

# Is carbon dioxide removal 'mitigation of climate change'?

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## Abstract

Carbon dioxide removal (CDR) is often characterized as separate from climate change mitigation. Discussion of CDR governance – despite enjoying growing interest – tends to overlook how key provisions on mitigation apply. Similarly, many climate policy processes have ignored CDR. CDR may have been discursively held separate from 'mitigation' due to a partial conceptual overlap with 'geoengineering'. We unpack how the 'mitigation of climate change' – as defined in the United Nations Framework Convention on Climate Change and its Paris Agreement – includes CDR as defined by the Intergovernmental Panel on Climate Change. We point to important implications and opportunities for strengthening governance by enhanced clarity regarding parties' obligations, principled equitable distribution of removal efforts, prioritization of rapid emissions reductions and careful paths to long-term removals, and a need for considering sustainability and human rights issues in the pursuit of CDR.

## 1 | INTRODUCTION

Scholars, policymakers and commentators often characterize the active removal of carbon dioxide (CO<sub>2</sub>) from the atmosphere (carbon dioxide removal, CDR) as a potential, or even necessary, means for achieving the Paris Agreement's temperature goals.<sup>1</sup> Yet very few observers and negotiators representing parties to the Agreement appear to fully recognize that CDR by its very definition<sup>2</sup> constitutes a form of 'mitigation of climate change'. This is so despite a very strong focus on 'mitigation' in core obligations of parties to the

United Nations Framework Convention on Climate Change (UNFCCC)<sup>3</sup> and its 2015 Paris Agreement.<sup>4</sup> This misperception is evinced in statements characterizing CDR as an alternative to mitigation or otherwise contrasting 'mitigation' and CDR, whereby 'mitigation' is understood to solely refer to the reduction of greenhouse gas (GHG) emissions (and occasionally also to land-use and forestry-related carbon flows).<sup>5</sup> This coincides with a lack of proactive deliberation and planning for potential deployment of CDR in national, regional and multilateral governance processes. We suspect that (except for some land-use-based approaches) the relative novelty of

<sup>1</sup>Vivid Economics, 'An Investor Guide to Negative Emission Technologies and the Importance of Land Use' (2020).

<sup>2</sup>All recent Intergovernmental Panel on Climate Change (IPCC) reports include the same glossary definition of 'carbon dioxide removal': JBR Matthews et al, 'Glossary' in V Masson-Delmotte et al (eds), *Global Warming of 1.5°C: An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty* (IPCC 2018) 541 (IPCC, *Global Warming of 1.5°C*); R van Diemen et al, 'Glossary' in PR Shukla et al (eds), *Climate Change and Land: An IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems* (IPCC 2019) 803; NM Weyer et al, 'Glossary' in HO Pörtner et al (eds), *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate* (IPCC 2019) 677.

<sup>3</sup>United Nations Framework Convention on Climate Change (adopted 29 May 1992, entered into force 21 March 1994) 1771 UNTS 107 (UNFCCC).

<sup>4</sup>Paris Agreement (adopted 12 December 2015, entered into force 4 November 2016) 55 ILM 740.

<sup>5</sup>The United Nations Environment Programme (UNEP) takes a multifaceted approach towards climate change mitigation in its efforts to help countries move towards climate-resilient and low emissions strategies; see UNEP, 'Mitigation' <<https://www.unep.org/explore-topics/climate-change/what-we-do/mitigation>> ('Climate Change Mitigation refers to efforts to reduce or prevent emission of greenhouse gases'); see also AC Lin, 'Carbon Dioxide Removal after Paris' (2018) 45 *Environmental Law Quarterly* 534, 534; 'Statement for the Record, The Honorable Ernest J. Moniz, 13th Secretary of Energy, Before the Senate Energy and Natural Resources Committee' (28 July 2020) <<https://www.energy.senate.gov/services/files/B4D86286-AA5A-45C6-93B7-07D4F3791B0D>> 5.

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various proposals for CDR and the association with the concept of 'geoengineering' has led to a discursive exclusion and misperception that CDR would not constitute a form of climate change mitigation. We seek to make the case here that the scope of the UNFCCC's and Agreement's references to 'mitigation' encompass the expert definition of CDR and outline the implications thereof.

We start by outlining and unpacking the definitions of 'mitigation' and 'CDR' to highlight their relation (Section 2). We then examine the concept of 'geoengineering' and the confusion due to overlapping definitions pertaining to 'large-scale' CDR (section 3). Next, we specify four pathways through which explicit recognition of CDR approaches as a form of mitigation could offer an important basis to significantly enhance operational clarity in climate change governance, the governance of CDR and broader sustainability governance: (i) countries' obligations regarding communication and implementation of mitigation efforts apply to reductions and removals (Section 4); (ii) principles and expectations regarding fairness and equity of mitigation efforts include CDR efforts – requiring industrialized countries to take the lead and to support developing nations in their own eventual pursuit of CDR (Section 5); (iii) the Paris Agreement appears to demand both a prioritization of rapid emissions reductions as well as the eventual consideration of all possible sources and sinks in calling for 'global peaking of emissions', 'highest possible ambition' and 'comprehensive action' (Section 6) and (iv) the Paris Agreement requests its parties to consider sustainability and rights implications of their actions to contribute to sustainable development and avoid infringements on (human) rights (Section 7). We conclude in Section 8 by highlighting the importance of greater clarity on the role of CDR in climate change governance.

