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# Countries need to provide clarity on the role of carbon dioxide removal in their climate pledges

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Carbon dioxide removal (CDR) involves capturing $CO_2$ from the atmosphere and storing it for decades to millennia. Alongside deep emissions reductions, CDR is required for meeting the temperature goal of the Paris Agreement (IPCC 2022). However, parties to the agreement do not currently distinguish CDR from emissions reductions in their climate pledges. In this perspective, we argue that this lowers transparency and hinders the assessment of how credible and ambitious mitigation plans are.

CDR can come from a range of methods, such as afforestation/reforestation, bioenergy with carbon capture and storage (BECCS), biochar, enhanced weathering, or direct air carbon capture and storage (DACCS) (Smith *et al* 2024). As progress is made in reducing economy-wide gross emissions, successfully scaling CDR would contribute to balancing residual emissions and reaching net-zero. CDR deployment at scale is also required for potentially achieving net negative emissions in the second half of the 21st century and the (partial) reversal of global warming (IPCC 2022). However, since CDR deployment is currently limited and faces a variety of technological, economic and sustainability constraints when scaling up, emissions must still be reduced as swiftly and deeply as possible (Dooley *et al* 2022b).

Current decisions under the United Nations Framework Convention on Climate Change (UNFCCC) do not explicitly foresee an assessment of how countries plan to scale CDR. Nonetheless, many parties already report removals from forestry in their national inventories and pledge them in their climate targets. A subset of these removals are generally considered to constitute CDR, as they are related to direct human intervention (e.g. afforestation/reforestation) (Friedlingstein *et al* 2023). Still, even though it is present, CDR is hidden from view: the Nationally Determined Contributions (NDCs) and other submitted documents tend to report and pledge net GHG emissions reductions, where emissions and removals are summed in their respective sectors.

The IPCC Task Force on National Greenhouse Gas Inventories is leading a process to provide more guidance on reporting novel CDR activities in inventories. But in addition to this, we argue that there is a strong rationale and urgency for transparent CDR targets and pledges under the UNFCCC. Recent evidence points towards a collective gap in scaling CDR in the short-term, and planning for it in the long-term (Lamb *et al* 2024). Different definitions of CDR are also highly consequential for benchmarking national progress towards net-zero (Gidden *et al* 2023). In addition, there are concerns that expectations of future CDR deployment may discourage near-term emissions reductions (McLaren *et al* 2019, Grant *et al* 2021), and that some countries already over-depend on CDR in their net-zero plans(Smith *et al* 2022, Dooley *et al* 2022a). Specific information on CDR is therefore instrumental for evaluating progress towards the climate objectives of the Paris Agreement. In this article we make three suggestions for how to improve transparency on CDR in climate pledges.

*Distinguish emissions reductions from removals in the Nationally Determined Contributions*

As it stands, countries are not required to declare the specific contribution of CDR to their national pledges. This follows from Decision 4/CMA.1 from the Katowice Climate Package, which governs the main content requirements of the NDCs, and Decision 5/CMA.3, which operationalises them. These decisions ensure that parties describe their NDC targets and methodologies in accordance with national GHG inventories, while structuring key information using the ICTU (Information to facilitate clarity, transparency and understanding) table format.

A consequence of the link between inventory reporting and the NDCs is that CDR already features implicitly in many pledges, namely as a subset of removals from managed forests in the inventory sector called land use, land-use change and forestry (LULUCF). However, quantifying the removals in the NDCs poses a major challenge for observers.

The issue is threefold. First, one needs to know the contribution of the overall LULUCF sector to a parties' climate pledge. Here the convention asks parties to specify whether or not a target includes LULUCF. In many cases, parties have declared targets with and without the LULUCF sector, allowing its contribution to be evaluated. However, in other cases, it remains vague, either due to the formulation of the headline target itself, or because further detail on LULUCF is only provided in other national documents. This creates a high burden on observers to compile sufficient information to evaluate (net) LULUCF-related pledges - despite the fact that it

contributed about one quarter of pledged mitigation under the first (Intended) NDCs (Grassi *et al* 2017).

