CARBON REMOVAL

WHAT IS CARBON REMOVAL?

Carbon removal, also known as carbon dioxide removal (CDR), is **the process of capturing carbon dioxide (CO_2) from the atmosphere and locking it away for decades or centuries** in plants, soils, oceans, geological features, or long-lived products like cement. Scientists have proposed many different methods of carbon removal. Some of these are already in use at relatively small scales, whereas others remain in the early stages of research and development. Technologies and practices for implementing carbon removal are often called negative emissions technologies or NETs.

Carbon removal matters because somewhere between 15–40% of the CO_2 that humanity emits will remain in the atmosphere for up to a thousand years, with 10–25% of it persisting for tens of thousands of years. **Removing and sequestering that CO_2 could permanently reduce climate risk by slowing or even reversing climate change.**

It will be very difficult to meet ambitious climate change mitigation goals without large-scale carbon removal. In the 2015 Paris Agreement, the international community committed itself to "holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C." In their Fifth Assessment Report, **the Intergovernmental Panel on Climate Change (IPCC) examined 116 scenarios in which society is likely to meet that 2°C goal and found that 101 of them involve net negative emissions later this century**, meaning that society would be removing more carbon from the atmosphere than it is emitting. This is only feasible through large-scale carbon removal. **The IPCC's *Special Report on Global Warming of 1.5°C* identifies carbon removal as crucial to meeting the 1.5°C target.**

While carbon removal might play an important role in fighting climate change, carbon removal is not a suitable replacement for cutting greenhouse gas emissions or taking steps to adapt to climate change. All known and proposed methods of carbon removal are too slow-acting to offset society's current CO_2 emissions, and almost all of them are too expensive to be cost-effective. Some methods are saturable, meaning that they face limits to the total amount of carbon they can sequester over time, and some are reversible, meaning that the carbon they sequester could be re-emitted under certain conditions. Furthermore, more research is still needed to determine whether any of these methods can be implemented safely and effectively at the necessary scale.

PROPOSED METHODS OF CARBON REMOVAL

Some proposed methods of carbon removal include: planting vast new forests; growing or collecting biomass to produce bioenergy and then capturing and storing the resulting carbon emissions; restoring degraded coastal wetlands; building machines to capture CO_2 directly from ambient air and store it underground; spreading powdered rock that would absorb CO_2 from the air; various methods of storing carbon in the oceans; and managing agricultural lands to increase their soil carbon content.

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CO-BENEFITS AND CONCERNS

- **Moral hazard**: people might use the prospect of carbon removal as an excuse to avoid cutting CO_2 emissions.
- **Cost**: most methods of carbon removal are costly, making it a relatively expensive form of climate action.
- **The precautionary conundrum**: emitting more CO_2 now because the we are counting on carbon removal to succeed amounts to a high-stakes gamble, but so does a failure to investigate carbon removal because we are counting on rapid emissions reductions to meet climate goals.
- **Method-specific co-benefits and concerns**: different methods offer different co-benefits and raise different method-specific concerns.

GOVERNANCE CONSIDERATIONS

- **Research and development**: good governance can support research to learn about each method's potential, cost, and side effects.
- **Avoiding moral hazard**: institutions are needed to prevent the prospect of carbon removal from slowing emissions reductions.
- **Supporting appropriate adoption and upscaling**: good governance and incentives could support adoption and upscaling of carbon removal.
- **Establishing social and environmental safeguards**: good institutions will be needed to balance the potential benefits of carbon removal with its social and environmental risks.
- **Method-specific governance considerations**: each method of carbon removal will raise its own governance considerations.

FURTHER READING

David R. Morrow et al. *Why Talk about Carbon Removal?* 2018. Washington, DC: Institute for Carbon Removal Law and Policy, American University. https://doi.org/10.17606/M6H66H

Royal Society. *Greenhouse Gas Removal*. 2018. London: Royal Society.

National Research Council. *Climate Intervention: Carbon Dioxide Removal and Reliable Sequestration*. 2015. Washington, DC: National Academies Press.

Pete Smith et al., "Biophysical and Economic Limits to Negative CO_2 Emissions," *Nature Climate Change* 6, no. 1 (2016): 42–50, https://doi.org/10.1038/nclimate2870.

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