## 2 | DEFINITIONS: 'MITIGATION' AND 'CARBON DIOXIDE REMOVAL'

'Mitigation' is perhaps the most critical term and concept in international climate policy, in that such efforts are essential to effectuate the overarching objective of the UNFCCC, which is the 'stabilization of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system'.<sup>6</sup> The term is further specified in the first operational paragraphs of the UNFCCC as a party's measures 'to mitigate climate change by addressing anthropogenic emissions by sources and removals by sinks of all GHGs not controlled by the Montreal Protocol'<sup>7</sup> and as 'limiting its anthropogenic emissions of GHGs and protecting and enhancing its GHG sinks and reservoirs'.<sup>8</sup> Both definitions explicitly span the two essential flow-directions of GHGs: in and out of the atmosphere, effectively describing GHG neutrality,<sup>9</sup> and thereby

substantively underpinning the 'ultimate objective of the Convention and any related legal instruments'.<sup>10</sup>

The UNFCCC defines several relevant terms in Article 1, and the Paris Agreement adopts those definitions.<sup>11</sup> Sinks are defined as 'any process, activity or mechanism which removes a greenhouse gas ... from the atmosphere'.<sup>12</sup> The French version of the UNFCCC explicitly adds '*naturel ou artificiel*' (natural or artificial) to its characterization of sinks, whereas the English, Spanish, Chinese and Russian versions do not differentiate between natural and anthropogenic sinks. Reservoirs are defined as 'a component or components of the climate system where a greenhouse gas or a precursor of a greenhouse gas is stored'.<sup>13</sup> The UNFCCC defines the 'climate system' as 'the totality of the atmosphere, hydrosphere, biosphere and geosphere and their interactions'.<sup>14</sup>

Given these definitions, a coherent paraphrasing of parties' commitments regarding the mitigation of climate change<sup>15</sup> would read: Parties are to address, limit or reduce their GHG emissions and protect and enhance processes, activities or mechanisms that remove GHGs from the atmosphere as well as their biological, hydrological and geological reservoirs of GHGs.

As technological processes to remove GHGs from the atmosphere, such as direct air capture,<sup>16</sup> were not being developed at the time of the Convention's genesis, it may be fair to assume that the text was written primarily with biological ecosystem sinks and reservoirs in mind.<sup>17</sup> However, a compelling case can be made under the treaty interpretation provisions of the Vienna Convention on the Law of Treaties<sup>18</sup> for a more capacious view. Under Article 31(1) of the Vienna Convention, treaty provisions are to be interpreted in accordance with their 'ordinary meaning'.<sup>19</sup> Given the fact that the definitions of 'sink' and 'reservoir' under the UNFCCC, and by extension the Paris Agreement, are extremely broad ('any process activity or mechanism'), even a literal reading would encompass any potential process (technological or combined techno-bio-geological) that

<sup>6</sup>UNFCCC (n 3) art 2.

<sup>7</sup>Paris Agreement (n 4) art 1.

<sup>8</sup>ibid art 1(8).

<sup>9</sup>ibid art 1(7).

<sup>10</sup>ibid art 1(3).

<sup>11</sup>UNFCCC (n 3) art 4(1).

<sup>12</sup>While carbon dioxide removal approaches are sometimes characterized as either 'nature-based' or 'technological' as well as 'hybrid' (see, e.g., UNEP, 'Emissions Gap Report 2017' (UNEP 2017) xxiii), such a distinction is not common in the scientific literature and has not been made in recent IPCC reports (n 2).

<sup>13</sup>On this interpretation, the French reference to 'artificial' sinks would be either a hedge against future technological developments or an explicit allowance for deliberate afforestation and reforestation. In either case, the broad definition of 'sink' would make the phrase 'natural or artificial' strictly unnecessary, which would explain its absence from the other versions and the equivalence between the five versions.

<sup>14</sup>Vienna Convention on the Law of Treaties (adopted 23 May 1969, entered into force 27 January 1980) 1155 UNTS 331 (VCLT). Most provisions of the Vienna Convention are recognized as customary international law; see, e.g., S Dothan, 'The Three Traditional Approaches to Treaty Interpretation: A Current Application to the European Court of Human Rights' (2019) 42 Fordham International Law Journal 765, 766; O Dörr and K Schmalenbach (eds), *Vienna Convention on the Law of Treaties: A Commentary* (Springer 2012) 524–525.

<sup>15</sup>ibid art 31(1).

<sup>6</sup>UNFCCC (n 3) art 2.

<sup>7</sup>ibid art 4(1)(b).

<sup>8</sup>ibid art 4(2)(a).

<sup>9</sup>J Fuglestedt et al, 'Implications of Possible Interpretations of 'Greenhouse Gas Balance' in the Paris Agreement' (2018) 376 Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences 20160445.

TABLE 1 Definitions of key terms<sup>a</sup>

Term	Definition	Source
Mitigation	Parties are 'to mitigate climate change by addressing anthropogenic emissions by sources and <i>removals by sinks</i> of all greenhouse gases not controlled by the Montreal Protocol' and 'limiting [their] anthropogenic emissions of greenhouse gases and protecting and <i>enhancing [their] greenhouse gas sinks and reservoirs</i> '	Articles 4(1)(b) and 4(2)(a) UNFCCC
Sink	'any process, activity or mechanism which removes a greenhouse gas ... from the atmosphere'	Article 1(8) UNFCCC
Reservoir	'a component or components of the climate system where a greenhouse gas or a precursor of a greenhouse gas is stored'	Article 1(7) UNFCCC
Climate system	'the totality of the atmosphere, hydrosphere, biosphere and geosphere and their interactions'	Article 1(3) UNFCCC
Carbon dioxide removal	'Anthropogenic activities removing CO <sub>2</sub> from the atmosphere and durably storing it in geological, terrestrial, or ocean reservoirs, or in products. It includes existing and potential anthropogenic enhancement of biological or geochemical sinks and direct air capture and storage, but excludes natural CO <sub>2</sub> uptake not directly caused by human activities.'	IPCC, Special Reports on Global Warming of 1.5°C, Climate Change and Land, and Oceans and the Cryosphere

<sup>a</sup>Emphasis added to selected phrases to highlight important points of connection between the definitions.

would effectuate the removal of GHGs from the atmosphere, regardless of whether the captured carbon ends up stored in biological reservoirs or other kinds of reservoirs. Moreover, the Vienna Convention provides that the ordinary meaning of treaty language is to be read 'in their context and in the light of its object and purpose'.<sup>20</sup> Given that a broad construction of mitigation (encompassing all anthropogenic GHG emissions and removals) is consistent with the UNFCCC's 'ultimate objective' of 'stabilization of GHG concentrations in the atmosphere',<sup>21</sup> this comports with the treaty's object and purpose.