Second, even where parties describe the role of LULUCF in their target, observers usually remain in the dark regarding the specific contribution of emissions reductions (e.g. reduced deforestation) versus CDR (e.g. afforestation/reforestation). The problem with this lack of disaggregation is that these are fundamentally different categories of mitigation effort. Whereas reductions in deforestation can have a short-term effect on emission trends, afforestation projects can take decades to deliver removals.

Third, if the LULUCF removal portion of a climate pledge can be inferred, observers must evaluate the subset of these that are CDR. Under inventory reporting conventions, LULUCF removals tend to include indirect anthropogenic effects such as $CO_2$ fertilisation, while following a broader definition of managed land compared to global bookkeeping model conventions (Grassi *et al* 2021). This drives gigatonne-scale differences in removal estimates between national inventories and mitigation scenarios, with implications for global benchmarks such as the appropriate timing of net-zero (Gidden *et al* 2023). While translation methodologies have been developed to bridge these different definitions (Grassi *et al* 2023), significant domain knowledge is still required to apply them.

Beyond the LULUCF sector, other types of CDR are becoming available to parties. Novel methods such as BECCS or DACCS are starting to be supported by national policies, and parties have clear incentives to gain the credit for these efforts. Right now, novel methods are only qualitatively mentioned in the NDCs, if at all (Lamb *et al* 2024). But as national CDR targets are formalised, there is a risk that parties start to integrate them following the same sectoral-based net approach that has been taken with LULUCF (e.g. with DACCS counting towards net reductions in the energy or industry sectors). This would again introduce ambiguity between different types of mitigation and hinder the tracking of progress towards Paris Agreement goals.

To allow CDR plans to be assessed for credibility, it is critical to make removals visible in the NDCs. Maximum transparency could be achieved by declaring absolute annual targets for CDR that are separate from emissions. These would be generally preferable to targets based on growth projections from a historical baseline, for the simple reason that estimates of current CDR are low and are inherently uncertain. However, other approaches are possible, for example by including separate headline reduction rate targets with and without CDR, or a similar formulation at the sector level, including for LULUCF. Of course, both the formulation of targets and their level of stringency can be updated in subsequent NDCs as parties learn more about their CDR capabilities. With respect to the LULUCF sector, parties can be expected to continue applying the broader inventory-based definition of removals. However, simply declaring their expected contribution and distinguishing these from LULUCF emissions will also greatly facilitate the harmonisation of differences between inventories, NDC assessments and mitigation scenarios. As these conventions are established, it would then be useful to see them consistently applied across other reporting mechanisms under the UNFCCC.

*Categorise removals by their carbon pools*

Beyond a simple description of how much removals countries are pledging, it is critical to characterise which CDR methods would be used. A whole range of CDR options are becoming available, which differ widely in their costs and state of readiness, but also with regards to their permanence characteristics (Smith, *et al* 2023). This raises important governance challenges, including how to appropriately measure, report and verify removals.

IPCC inventory guidelines provide the basis for parties to report their GHG sources and sinks (IPCC 2006). Parties are expected to use this same reporting for defining and tracking progress towards their respective NDCs. However, the coverage of CDR methods in IPCC guidelines is incomplete. Right now, there are guidelines for afforestation/reforestation, soil carbon sequestration, ecosystem restoration including wetlands, durable wood products, BECCS, and the use of biochar as a soil amendment. These methods cover the vast majority of current CDR deployment, but they only represent a relatively small share of current investments and R&D activity (Smith *et al* 2024). The upcoming *IPCC Methodology Report on Carbon Dioxide Removal Technologies and Carbon Capture Utilization and Storage* will provide an opportunity to expand guidelines for novel methods and lay the accounting foundations for more comprehensive CDR reporting under the UNFCCC.

