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Project *brief*

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Forests as elements of bio-based carbon removal strategies

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- **25 fact sheets on the removal potential of forests, farmland, and peatlands, of bioenergy production with CO_2 capture and storage, and of bio-based building materials**
- **Forestry measures need time to develop their full removal potential, but they are long-lasting, cost-effective, and have many positive environmental impacts**

Background and objectives

Carbon dioxide (CO_2) removal using biomass and soils is a central element of German climate policy to achieve the goal of greenhouse gas neutrality by 2045. Bio-based CO_2 removal processes can be implemented in various ways. In a large-scale research consortium, we investigated the regional feasibility of bio-based CO_2 removal methods and set up an information portal for politics, industry, agriculture, and forestry.

Approach

We contribute to the overall project with suitable forestry concepts, focusing primarily on afforestation and timber harvesting restrictions. These are recorded in fact sheets, which describe the emissions balance over time, the effects on yield, and on the value of environmental services.

Results

A comparison of the various bio-based concepts for CO_2 removal in agriculture and forestry, in building materials, and in bioenergy production with CO_2 capture and storage (BECCS) shows that the temporal dynamics of these concepts differ significantly up to 2045. Concepts for CO_2 sequestration from the atmosphere that involve increasing natural sinks are characterized by gradually rising rates, followed by saturation and possibly a decline after a few decades. Forestry measures only become fully effective after a certain lead time, but have a very long-term impact; in contrast, construction projects and bioenergy plants have constant annual removal rates during operation, which then drop to zero. The cost of removing one ton of CO_2 from the atmosphere ranges from €8 to €520 per ton of CO_2, which is due to large differences between the concepts in terms of both investment and operating costs.

This high variability in costs suggests that the more cost-effective concepts should be implemented first. However, when developing implementation strategies, aspects such as economic efficiency, available resource base, and environmental impacts, including social and political implications for Germany, must be taken into account. All of the concepts examined could be implemented on a scale that would make a significant contribution to Germany's climate neutrality goal.

Conclusions

The fact sheets we have developed provide a straightforward source of information. They offer stakeholders from politics, industry, agriculture, and forestry practical guidance on suitable bio-based CO_2 removal options and their respective advantages and disadvantages.

Further information

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Wollnik et al., Factsheets for bio-based carbon dioxide removal options in Germany. Open Agrar 2025 (2.ed.).

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