Although largely self-explanatory, the expert definition of CDR by the Intergovernmental Panel on Climate change (IPCC) also supports our argument: 'Anthropogenic activities removing CO<sub>2</sub> from the atmosphere and durably storing it in geological, terrestrial, or ocean reservoirs, or in products. It includes existing and potential anthropogenic enhancement of biological or geochemical sinks and direct air capture and storage, but excludes natural CO<sub>2</sub> uptake not directly caused by human activities'.<sup>2</sup> The IPCC, thus, distinguishes between anthropogenic activities causing CO<sub>2</sub> removal and natural sinks that do not require human intervention. The emphasis on human measures in the characterization of 'mitigation' overlaps with the above CDR definition as the 'anthropogenic enhancement of ... sinks' (but additionally includes the protection of (natural) sinks and reservoirs and abatement of emissions).<sup>22</sup> Therefore, we argue that the IPCC offers a supplementary means for interpreting provisions regarding 'mitigation' and confirms the meaning derived above – in the spirit of the Article 32 of the Vienna Convention.<sup>23</sup> In light of

this, the theory of evolutionary treaty interpretation would suggest that parties in 1992 intended to give 'mitigation of climate change' a meaning capable of evolving over time – in accordance with the best available science – to achieve their unambiguously stated 'ultimate objective'. Table 1 summarizes these definitions. These definitions from the UNFCCC and the IPCC entail that CDR is a form of mitigation for the purposes of the UNFCCC and related legal instruments, including the Paris Agreement.

Based on these definitions, the term 'mitigation' spans the following concepts: (i) the limitation or reduction of GHG emissions; (ii) the protection of reservoirs; (iii) the protection of removals by sinks and (iv) the enhancement of sinks. The first type most straightforwardly corresponds to emissions reductions, also seen as the 'classical form' of mitigation. Protecting ecosystems achieves the second and third type of mitigation by preventing their stored carbon from being emitted into the atmosphere (thereby reducing or limiting emissions) and actively maintaining ecosystems' ability to draw CO<sub>2</sub> out of the atmosphere (CDR). Enhancement of removals by sinks, finally, corresponds to the definition of CDR (as well as more generally GHG removal; see Table 2).

In the Paris Agreement, *mitigation* is prominently operationalized in Article 4, sometimes casually referred to as its 'mitigation' article: it addresses parties' nationally determined contributions (NDCs), which are sometimes still referred to as the 'nationally determined mitigation contributions',<sup>24</sup> despite an expectation that NDCs may also encompass adaptation efforts. The article's first paragraph specifies that to achieve the Agreement's long-term temperature goal, parties ought to 'achieve a balance between anthropogenic

<sup>20</sup>ibid.

<sup>21</sup>UNFCCC (n 3) art 2.

<sup>22</sup>Note that definition of 'mitigation (of climate change)' in IPCC, *Global Warming of 1.5°C* (n 2) also aligns with our reading: 'A human intervention to reduce emissions or enhance the *sinks of greenhouse gases*', as it also includes the UNFCCC's three key elements (anthropogenic, sources and sinks) (emphasis added).

<sup>23</sup>VCLT (n 18) art 32.

<sup>24</sup>This may be explained by the use of the phrase 'mitigation contribution' in the run-up to the COP 21 in early negotiation texts and perhaps also reflects industrialized countries' preference to focus the scope of NDCs on mitigation. See, e.g., S Moarif, 'Establishing Cycles for Nationally Determined Mitigation Contributions or Commitments' (Organisation for Economic Co-operation and Development 2015).

TABLE 2 Components of the legal concept 'mitigation of climate change' under the United Nations Framework Convention on Climate Change

Concept	The mitigation of climate change			
Components	The limitation or reduction of greenhouse gas emissions	The protection of greenhouse gas reservoirs	The protection of greenhouse gas removals by sinks	The enhancement of removals by sinks
Colloquially referred to as	'Conventional mitigation', 'emissions reductions' or 'emissions abatement'	Ecosystem preservation or restoration, nature-based (or natural) solutions		Greenhouse gas removal, carbon dioxide removal, negative emissions

emissions by sources and removals by sinks of greenhouse gases in the second half of this century'.<sup>25</sup>

Here again, the English version remains ambiguous on the nature of removals, whereas the French version repeats the word '*anthropique*' with regard to '*absorptions par les puits*', which translates to 'anthropogenic removals by sinks', and the Spanish version similarly refers to both '*emisiones antropógenas*' (anthropogenic emissions) and '*la absorción antropógena por los sumideros*' (the anthropogenic absorption by sinks). Given that all language versions carry the same legal status,<sup>26</sup> it is clear that this text refers to emissions reductions and removal of GHGs (including CDR) to describe an atmospheric balance of all anthropogenic GHG flows, also known as 'GHG neutrality'.<sup>27</sup>

Given that Article 4 elaborates the preceding Articles 2 and 3 describing objectives (temperature goal) and obligations (national contributions) of the Paris Agreement, respectively, we argue that the above phrasing is intended to describe 'mitigation' as a core pillar of the Paris Agreement, thus encompassing both the reduction of emissions and the removal of GHGs.

