

Research highlights a dangerous overreliance on future CO₂ removal

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Governments and businesses are relying on dangerous amounts of future removal of carbon dioxide (CO₂) from the atmosphere, instead of more rapidly reducing emissions and phasing out fossil fuels. This problem is

partly due to an incomplete picture of the damaging consequences of carbon dioxide removal for people, food security and natural ecosystems, according to new research [published](#) in *Science*.

The paper finds that the [carbon dioxide removal](#) potential currently reported by the UN climate science assessment body, the Intergovernmental Panel on Climate Change (IPCC), greatly overestimates how much heavy lifting carbon dioxide removal, specifically bioenergy with carbon capture and storage, and tree-planting, can safely do in the pursuit of climate targets.

The IPCC works by synthesizing the best available literature at the time of writing and publishing their reports.

Scientific understanding of how to slow and halt [global warming](#) has become more sophisticated in recent years, allowing the researchers to now map carbon dioxide removal options against sustainability risks, to see what would keep to climate policy goals without posing unacceptable hazards.

Lead author, Alexandra Deprez, IDDRI-Sciences Po said, "Governments and industries are banking on large future deployments of carbon dioxide removal to deliver the Paris Agreement climate goals, but the scale proposed threatens food security, human rights, poses serious damage to natural ecosystems and risks overstepping multiple planetary boundaries in potentially irreversible ways."

The researchers examined the published climate science that informed the most recent IPCC reports, and the pathways limiting warming to 1.5°C.

They found the sustainable thresholds for land-based carbon dioxide removal using bioenergy crops, forestry and ecosystem restoration to be

significantly lower than deployment expectations conveyed by most pathways presented in the IPCC reports, once biodiversity and human livelihoods risks are applied to the various scenarios.

Co-author Prof. Paul Leadley, University of Paris-Saclay said, "The levels of carbon dioxide removal that are considered to be feasible at reasonable cost by the IPCC create high risks for agriculture, livelihoods and the environment. That's because there isn't enough land on our planet for huge amounts of carbon dioxide removal—something else has to give. Biodiversity, freshwater use, and [food security](#) should be the issues that guide limits to carbon dioxide removal rather than current estimates of technical and economic potentials."

The latest IPCC mitigation report ([AR6 WGIII](#)) deals with the issue of delivering against the Paris Agreement ambitious climate goals, in part by identifying the technical and economic limits to carbon dioxide removal options.

The upper end of the proposed ceiling for bioenergy with carbon capture and storage, and afforestation/reforestation (maintaining, enhancing or planting new forests) when considered as [land area](#), could require converting up to 29 million km² of land—over three times the area of the United States—to bioenergy crops or trees. This could potentially push over 300 million people into food insecurity, which is almost equivalent to the entire US population.

Analysis of existing climate commitments reveals that by the end of this decade, countries collectively plan to produce twice the amount of [fossil fuels](#) than recommended in the IPCC Paris-aligned pathways with low or no overshoot past 1.5°C, and by 2060 use 12 million km² for land-based carbon removal, close to the total amount of currently available global cropland.

Co-author Dr. Kate Dooley, University of Melbourne said, "Carbon dioxide removal into land and forests cannot legitimately be used to offset continuing fossil fuel emissions. Government climate plans should set separate, transparent targets for emission reductions and removals, which limit reliance on the latter, and meet climate and biodiversity commitments through restoring and maintaining [natural ecosystems](#)."

The paper makes three recommendations to policymakers and scientists:

1. Estimate a sustainable carbon dioxide removal (CDR) budget, based on socio-ecological limit
2. Identify viable 1.5°C pathways that do not overstep sustainability CDR thresholds, with focus on near term national climate plans (NDCs) due in 2025 under the UNFCCC process
3. CDR governance should allocate limited sustainable supply to most legitimate uses

The paper also calls on the scientific community to inform the next cycle of IPCC reports—which will come in the second half of this critical decade for climate action. Identifying Paris-aligned scenarios that do not overstep sustainability limits should be a key priority for the seventh IPCC assessment report ([AR7](#)) cycle.

Alexandra Deprez added, "The climate and biodiversity crises are two sides of the same coin, and large-scale carbon dioxide removal will not solve either of these problems. Carbon removal needs to be carefully deployed at a much smaller scale than current climate plans and most climate scenarios suggest, and alongside a rapid, just, and orderly fossil fuel phaseout, if we are to meet our climate targets."

More information: Alexandra Deprez et al, Sustainability limits

needed for CO₂ removal, *Science* (2024). DOI: [10.1126/science.adj6171](https://doi.org/10.1126/science.adj6171)
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