

Carbon dioxide removal: Feasibility study evaluates possible measures for Germany

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Using biomass from rewetted peatlands (f.i. Common reed *Phragmites australis*) for bioenergy together with carbon capture and storage could potentially also contribute to carbon dioxide removal. Credit: Tobias Dahms, AESA aerial 2018

In order for Germany to become climate neutral by 2045, CO₂ emissions

must first be drastically and permanently reduced. However, CDR measures alone cannot remove the large quantities of CO₂ that are emitted in Germany. It is assumed that they can offset only approx. 5–15% of the current emissions.

But how effective and efficient are the various possible measures? What are the hurdles to implementing them? What are the costs? How environmentally friendly are they?

The research team investigated these and other questions in its latest study in which it analyzed the feasibility of 14 CDR measures that could be implemented in Germany. The measures include direct air [carbon capture](#) and storage (DACCS) and bioenergy with carbon capture and storage (BECCS) as well as measures to increase carbon uptake by ecosystems.

For their investigations, the researchers used an evaluation framework they had jointly developed in a previous study. Six different dimensions are assessed: ecological, technological, economic, social, institutional, and systemic.

"For a good and comparable assessment of the feasibility, taking into account the risks and opportunities of different CDR measures, various aspects must be considered. Because these are not easy to keep track of and compare, we wanted to shed light on them with our study," says Dr. Malgorzata Borchers from the UFZ and co-first author of the study together with Dr. Johannes Förster and Dr. Nadine Mengis.

Within the framework of workshops in multidisciplinary teams of the Helmholtz Climate Initiative, the expertise of 28 co-authors was incorporated into the study. "We thus had an incredibly large pool of expert knowledge at our disposal. This enabled us to assess the current state of knowledge on the CDR methods analyzed in our study," says

Mengis.

The researchers have presented their results in a clear evaluation matrix using a traffic light color system. Red means that the hurdles to introducing a CDR measure are high in a certain area (e.g. ecological or economic). Yellow means they are medium, and green means they are low.

The study results show that the CDR measures with the lowest technological hurdles include mainly ecosystem-based measures such as the restoration of seagrass meadows, the cultivation of intermediate crops in agriculture, the rewetting of peatlands, and the reforestation of degraded land.

"Ecosystem-based measures are already being used to avoid emissions in particular. They also contribute to the removal of carbon dioxide from the atmosphere. However, the potential of these measures is limited because Germany is quite restricted in terms of area and because we cannot rewet peatlands or reforest large areas indefinitely," says Förster.

"Nevertheless, we should try to leverage these synergies. In order to achieve the climate target, it will be necessary to combine different CDR measures in a portfolio of climate protection measures."

For measures with a higher CO₂ removal potential such as BECCS, the traffic light color in the evaluation matrix is red in many areas. "With technological CDR measures, the economic and institutional hurdles in particular are still quite high," says Prof Daniela Thrän, who heads the Department of Bioenergy at the UFZ.

"Because there are [regional differences](#) in the feasibility and potential of these CDR measures, we believe that more practical experience is needed at the regional and local level in order to better understand how

the technologies can be further developed and established as part of local value chains."

In the evaluation matrix, there are also white spots, which indicate that there are currently no data available. "This is particularly the case with the social assessment aspects of the CDR measures. Further research is urgently needed. For example, on how the costs and disadvantages of CDR measures could be distributed fairly across society and how their implementation would benefit society as a whole," says Mengis.

The scientists hope that their feasibility study for possible CDR measures in Germany can help [decision-makers](#) to better understand and categorize the complex information. This is the only way to set the right course for achieving the climate target for 2045.

More information: Malgorzata Borchers et al, A Comprehensive Assessment of Carbon Dioxide Removal Options for Germany, *Earth's Future* (2024). [DOI: 10.1029/2023EF003986](https://doi.org/10.1029/2023EF003986)

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