Other provisions of the Paris Agreement in which mitigation is characterized align with this reading, most notably the temperature goal in the Agreement's Article 2 (referring back to the stated objective of the Convention<sup>28</sup>). Jointly, Articles 2 of the Convention and the Paris Agreement, thus, seem to substantively underpin the above-mentioned anthropogenic 'GHG neutrality' definition of Article 4 of the Paris Agreement.<sup>29</sup>

From this, we conclude that, along with the other components identified in Table 2, the removal of a GHG (including CO<sub>2</sub>) is 'mitigation of climate change'. To date, discussions around removals have focused on one single GHG (CO<sub>2</sub>). In principle, however, other processes resulting in the removal of other GHGs would equally fit the definition.<sup>30</sup>

### 3 | THE NOVELTY OF CARBON DIOXIDE REMOVAL AND THE CONFUSION AROUND LARGE-SCALE INTERVENTIONS

With the adoption of the UNFCCC in 1992, 'climate change mitigation' was firmly introduced as a globally shared objective, understood as a combination of measures that lowered the rate at which GHGs were emitted at their source and measures to protect reservoirs – or enhance removals of GHGs through 'sinks'. As argued in Section 2, the latter was likely primarily understood at the time to mean the protection and restoration of ecosystems that remove and/or store CO<sub>2</sub>. Since then, possible additional approaches to CDR have been identified, which, as argued, also fit the UNFCCC's and the Paris Agreement's 'mitigation' definition.

A different concept, namely 'geoengineering', defined as 'deliberate large-scale manipulation of the planetary environment to counteract anthropogenic climate change',<sup>31</sup> has more recently introduced a novel – and in part redundant – categorization. CDR – undertaken at large scales – could be construed as a form of 'geoengineering', yet scholarly discussions have generally neglected to define 'large scale'. The Conference of the Parties (COP) to the United Nations Convention on Biological Diversity (CBD), while addressing 'geoengineering',<sup>32</sup> has further obscured this issue.

We submit that such overlap of alternative categorizations and the lack of an operationalizable definition has contributed to – if not caused – confusion around CDR, as two parallel conceptualizing discourses have emerged. In the first discourse, a simplifying (and false) view was adopted in which all CDR (independent of scale) was viewed as 'geoengineering'. In the second (original climate governance) discourse, the 'enhancement of sinks' (i.e. CDR) was always understood to contribute to reaching temperature limitation targets.<sup>33</sup> The former view appears, for instance, in a resolution that Switzerland introduced at the United Nations Environment Assembly (UNEA) in 2019. The resolution, which was ultimately withdrawn,

<sup>25</sup>Paris Agreement (n 4) art 4(1).

<sup>26</sup>ibid art 29.

<sup>27</sup>Fuglestad et al (n 9).

<sup>28</sup>UNFCCC (n 3) art 2.

<sup>29</sup>Fuglestad et al (n 9).

<sup>30</sup>It may be worth noting, however, that some proposals to eliminate methane from the atmosphere involve converting it to CO<sub>2</sub> rather than capturing and sequestering it. While one could argue that converting one greenhouse gas into another greenhouse gas counts as 'removing' the former from the atmosphere, this is less clear-cut than in the case of CDR. See, e.g., T Ming et al, 'A Nature-Based Negative Emissions Technology Able to Remove Atmospheric Methane and Other Greenhouse Gases' (2021) *Atmospheric Pollution Research*.

<sup>31</sup>Royal Society, 'Geoengineering the Climate: Science, Governance and Uncertainty' (Royal Society 2009) 1.

<sup>32</sup>CBD 'Decision IX/16, Biodiversity and Climate Change' UN Doc UNEP/CBD/COP/DEC/IX/16 (9 October 2008) Section C.

<sup>33</sup>See, e.g., K Anderson and G Peters, 'The Trouble with Negative Emissions' (2016) 354 *Science* 182; UNEP (n 16) 58.

initially called for an 'assessment of geoengineering technologies, in particular CDR technologies and solar radiation management'.<sup>34</sup> Other countries objected to, *inter alia*, lumping CDR and solar radiation management together under the heading of geoengineering, contributing to the resolution's failure.<sup>35</sup>

The former contextualization (CDR as 'geoengineering') is also associated with an expectation that such activities are regulated outside of the UNFCCC, in part rooted in CBD COP Decisions IX/16 (addressing ocean fertilization).<sup>36</sup> X/33,<sup>37</sup> XI/20<sup>38</sup> and XIII/14<sup>39</sup> address 'geoengineering', including large-scale CDR.<sup>40</sup> Parties to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter and its Protocol similarly rely on this construction of 'geoengineering', including marine CDR approaches.<sup>41</sup> On the other hand, the UNFCCC and its Paris Agreement are entirely silent on the concept of 'geoengineering', yet were – as presented above – conceived to achieve mitigation for the limitation of global warming, which conceptually (and as argued in Section 2 also legally) includes CDR. The IPCC (since 2018) merely acknowledges 'geoengineering' as a concept of limited use.<sup>42</sup>

Consequently, *large-scale* CDR activities appear to not only correspond to 'mitigation' but also fall under common definitions of 'geoengineering', whereas other (small-scale) CDR activities would solely correspond to 'mitigation'. Overlapping definitions are not a problem as such (and may be a common feature in international law). There is no contradiction in recognizing large-scale CDR as fitting both under the rubrics of 'mitigation' and 'geoengineering'. Existing governance for 'geoengineering' includes guidance or regulation of specific activities.<sup>43</sup> However, it seems as though the 'mitigation' conceptualization offers opportunities for governance of CDR as a

climate policy option, which go beyond those afforded by the concept of 'geoengineering'. This appears insufficiently recognized to date, with a flurry of literature generating novel ideas for the governance of 'geoengineering' rather than elaborating on how CDR can be governed by established UNFCCC and Paris Agreement provisions. Not only does the 'geoengineering' concept appear too broad to be of practical use in climate policy (as it also includes measures to reflect or scatter solar radiation), but the lack of definitional clarity with regard to scale seems additionally problematic.

