CDR) credits. Further, the lack of regulation allows vagueness and strategic ambiguity on the part of policy makers, as manifested in the ambiguity surrounding the category of residual emissions in national strategies (Buck et al., 2023). It reduces the incentives for, and

pressure on particular industries to reduce emissions. Insofar that one of the intended functions of CDR, as compensation for residual emissions, presupposes substitution between emissions reductions and removals, CDR technology is particularly prone to such market-driven deterrence.

Third, MD is enabled by a *media ecosystem* that facilitates the promotion and circulation of narratives and imaginaries to an ever wider audience. In contemporary society, companies are in a privileged position vis-a-vis other societal groups, because they can use the power of money to disseminate their visions and target influential constituencies like people working in research, investment, and policy (see e.g. Brad and Schneider, 2023; Hanegraaff and Poletti, 2021; Veng et al., 2023). In a fast-paced, resource constrained media landscape highly dependent on advertisement, journalists lack the time, resources and freedom to carry out in-depth reporting on science or investigation into the impacts of projects on the ground. They circulate company talk or are constrained to desk research, thereby sustaining collective imaginaries of potential future solutions that might not end up delivering as promised in time. Such media reports easily overestimate removal potentials, generate elevated expectations by the general public and reduce the perceived need for reducing emissions (see for example the media coverage of Bastin et al. 2019).

A fourth background condition pertains to the *role and position of research* in society. Research in neoliberal societies is increasingly mission-driven, focused on specific technological solutions, or driven by the private sector. This often leaves basic scientific research underfunded, and means that technologies may be marketed even before their efficacy and ecological impacts are fully understood. Research on the social and political dimensions of carbon removal suffers from the same problem and is underfunded and marginalised (Markusson et al., 2020; Overland and Sovacool 2020). Most acutely perhaps, this has expressed itself in climate scenario exercises that prioritise techno-economic perspectives and only minimally capture more complex social, cultural and political issues (Larkin et al., 2018; van Vuuren et al., 2017). The result is an exceedingly narrow representation of possible climate futures, excluding among others opportunities for reductions in energy and resource use (Keyßer and Lenzen, 2021). This in turn limits policy makers' ability to imagine alternatives and has created an overly optimistic idea about the potential of CDR (Beck and Oomen, 2021; Creutzig et al., 2023; Dooley et al., 2018).

Moreover, neoliberal funding infrastructures give space to consultancies on the assumption that they give 'neutral' policy advice, though scholars have pointed to their entanglements with fossil industries (Mazzucato and Collington, 2023). Even with public funding, results and data are often controlled by private companies (Stanley, 2024) This risks leading to distortions in representations of research findings and - as the case with media reports - inflating expectations of CDR potentials. To reduce the risk of MD, a more robust and balanced public funding infrastructure for carbon removal research is needed, placing high demands on transparency of data and knowledge production. This would also improve conditions for a more open societal conversation on possible sustainable futures.

Finally, we identify *racial capitalism* as a fifth background condition (Buck et al 2024). The way carbon removal is currently envisioned systematically ignores racial impacts on those living next to polluting facilities, and on the land use practices of non-white peoples. This makes it overly easy to plan and rely on carbon removal and thus to deter or delay

emissions reductions. This has practical implications for the prospects of CDR as well. Inevitably there will be critique and protests, which may well disrupt implementation and lead to failed projects - yet another possible 'substitution and failure' dynamic. More generally, ignoring racial impacts makes it easier to advocate for carbon removal and makes future removal look more attractive and useful than it actually is.

The conditions discussed in this section all increase the likelihood of MD. Defusing them relies on intervening in multiple systems and at a range of scales. In other words, MD is not something that only resides in CDR "technology". Nor does it come about simply because the fossil fuel industry is an unethical corporate actor — such framings obscure the broader problem. Instead, MD as an emergent property demands a more complex set of correctives and interventions.

## 5. What to do about MD?

Reflecting on these overarching political-economic structures and background conditions, we identify four societal imperatives that could help reduce the risk of MD and wider forms of climate delay (Carton et al., 2021). First, the power of vested interests and status-quo politics must be challenged, allowing for alternative visions of how society can be organised. Second, there is an urgent need to phase out fossil fuels. High-income societies in particular need to confront current rates of production and consumption of carbon-intensive products. This includes a need to question assumptions about what is to be considered necessary consumption (Lund et al., 2023). Third, the construction of reductions and removals as equivalent must be dismissed along with assumed equivalences between different forms of carbon removal (Carton et al., 2021). Finally, the narrow framings of technology that underpin technology over-optimism need to be opened up (Stirling, 2008).

While these suggestions might seem daunting, the papers in this special issue provide concrete suggestions for how to proceed. Several authors argue against the use of CDR to offset emissions that are not truly unavoidable – implying a need to better define residual emissions. In relation to EU policy, Brad & Schneider (2023) call for regulation (or re-regulation) of offsetting. In the UK, Price et al (2024) discuss the importance of carefully considering carbon market design and its entanglement with other areas of climate policy, while Stanley (2024) calls for treating carbon sequestration as a public good. Palm et al. (2024) warn decision makers not to rely on unproven technical systems, even if the alternatives are more costly or painful in the short term.

Other recommendations are about awareness and how actors think. The papers call for more awareness among actors in different parts of society, and at different scales, about the risks of MD. This involves closer consideration of the risks of CDR failure and delay, CDR's adverse side-effects, as well as an openness to alternative mitigation options (Palm et al. 2024). Several authors also identify a need to question widely held assumptions about the links between entrenched, fossil-dependent systems of production and consumption, and the provision of welfare and comfort (e.g. Palm et al. 2024).

