

Research quantifies 'gap' in carbon removal for first time—shows countries need more awareness, ambition and action

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New research involving the University of East Anglia (UEA) suggests that countries' current plans to remove CO₂ from the atmosphere will not

be enough to comply with the 1.5°C warming limit set out under the Paris Agreement.

Since 2010, the United Nations environmental organization UNEP has taken an annual measurement of the emissions gap—the difference between countries' climate protection pledges and what is necessary to limit global heating to 1.5°C, or at least below 2°C.

The UNEP Emissions Gap Reports are clear: [climate policy](#) needs more ambition. This new study now explicitly applies this analytical concept to [carbon dioxide removal](#) (CDR)—the removal of the most important greenhouse gas, CO₂, from the atmosphere.

The [study](#), published in the journal *Nature Climate Change*, was led by the Berlin-based Mercator Research Institute on Global Commons and Climate Change (MCC) and involved an international team of scientists.

"In the Emissions Gap Reports, carbon removals are only accounted for indirectly," said lead author Dr. William Lamb, of the MCC Applied Sustainability Science working group.

"After all, the usual benchmark for climate protection pledges is net emissions, i.e., emissions minus removals. We are now making transparent the specific ambition gap in scaling up removals.

"This planetary waste management will soon place completely new requirements on policymakers and may even become a central pillar of climate protection in the second half of the century."

Co-author Dr. Naomi Vaughan, of the Tyndall Centre for Climate Change Research at UEA, added, "Carbon dioxide removal methods have a small but vital role to play in achieving net zero and limiting the impacts of climate change.

"Our analysis shows that countries need more awareness, ambition and action on scaling up CDR methods together with deep emissions reductions to achieve the aspirations of the Paris Agreement."

According to the study, if national targets are fully implemented, annual human-induced carbon removals could increase by a maximum of 0.5 gigatonnes of CO₂ (500 million metric tons) by 2030, and by a maximum of 1.9 gigatonnes by 2050.

This contrasts with the 5.1 gigatonne increase required in a "focus scenario," which the research team depicts as typical from the latest Intergovernmental Panel on Climate Change (IPCC) assessment report.

There, global heating, calculated over the entire course of this century, is limited to 1.5°C, and a particularly rapid expansion of renewable energies and reduction of fossil emissions is depicted as the core climate protection strategy.

But, the focus scenario still relies on scaling up carbon removals. The gap for the year 2050 is therefore at least 3.2 gigatonnes of CO₂ (5.1 minus a maximum of 1.9).

An alternative focus scenario, also derived from the IPCC, assumes a significant reduction in global energy demand, due to politically initiated behavior changes as the core element of climate protection strategy.

Here, carbon removals would increase by a more modest amount: 2.5 gigatonnes in 2050. Fully implemented national targets would be close to sufficient when compared to this scenario, with a gap in 2050 of 0.4 gigatonnes.

The research team points out the problem of sustainability limits in scaling up carbon removals; for example, the associated land area

demand will come to jeopardize biodiversity and food security. Nevertheless, there is still plenty of room for designing fair and sustainable land management policies.

In addition, novel carbon removal options, such as air filter systems, or "enhanced rock weathering," have hardly been promoted by politicians to date.

They currently only remove 0.002 gigatonnes of CO₂ per year from the atmosphere, compared to 3 gigatonnes through conventional options such as afforestation, and they are unlikely to significantly increase by 2030. According to the scenarios, they must become more prevalent than conventional options by 2010.

Since only 40 countries have so far quantified their removal plans in their long-term low emissions development strategies, the study also draws on other national documents and best-guess assumptions.

"The calculation should certainly be refined," said Dr. Lamb. "But our proposal using the focus scenarios further opens the discourse on how much carbon removal is necessary to meet the Paris Agreement.

"This much is clear: without a rapid reduction in emissions towards zero, across all sectors, the 1.5°C limit will not be met under any circumstances."

More information: The carbon dioxide removal gap, *Nature Climate Change* (2024). DOI: [10.1038/s41558-024-01984-6](https://doi.org/10.1038/s41558-024-01984-6).
www.nature.com/articles/s41558-024-01984-6

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