By contrast, the concept of 'mitigation' is well defined and comes with a rich set of political, institutional and legal structures and meanings, which – as we argue in the next sections – can facilitate addressing the governance of CDR comprehensively and appropriately.

## 4 | OBLIGATIONS REGARDING COMMUNICATION AND IMPLEMENTATION OF MITIGATION EFFORTS

Recognizing that CDR qualifies as 'mitigation' comes with the implication that key procedural and substantive obligations under the Paris Agreement and the UNFCCC apply not only to reducing emissions but also to CDR. Procedural obligations include notably the communications by the parties regarding mitigation (and adaptation) – such as NDCs and their updated iterations, long-term low greenhouse gas emission development strategies (LT-LEDS), and biennial transparency reports on GHG emissions and sinks and the implementation of NDCs.<sup>44</sup> The key substantive obligation is the pursuit of domestic mitigation measures.<sup>45</sup> In the following sections, we detail what these obligations are and how they apply to CDR.

Under the UNFCCC as well as the Paris Agreement, parties are to act domestically and communicate in various ways on their respective contributions to the achievement of overarching objectives. The UNFCCC imposes an obligation on developed country parties to 'adopt national policies and take corresponding measures on the mitigation of climate change'.<sup>46</sup> The Paris Agreement effectively extends this obligation to all parties, requiring them to 'prepare, communicate and maintain successive nationally determined contributions' and to 'pursue domestic mitigation measures, with the aim of achieving the objectives of such contributions'.<sup>47</sup> It also requires parties to regularly provide '[i]nformation necessary to track progress made in implementing and achieving its nationally determined contribution under Article 4'.<sup>48</sup> The UNFCCC also includes an obligation for parties to communicate 'a national inventory of

<sup>34</sup>Government of Switzerland, 'Draft Resolution for Consideration for the 4<sup>th</sup> United Nations Environment Assembly: "Geoengineering and Its Governance" (21 January 2019) <[https://papersmart.unon.org/resolution/uploads/switzerland\\_-\\_resolution\\_submission\\_-\\_geoengineering\\_and\\_its\\_governance\\_-\\_unea\\_4\\_.pdf](https://papersmart.unon.org/resolution/uploads/switzerland_-_resolution_submission_-_geoengineering_and_its_governance_-_unea_4_.pdf)>.

<sup>35</sup>S Jinnah and S Nicholson, 'The Hidden Politics of Climate Engineering' (2019) 12 *Nature Geoscience* 874.

<sup>36</sup>Decision IX/16 (n 32).

<sup>37</sup>CBD 'Decision X/33, Biodiversity and Climate Change' UN Doc UNEP/CBD/COP/10/27 (20 January 2011) paras 8(w), 9(l) and (m) refer to 'geo-engineering'.

<sup>38</sup>CBD, 'Decision XI/20, Climate-Related Geoengineering' UN Doc UNEP/CBD/COP/DEC/XI/20 (5 December 2012).

<sup>39</sup>CBD 'Decision XIII/14, Climate-Related Geoengineering' UN Doc CBD/COP/DEC/XIII/14 (8 December 2016).

<sup>40</sup>CBD Decision XI/20 (n 38) para 4 emphasizes "that climate change should primarily be addressed by reducing anthropogenic emissions by sources and by increasing removals by sinks of greenhouse gases under the United Nations Framework Convention on Climate Change". This emphasis is repeated in Decision XIII/14 (n 39).

<sup>41</sup>Resolution LP.4(8) on the Amendment to the London Protocol to Regulate the Placement of Matter for Ocean Fertilization and other Marine Geoengineering Activities' (18 October 2013) Annex 4ff (London Convention 2013 amendment) (this amendment is not in effect yet); 'Resolution LC-LP.1 (2008) on the Regulation of Ocean Fertilization' (31 October 2008); 'Resolution LC-LP.2 (2010) on the Assessment Framework for Scientific Research Involving Ocean Fertilization' (14 October 2010).

<sup>42</sup>The glossary entries of the three recent IPCC Special Reports (n 2) for 'geoengineering' read as follows: 'In this report, separate consideration is given to the two main approaches considered as 'geoengineering' in some of the literature: *solar radiation modification (SRM)* and *carbon dioxide removal (CDR)*. Because of this separation, the term 'geoengineering' is not used in this report.'

<sup>43</sup>The London Convention 2013 amendment (n 41) offers a rough framework for case-by-case decisions on the permissibility of marine geoengineering activities.

<sup>44</sup>S Oberthür, and L Groen, 'Hardening and Softening of Multilateral Climate Governance towards the Paris Agreement' (2020) 22 *Journal of Environmental Policy and Planning* 801.

<sup>45</sup>D Bodansky, 'The Legal Character of the Paris Agreement' (2016) 25 *Review of European, Comparative and International Environmental Law* 142.

<sup>46</sup>UNFCCC (n 3) art 4(2)(a).

<sup>47</sup>Paris Agreement (n 4) art 4(2).

<sup>48</sup>*ibid* art 13(7)(a).

anthropogenic emissions by sources and removals by sinks of all greenhouse gases'.<sup>49</sup> The Paris Agreement also makes this a recurring obligation.<sup>50</sup> The Paris Agreement furthermore requests parties to submit biennial transparency reports (the first ones by the year-end of 2024).<sup>51</sup> All these provisions apply to the 'mitigation of climate change', which includes – as argued in Section 2 – CDR, among other measures. NDCs and domestic climate policy measures thus are increasingly expected to include policy measures towards CDR application, and parties will increasingly be expected to report on their advancements in that regard.

