Policy brief

Climate pledges

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Current national proposals are off track to meet carbon dioxide removal needs

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Meeting the Paris Agreement targets requires deep emissions reductions supported by a scale-up in carbon dioxide removal. However, current country-reported mitigation pledges are off track to meet carbon dioxide removal needs, unless countries dramatically reduce emissions consistent with low-energy-demand scenarios.

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The policy problem

Many countries have declared net-zero targets as part of their commitments under the Paris Agreement. In addition to emissions reductions, these national targets imply proposals to sustain or increase carbon dioxide removal (CDR). Countries have communicated these proposals in their reporting to the UN Framework Convention on Climate Change (UNFCCC), so far describing contributions from conventional CDR methods in the land-use, land-use change and forestry (LULUCF) sector, such as afforestation, as well as novel methods such as direct air carbon capture and storage. Much attention has been given to overall mitigation targets. However, so far, there has been a lack of evaluation and critical reflection on the specific role of CDR in these targets (Fig. 1).

The findings

In our study we found that compared with 2020, the most ambitious national proposals for CDR imply an additional 0.5 $GtCO_2\,yr^{-1}$ of removals by 2030, and 1.9 $GtCO_2\,yr^{-1}$ by 2050. Compared with CDR scaling in Paris Agreement-consistent scenarios, we found that these national CDR proposals tend to fall short by hundreds of megatonnes of carbon dioxide in 2030 to several gigatonnes of carbon dioxide in 2050, highlighting a 'CDR gap'. However, we find that the most ambitious proposals do come close to levels in a low-energy-demand scenario where CDR requirements are minimized, suggesting that if countries pledge more ambitious emissions reductions consistent with these scenarios, the CDR gap will be closed. As levels of reporting vary, our evaluation of proposed CDR does assume that a number of countries simply maintain their current levels of (conventional) removals. In addition, it remains unknown to what extent firm CDR policies will follow these proposals.

The study

We evaluated CDR proposals based on a range of country-submitted reports to the UNFCCC. In the LULUCF sector, inventories are based on direct observations and hence cannot factor out 'indirect anthropogenic effects'. Since this inflates apparent proposals for CDR when compared to scenario conventions, we discount these indirect effects to focus only on direct anthropogenic removals, consistent with the IPCC definition of CDR. We then added conventional removals to any national proposals for scaling novel CDR. Finally, we benchmarked the collective national proposals against CDR in a set of Paris Agreement-consistent integrated assessment scenarios, orienting our selection of scenarios to those with relatively moderate levels of CDR scaling — recognizing the existence of both sustainability constraints and limits to the pace of upscaling.

Recommendations for policy

- Prioritize reducing emissions rapidly across all sectors (including from deforestation and land degradation) to minimize dependency on CDR.
- Report planned emissions reductions and removals separately in the nationally determined contributions and long-term strategies, while acknowledging the difficulty of isolating only direct anthropogenic effects in country reporting.
- Focus on policies that incentivize further removals on land, support afforestation, and improve forest management and gains in soil carbon, while protecting ecosystems and biodiversity.
- Develop plans to mitigate future risks for removals on land, including the impacts of climate change (such as wildfires) and changes in indirect anthropogenic effects (such as carbon dioxide fertilization).
- Close the CDR gap by designing 'technology push' and 'demand pull' policies that promote the innovation, development and upscaling of energy-efficient, scalable, cost-effective novel CDR technologies.

