

CARBON REMOVAL

WHAT IS CARBON REMOVAL?

Carbon removal, also known as carbon dioxide removal (CDR), is **the process of capturing carbon dioxide (CO₂) 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.

WHY IS CARBON REMOVAL IMPORTANT?

Carbon removal matters because roughly 15–40% of the CO₂ 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 storing that CO₂ 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 the studies reviewed by the Intergovernmental Panel on Climate Change for their *Fifth Assessment Report* and their *Special Report on Global Warming of 1.5°C*, **most of the pathways to meeting the Paris Agreement’s targets require the world to supplement rapid emissions reductions with at least some form of large-scale carbon removal.**

CARBON REMOVAL’S ROLE IN CLIMATE POLICY

While carbon removal could play an important role in limiting climate change, it 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, limited in scope, and/or expensive to offset anything like society’s current CO₂ emissions. When paired with ambitious emissions reductions, carbon removal could make it possible to reach **net-zero emissions**, so that humans are removing one ton of CO₂ from the atmosphere for every ton they emit. Eventually, carbon removal could also enable **net-negative emissions**, meaning that humanity would remove more CO₂ from the atmosphere each year than it emits, gradually lowering atmospheric CO₂ concentrations.

PROPOSED METHODS OF CARBON REMOVAL

Some proposed methods of carbon removal include: restoring forests; growing or collecting biomass to produce bioenergy and then capturing the resulting carbon emissions; restoring degraded coastal wetlands; building machines to capture CO₂ directly from ambient air and store it underground or in long-lived products; spreading powdered rock that would absorb CO₂ 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

- **Method-specific co-benefits and concerns:** different methods come with different co-benefits concerns. See [our other fact sheets](#) for details.
- **Moral hazard:** people might use the prospect of carbon removal as an excuse to delay or avoid cutting CO₂ emissions.
- **Cost:** most methods of carbon removal are costly, making them expensive forms of climate action.
- **The precautionary conundrum:** emitting more CO₂ now because 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: either one could lock in warming that could have been avoided.

GOVERNANCE CONSIDERATIONS

- **Research and development:** good governance can support research to learn about each method's potential, cost, and side effects.
- **Avoiding moral hazard:** societies must 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. See our other fact sheets for details.

FURTHER READING

David R. Morrow et al. *Why Talk about Carbon Removal?* 2018. Washington, DC: Institute for Carbon Removal Law and Policy, American University. [doi 10.17606/M6H66H](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 CO₂ Emissions," *Nature Climate Change* 6, no. 1 (2016): 42–50, [doi 10.1038/nclimate2870](https://doi.org/10.1038/nclimate2870).

For more fact sheets on carbon removal, visit <https://carbonremoval.info/factsheets>.