Parties' communications are subject to a dedicated review process under the Paris Agreement's enhanced transparency framework, comprising of a facilitative, multilateral consideration of progress and a technical expert review.<sup>52</sup> The global stocktake taking place every 5 years<sup>53</sup> and the facilitative compliance mechanism<sup>54</sup> may also offer opportunities for identifying weaknesses and possibilities to strengthen mitigation action on emissions and removals. The Paris Agreement uses and integrates the combination of procedural obligations to communicate targets (NDCs) and regularly update on achievements as well as enhanced NDCs into what is sometimes referred to as the 'ambition mechanism', which, thus, underpins the substantive obligation of pursuing climate change mitigation. Although numerous challenges have been identified,<sup>55</sup> perhaps the ambition mechanism can serve not only to gradually strengthen emissions reductions efforts but also facilitate learning between countries regarding their measures to advance research, develop and gradually scale up – as appropriate within national circumstances – various CDR approaches.

## 5 | PRINCIPLES AND EXPECTATIONS ON THE FAIR SHARING OF MITIGATION EFFORTS APPLY TO CARBON DIOXIDE REMOVAL

The principle of common but differentiated responsibilities and respective capabilities (CBDR-RC)<sup>56</sup> is perhaps the most central principle in international climate change governance. It describes the strong expectation that the most advanced, industrialized nations take the lead in global mitigation efforts.<sup>57</sup>

Recognizing that CDR is included under the rubric of 'mitigation' implies that expectations – and associated negotiation dynamics

– regarding the leading efforts of advanced industrialized nations as well as regarding technical, financial and capacity support to developing nations – apply as much to CDR as they apply to the reduction of GHG emissions. Expectations that industrialized countries will take the lead on mitigation efforts overall – including on CDR deployment – are relevant given that many promising CDR approaches are at present more expensive than other mitigation measures, yet they might over time mature and become more affordable than they are now due to technological development, learning, and scaling effects. For industrialized countries (i.e. those with the greatest responsibility and capacity) to lead would mean for them to proactively invest in such technologies early on to reduce the costs for later followers and to ensure much more rapid deployment at scale than might otherwise occur. Furthermore, many such measures come with high initial investment costs (e.g. pertaining to the geological storage of CO<sub>2</sub>), which have to be shouldered initially and might only gradually be paid off. Owing to high costs associated with elevated regulatory and political risk in developing countries, such initial investments often do not occur in developing countries without targeted support.

Accordingly, developing countries risk missing out on important mitigation opportunities. Common expectations and the principle of CBDR-RC dictate that industrialized countries take the lead in advancing CDR and thereby enable CDR cost reductions. Furthermore, they are expected to support mitigation efforts (including CDR) of developing countries, including by contributing to technology transfer, capacity building and climate finance, including risk-mitigating financial instruments.<sup>58</sup> Market mechanisms and non-market mechanisms under Article 6 of the Paris Agreement could also serve the purpose of enabling developing countries to pursue CDR once their rulebook is finalized.<sup>59</sup>

Furthermore, CDR affords parties the theoretical possibility to clean up their emissions, including the historical ones. Arguably, the principle of CBDR-RC entails that in so far as cleaning up past emissions is or becomes necessary to achieve the objectives of the UNFCCC and the Paris Agreement, countries with high emissions, including particularly those with high cumulative historical emissions, have a greater responsibility to implement CDR.<sup>60</sup>

## 6 | PRIORITIZATION OF RAPID EMISSIONS REDUCTIONS AND LONG-TERM CARBON DIOXIDE REMOVAL

Although the Paris Agreement does not provide for any particular (temporal or absolute) prioritization of particular types and scales of mitigation activities and it remains unspecific regarding the role of

<sup>49</sup>UNFCCC (n 3) art 12(1)(a).

<sup>50</sup>Paris Agreement (n 4) art 13(7)(a).

<sup>51</sup>ibid art 13(4).

<sup>52</sup>ibid art 13(11).

<sup>53</sup>ibid art 14.

<sup>54</sup>ibid art 15.

<sup>55</sup>R Weikmans, H van Asselt, and JT Roberts, 'Transparency Requirements under the Paris Agreement and Their (Un)likely Impact on Strengthening the Ambition of Nationally Determined Contributions (NDCs)' (2020) 20 Climate Policy 511.

<sup>56</sup>UNFCCC (n 3) art 3(1).

<sup>57</sup>ibid art 2(2).

<sup>58</sup>CL Fyson et al, 'Fair-Share Carbon Dioxide Removal Increases Major Emitter Responsibility' (2020) 10 Nature Climate Change 836.

<sup>59</sup>M Honegger and D Reiner, 'The Political Economy of Negative Emissions Technologies: Consequences for International Policy Design' (2018) 18 Climate Policy 306.

<sup>60</sup>D Lenzi, 'The Ethics of Negative Emissions' (2018) 1 Global Sustainability E7.

enhancing sinks,<sup>61</sup> there are several indications that rapid emissions reductions are a priority and that increasingly all possible forms of emissions reductions and removals ought to be considered. In the following sections, we highlight provisions suggesting – or requiring – parties to pursue rapid absolute emissions reductions (Section 6.1), a long-term view as well as near-term action (Section 6.2), and a diverse and broad mitigation portfolio (Section 6.3).

## 6.1 | Global peaking of greenhouse gas emissions

The Paris Agreement specifies that the 'Parties aim to reach global peaking of greenhouse gas emissions as soon as possible ... and to undertake rapid reductions thereafter in accordance with best available science'.<sup>62</sup> Given that the Agreement in this instance solely refers to 'emissions' (whereas it in other cases consequently refers to either 'mitigation' or emissions and removals), this could arguably but not indisputably be interpreted as implying a collective goal of achieving a peak and decline of gross emissions, as opposed to net emissions, in addition to the broader goal of achieving a balance between emissions and sinks. On this interpretation, the Agreement retains an explicit aspiration of achieving a rapid, absolute reduction in gross emissions, independent of any CDR efforts.