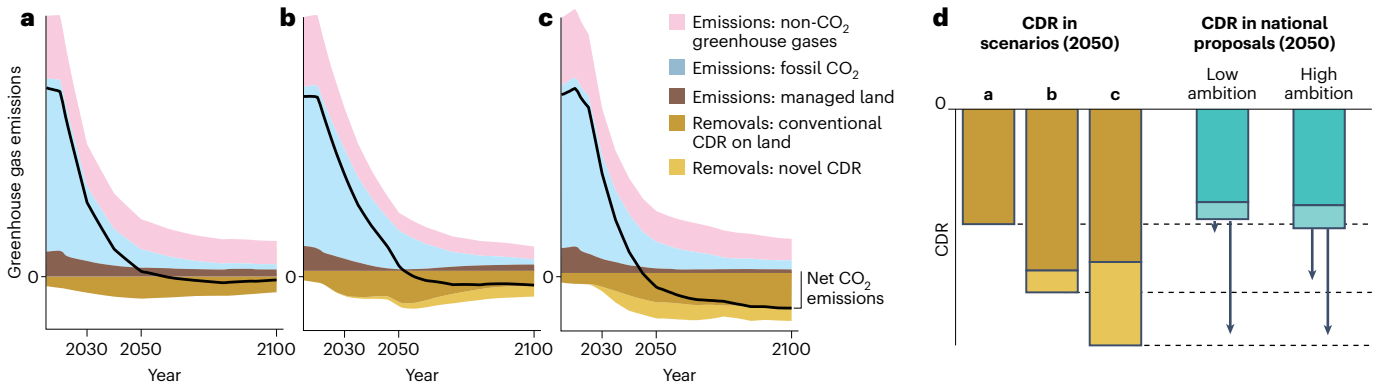

Fig. 1 | The CDR gap concept. a–**c**, Different scenarios can be followed to reach the temperature goal of the Paris Agreement, all of which involve deep, near-term emissions reductions complemented by CDR. We choose three such scenarios focused on demand reduction (**a**), renewables (**b**) or carbon removal (**c**) with different levels of conventional and novel CDR in 2050, avoiding those with extremely high CDR scaling rates due to sustainability constraints and other trade-offs. We then focus on the removal component of these pathways in 2030 and 2050. **d**, We then compare CDR levels in the scenarios to levels proposed by countries in their net-zero plans. The CDR gap refers to the difference between these scenarios and national proposals (arrows). A large gap suggests that countries need to strengthen their ambitions to scale CDR, while still ensuring deep emissions reductions. The CDR gap frames out the necessary emissions reductions that would accompany any mitigation strategy to reach the temperature goal of the Paris Agreement. It also involves implicit normative choices about which pathways should be taken to mitigate climate change, and how they balance emissions reduction versus CDR scaling efforts. The dark and light shaded areas of the bars labelled a, b and c correspond to the legend in **c**. The dark and light shaded areas of the bars labelled 'Low ambition' and 'High ambition' represent conventional and novel CDR removal, respectively. The horizontal dashed lines are the totals for the bars labelled a, b and c. Figure adapted from W. F. Lamb et al. *Nat. Clim. Change* https://doi.org/10.1038/s41558-024-01984-6 (2024), Springer Nature Ltd.

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Further reading

1. Smith, S. M. et al. *The State of Carbon Dioxide Removal* 1st edn (2023); https://doi.org/10.17605/OSF.IO/W3B4Z
Provides a comprehensive analysis of CDR, including technology readiness, current deployment and scaling in scenarios.
2. Smith, H. B., Vaughan, N. E. & Forster, J. Long-term national climate strategies bet on forests and soils to reach net-zero. *Commun. Earth Environ.* **3**, 305 (2022).
Evaluates the CDR levels implied by country scenarios in the long-term mitigation strategies submitted to the UNFCCC.
3. Buck, H. J., Carton, W., Lund, J. F. & Markusson, N. Why residual emissions matter right now. *Nat. Clim. Change* **13**, 351–358 (2023).
Evaluates the residual emissions implied by country scenarios in the long-term mitigation strategies submitted to the UNFCCC.
4. Gidden, M. J. et al. Aligning climate scenarios to emissions inventories shifts global benchmarks. *Nature* **624**, 102–108 (2023).
Provides a first alignment of integrated assessment scenarios to national inventory conventions, showing how global mitigation benchmarks shift when aligned to country reporting.
5. Grassi, G. et al. Carbon fluxes from land 2000–2020: bringing clarity to countries' reporting. *Earth Syst. Sci. Data* **14**, 4643–4666 (2022).
Provides a consistent database of national LULUCF emissions and removals based on inventory submissions and other national reporting to the UNFCCC.

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Competing interests
The authors declare no competing interests.