This connects to how we research and communicate about CDR (see also Price et al. 2024). For CDR researchers, it is important to balance promises and risks when communicating about different removal approaches. Studies that examine the techno-economic feasibility of



CDR should be balanced by similarly detailed assessments of resource demands, risk of failure and delay, and possible co-benefits that are missed if any particular form of CDR were to substitute for emissions reductions. Research on CDR should also be broadened to explicitly include the social context of implementation (Bellamy and Raimi, 2023). More diverse forms of assessment are thus needed, including multi-criteria assessments (Markusson et al., 2020) and deliberative assessments that take the emotional and political allure of delay seriously (Markusson et al., 2022). Social scientists can work together with CDR researchers to develop communication strategies that can reduce the danger of MD, in an unhelpful media landscape.

For MD researchers, there is concern that critical research can itself facilitate MD simply by directing more attention towards CDR. Given that, is there any need for further research on NMD? There are indications that MD is now widely established as a concern. The IPCC AR6 explicitly refers to it (Lecocq et al., 2022) along with the European Parliament and the European Commission (Brad and Schneider, 2023). Similarly, the idea that 'we need to do both' and that 'emissions reductions must come first' are increasingly mainstreamed in CDR discussions (Carton et al 2023; von Rothkirch 2024). One could conclude from this that further research on whether MD exists is no longer needed.

Yet, the growth in societal attention to MD is not a guarantee that it is being dealt with. As illustrated by von Rothkirch et al. (2024), societal actors might simply have moved from ignoring or rejecting the risk of MD to actively acknowledging it, if only in a shallow fashion. Expressed concern is typically staved off quickly through standard clauses such as 'we need to do both' - a rather unhelpful phrase that itself reproduces the false equivalence between different forms and amounts of emissions reductions and carbon removal. Increased awareness and defensiveness are therefore insufficient reasons to halt social science research on MD, but they do suggest that this kind of research is having an impact.

Given that impact, there is now a need to shift attention away from simply arguing that 'MD is a thing' towards more specific guidance on how to recognize when and how it takes place, and, importantly, what can be done to avoid or minimise it. The present special issue of papers contributes towards this, but we believe there is a need for more engagement. One possible avenue is to situate MD research more clearly within the wider literature on climate inaction, including scholarship on the logics of discourses of delay (Lamb et al., 2020), and the dynamics of climate denial (Oreskes and Conway, 2012). This could include exploring the relative importance of MD in relation to other mechanisms of delay, as well as the interaction with, and difference from other forms of climate inaction.

## 6. Conclusion and call for further research

The special issue papers help us flesh out how MD unfolds (or not) in settings beyond climate science, beyond individual perceptions, and informed by theory rather than based entirely on it (cf. Carton et al. 2023). This introductory paper identifies three broad mechanisms through which MD may unfold, and the contextual conditions that make it more likely to happen. These studies invite us to pay close attention to how different actors envision CDR, render it knowable, and how they mobilise it as an offsetting method. These are social processes where MD can be identified. They are entangled with and impacted by political and economic interests who may gain from cultivating a climate profile or

maintaining the status-quo, or who may benefit from new business opportunities. This resonates with and underpins earlier conceptual work on MD (Carton et al 2023; McLaren 2020, McLaren et al 2021; Markusson et al 2018). The special issue papers make conceptual (e.g Stanley 2024) and methodological (e.g. Brad and Schneider 2023) contributions, but taken together the most important advancement is the focus on case studies confirming and detailing empirically how MD processes unfold in contextualised practice.

This special issue also challenges some of the language and underlying assumptions in previous work on MD. They raise the question of what exactly is being deterred through the promise of CDR. Mitigation is usually understood as reductions in greenhouse gas emissions, but the IPCC's official definition also includes the enhancement of carbon sinks, i.e. a form of carbon removal (IPCC, 2022, p. 1087) This raises the question of conceptual specificity and whether any one form of mitigation could deter another form of mitigation (Markusson et al., 2018). In some of the papers, what is being deterred is the phaseout of fossil fuels (e.g. Palm et al. 2024). Reductions in the agricultural sector and a transition away from animal-based production are other examples mentioned (Hougaard 2024). Often, this deterrence takes the form of avoiding or slowing down emissions reductions. But in many cases, 'mitigation' is still conceptualised on an abstract level, which risks reifying the abstraction of carbon and working along the logics of carbon and emissions, rather than the logics of, say, financialisation, extractivism, or other important and perhaps more pointed conceptualisations of the climate problem. A narrow understanding of 'mitigation' restricts the research focus to emissions reductions, as it leaves out other aspects. Other 'deterrences' that are important to understand — fossil fuel phaseout, post-extraction futures, air quality for all, or other futures - are foreclosed or stalled. Thus, further research can better explore and define what actions or processes are being deterred. It is possible to question not just 'mitigation', but also the term 'deterrence'. Price et al. (2024) suggest that the term is confusing and should be replaced with 'failure', especially when communicating with decision makers. While it may be abstract, 'deterrence' has the advantage of including both failure and delay, and brings a temporal dimension that invites discussion about alternative futures. However, the jury is still out, and academics should engage with policy makers, civil society groups and others in dialogue on best terminology.

Throughout this introduction, we have identified some apparent gaps and weaknesses in the literature on MD. To recap, a wider geographic spread, beyond Europe, is important, and especially studies about places in the Global South should be a priority. Particular attention should be paid to how the racialised and gendered nature of capitalism enables MD (Buck et al 2024). Further, while the papers in this special issue cover literatures from political theory, sociology, anthropology, and political ecology as well as STS and innovation studies, further work connecting these different traditions is possible. Not least, there is untapped potential in working with media studies, feminist literature, decolonial studies, and political economy theory. Finally, MD research needs to be better linked into and contextualised by other research on climate delay. There is much more work still to be done in this space.

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