## 6.2 | 'Highest possible ambition'

Article 4 of the Paris Agreement also states that '[e]ach Party's successive nationally determined contribution will represent a progression beyond the Party's then current nationally determined contribution and reflect its *highest possible ambition*, reflecting its common but differentiated responsibilities and respective capabilities, in the light of different national circumstances'.<sup>63</sup> The call for NDC's to reflect each party's 'highest possible ambition' has important implications for the role that CDR should and should not play in NDCs.

At least in the near term, any NDC that relied solely or primarily on CDR would likely fall afoul of the expectation that NDCs reflect a party's highest possible ambition. This is primarily because nearly every party has feasible options for reducing, preventing or slowing the growth in its GHG emissions, especially with the technical and financial support from other parties called for in Article 4(5) of the Paris Agreement. Thus, an NDC that does not include significant emissions reductions efforts cannot plausibly reflect a party's highest possible ambition.

At the same time, particularly for developed country parties, failure to include some form of CDR as a component of an NDC arguably means or will soon mean that the NDC falls short of the party's

highest possible ambition. Whatever efforts the party is making with respect to emission reduction, it could *also* invest in research, development and deployment of one or several nationally appropriate approaches to CDR. This does not apply to parties for whom investments in CDR would necessarily detract from efforts towards or investments in emission reductions, as may be the case for some developing countries. National circumstances and capabilities will determine which approaches to CDR are appropriate for each party. For example, so-called 'natural climate solutions',<sup>64</sup> such as forest restoration and regenerative agriculture, may already be feasible for most parties, whereas more expensive, technological approaches, such as direct air capture, may for now only be within the reach of developed country parties.

In the longer term, when some parties have eliminated emissions from all but the hardest-to-abate sectors, it might be plausible for parties' successive NDCs to focus on CDR as a means of cleaning up emissions from those sectors. Until then, however, the call for NDCs to reflect parties' 'highest possible ambition' implies an emphasis on rapid and deep emission reductions, as well as – where appropriate – preparing the ground for responsible applications of CDR.

## 6.3 | Comprehensiveness of action

Parties are not only expected to address some GHGs or some sectors of the economy, but their action and communications related thereto ought to span all such areas. As Article 3 of the Convention states: 'policies and measures should ... be comprehensive, cover all relevant sources, sinks and reservoirs of greenhouse gases and adaptation, and comprise all economic sectors'. The Paris Agreement in a similar vein states that parties should strive towards economy-wide targets.<sup>65</sup> This is relevant for national climate policy planning processes, in so far as to date many parties have chosen to only develop policies for some CDR approaches (e.g. afforestation, reforestation or ecosystem restoration) if any, while disregarding other approaches, especially those that may be more costly or cumbersome in the near term.

Increasingly ubiquitous, net-zero targets can be viewed as an effort for complying with the above provisions<sup>66</sup> and towards a global 'balance of sources and sinks'.<sup>67</sup> Net-zero targets further underscore the need for comprehensive policy planning, given that such targets can only be achieved if all parts of an economy play their part and

<sup>61</sup>M Doelle, 'The Paris Agreement: Historic Breakthrough or High Stakes Experiment?' (2016) 6 *Climate Law* 1.

<sup>62</sup>Paris Agreement (n 4) art 4(1).

<sup>63</sup>*ibid* art 4(3) (emphasis added).

<sup>64</sup>The term 'natural climate solutions' has long been used as synonymous with 'nature-based solutions' (cf n 16), for instance by the International Union for the Conservation of Nature (IUCN) to describe the protection and management of natural ecosystems as carbon sinks carbon storage and resources for adaptation. See, e.g., N Dudley et al (eds), 'Natural Solutions: Protected Areas Helping People Cope with Climate Change' (IUCN 2010).

<sup>65</sup>Paris Agreement (n 4) art 4(4).

<sup>66</sup>HL van Soest, MGJ den Elzen and DP van Vuuren, 'Net-Zero Emission Targets for Major Emitting Countries consistent with the Paris Agreement' (2021) 12 *Nature Communications* 2140.

<sup>67</sup>Paris Agreement (n 4) art 4(1).

CDR is expected to play a role on the way to and for maintaining a net-zero state in spite of some residual emissions.<sup>68</sup>

The terms 'mitigation obstruction' or 'mitigation deterrence' describe concerns that consideration of CDR (or SRM) result in a lowered impetus for emission reductions.<sup>69</sup> In light of the above provisions, these terms may seem imprecise. Nonetheless, we find our observations reinforce the case for increasingly specific emission reductions and removal targets including near-term action plans – in addition to long-term net-zero targets – to limit the divergence between mitigation targets and implementation.<sup>70</sup>

## 7 | CONSIDERING POSSIBLE SUSTAINABLE DEVELOPMENT AND RIGHTS IMPLICATIONS OF MITIGATION MEASURES

The Paris Agreement also contains several provisions that could be pertinent to scrutinizing possible adverse (and beneficial) impacts of deployment of CDR. Its preamble recognizes that the 'Parties may be affected not only by climate change but also by the impacts of the measures taken in response to it'.<sup>71</sup> This can be viewed as an extension of Article 4(8) of the UNFCCC, which provides 'Parties shall give full consideration to what actions are necessary ... to meet the specific needs of developing country Parties arising from the impact of the implementation of response measures'.<sup>72</sup> Although often associated with impacts on oil-producing countries with development status, these provisions can be interpreted as a more general call for parties to consider social, economic and environmental concerns related to mitigation efforts – including CDR.