Ideally, parties would provide full transparency on the specific CDR measures that contribute to their pledges. Yet, due to the bottom-up nature of the Paris Agreement and the tendency to shy away from burdensome transparency requirements, it will be important to prioritise specific aspects that should be covered in the NDCs. The ICTU tables understandably focus on delivering the information necessary to evaluate economy-wide emission reduction targets, which remain challenging to quantify (Den Elzen *et al* 2022). But they also ask parties to describe which carbon pools are covered by their NDCs. As the next steps are taken towards clarity on CDR, this creates an opportunity for parties to categorise which types of CDR will be implemented as part of their pledges.

The IPCC guidelines currently include a range of carbon pools: pools in managed lands; harvested wood products; geological $CO_2$ storage; and a generic "other" category. As these final pools are a major determinant of the permanence characteristics of different types of CDR, we suggest that parties move beyond qualitatively describing which pools are covered by their pledges, and start to actually quantify the removals associated with each. In doing so, we would gain valuable insight into the nature of CDR-related pledges.

A categorisation by carbon pool category would facilitate the tracking of land-based CDR pledges, stimulating reflection and mutual learning on how low permanence in these approaches would be dealt with in terms of accounting and governance arrangements. Conversely, clarity on the contribution of novel methods using geological storage pools would allow observers to evaluate whether sufficient policy support is being put in place to realise a significant contribution from these methods by the mid-century (Nemet *et al* 2023).

A drawback of this proposal is that it would exclude pools not yet covered in the IPCC guidelines, namely minerals, and marine sediments in the open ocean, which cover e.g. enhanced weathering, carbon-negative cement, or biomass sinking. However, it may be prudent to wait for updated IPCC guidance before declaring these pools, as a means of filtering those removal methods which have achieved a sufficient level of scientific robustness in implementation and measurement. Still, parties would have the option of declaring "other" carbon pools, even though this would come at the expense of transparency and a norm of only including options supported by the best available science.

*Carefully integrate CDR across provisions of the Paris Agreement*

The emergence of CDR has significant implications across many provisions of the Paris Agreement (Mace *et al* 2021). Our discussion so far has focused on the NDCs (Art. 4), accounting conventions for sinks (Art. 5), transparency (Art. 13), and the global stocktake (Art. 14). However, CDR is also relevant for international cooperation (Art. 6), implementation and compliance (Art. 15), as well as broader aspects of equity (Art 2.1, 4).

We expect that CDR will play a role in internationally transferred mitigation outcomes (Art. 6.2, 6.4), since many countries have limited access to domestic CDR options. Trade in CDR-based mitigation outcomes is already possible under Article 6, but at the time of writing there are no such projects in the pipeline. Indeed, Article 6 still lacks effective mechanisms to address reversals, and the means to robustly distinguish and fund CDR based projects alongside those focused on emission reductions (UNEP Copenhagen Climate Centre 2024). Again, as a first step, it would be important to simply know the volume of transfers that parties will seek to obtain, enabling observers to track expectations for an international transfer system.

CDR policymaking is in its infancy, and some countries may struggle to provide the transparency that we call for. There is therefore an imminent need for systematic knowledge sharing. Annex I parties could take the lead and clearly distinguish between emission reductions and removals in the next round of NDCs. This would provide the basis for an assessment of emerging CDR commitments as well as collective learning over the coming years. Ideally, this would feed into the second Global Stocktake and could inform considerations of CDR under the Paris Agreement framework going forward.

Of course, some parties may prefer to continue pledging net targets, since this gives greater flexibility to determine the exact split of reductions and CDR at a later point in time, based on how future costs and potentials develop. However, we would still argue that transparency takes precedence over flexibility, on the basis that parties are not exposed to any compliance risks under the Paris Agreement, and that others have much to gain in terms of learning from failures and tracking progress towards meeting the agreement.

CDR is already part of international climate negotiations and will continue to gain traction as policies are put in place. But unless parties take the next step and explicitly declare CDR as part

of their next national climate pledges, there is a risk that we will fall further off-track to meet the climate objectives of the Paris Agreement.

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