The Paris Agreement's preamble, as well as Articles 2(1) and 4, emphasizes that climate change responses take place 'in the context of sustainable development and the eradication of poverty'.<sup>73</sup> and other provisions reiterate the aim of promoting sustainable development. Moreover, the parties are (in the preamble) are called upon to 'respect, promote and consider their respective obligations on human rights, the right to health, the rights of indigenous peoples, local communities, migrants, children, persons with disabilities and people in vulnerable situations and the right to development, as well as gender equality, empowerment of women and intergenerational equity' when taking action to address climate change.<sup>74</sup>

Such provisions provide guidance as parties identify and select ensembles of mitigation measures and as they design their respective domestic mitigation policies – including where appropriate for incentivizing and regulating CDR. Such guidance is particularly pertinent given the substantial concerns regarding possible side-effects associated with large-scale CDR – such as food price spikes due to possible diversions of land from food crop production, which could undermine the human right to food, contribute to poverty and undermine sustainable development.<sup>75</sup> The possible implications of CDR for sustainable development appear to strongly depend on scale, local socio-economic and environmental conditions, as well as policy design and governance.<sup>76</sup> By heeding the above guidance regarding rights and sustainable development, parties might therefore design mitigation portfolios that critically contribute to limiting atmospheric levels of CO<sub>2</sub> as well as other sustainable development objectives while protecting vulnerable populations.<sup>77</sup> This may specifically be achieved if parties conduct *ex-ante* policy impact assessments, carefully select and design CDR approaches and policies, and generally view their mitigation efforts as an ongoing learning process requiring participatory decision making and mutual learning on the international stage.<sup>78</sup> Failure to limit warming to well below 2°C would devastate sustainable development efforts,<sup>79</sup> proactive engagement on this matter, therefore, seems urgent.

## 8 | CONCLUSION

We have shown how a literal as well as a teleological reading of the UNFCCC and the Paris Agreement entails that CDR is a form of the 'mitigation of climate change'. We have argued that conceptual overlap and confusion associated with the concept of 'geoengineering' may partly explain the false perception that CDR is separate from 'mitigation'. Furthermore, we have highlighted numerous implications that flow from recognizing CDR as 'mitigation'. We have also examined how existing provisions and processes can be leveraged to strengthen the governance of climate change and CDR.

Recognizing CDR as part of the mitigation of climate change affords four avenues for strengthening CDR governance. First, procedural obligations regarding the communication of NDCs, LT-LEDS, national GHG inventories and the substantive obligation to pursue domestic mitigation efforts pertain not only to emission reductions but also CDR, which suggests that there may be various underutilized avenues to scrutinize

<sup>68</sup>M Honegger, A Michaelowa and M Poralla, 'Net-Zero Emissions: The Role of Carbon Dioxide Removal in the Paris Agreement' (NET-Rapido and Perspectives Climate Research 2020).

<sup>69</sup>DR Morrow, 'Ethical Aspects of the Mitigation Obstruction Argument against Climate Engineering Research' (2014) 372 *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences* 20140062; N Markusson, D McLaren and D Tyfield, 'Towards a Cultural Political Economy of Mitigation Deterrence by Negative Emissions Technologies (NETs)' (2018) 1 *Global Sustainability* E10.

<sup>70</sup>D McLaren et al 'Beyond "Net-Zero": A Case for Separate Targets for Emissions Reduction and Negative Emissions' (2019) 1 *Frontiers in Climate* 4; SM Smith 'A Case for Transparent Net-Zero Carbon Targets' (2021) 2 *Communications Earth & Environment* 1.

<sup>71</sup>Paris Agreement (n 4) preamble.

<sup>72</sup>UNFCCC (n 3) art 4(8).

<sup>73</sup>Paris Agreement (n 4) preamble, arts 2(1) and 4.

<sup>74</sup>*ibid* preamble.

<sup>75</sup>WCG Burns, 'Human Rights Dimensions of Bioenergy with Carbon Capture and Storage: A Framework for Climate Justice in the Realm of Climate Geoengineering' in R Abate (ed), *Climate Justice: Case Studies in Global and Regional and Governance Challenges* (Environmental Law Institute Press 2016) 149; C Gough et al, 'Challenges to the Use of BECCS as a Keystone Technology in Pursuit of 1.5°C' (2018) 1 *Global Sustainability* E5.

<sup>76</sup>M Honegger, A Michaelowa and J Roy, 'Potential Implications of Carbon Dioxide Removal for the Sustainable Development Goals' (2021 *fc*) *Climate Policy*.

<sup>77</sup>JC Minx et al, 'Negative Emissions – Part 1: Research Landscape and Synthesis' (2018) 13 *Environmental Research Letters* 063001.

<sup>78</sup>Honegger et al (n 62).

<sup>79</sup>F Nerini et al, 'Connecting Climate Action with other Sustainable Development Goals' (2019) 2 *Nature Sustainability* 674.



and strengthen parties' mitigation targets and efforts towards both. Given the relative lack of attention to CDR in these areas to date and the growing number of long-term net-zero emissions targets, scrutiny regarding CDR may be expected to increase. Second, principles and expectations regarding fairness and equity of mitigation efforts include CDR efforts, meaning that industrialized countries are expected to take the lead on CDR – including particularly those at an early technological development stage – and to support developing nations where appropriate in their eventual pursuit of CDR. Third, the Paris Agreement appears to ask parties to both prioritize rapid emissions reductions as well as to increasingly address all possible forms of mitigation. Fourth, the Paris Agreement requests its parties to consider sustainability and rights implications of their actions so that they contribute to sustainable development and avoid infringing on (human) rights.

Greater clarity on the role of CDR in international and domestic climate change governance is certainly desirable. Understanding the full scope of the 'mitigation of climate change' is a first and necessary but not sufficient step in that direction.

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