BIOCHAR

WHAT IS BIOCHAR?

Biochar is a kind of charcoal produced by burning biomass (organic material) in a low-oxygen environment. This process, known as pyrolysis, converts the carbon in the biomass to a form that resists decay. When the charcoal is buried or added to soils, most of the carbon can remain in the charcoal or soil for decades to centuries, given the right conditions. The process of growing plants or collecting waste biomass, converting that biomass to biochar, and adding the biochar to soils removes carbon dioxide (CO_2) from the atmosphere: as plants grow, they remove CO_2 from the atmosphere and use it to make more biomass; the carbon in that biomass gets converted to a stable form in biochar; and burying the biochar can keep the carbon out of the atmosphere for long periods of time. This makes producing and burying biochar a form of carbon removal.

CO-BENEFITS AND CONCERNS

+ **Improved soil quality:** biochar can help restore degraded soils, improving agricultural productivity and helping soils retain water.
+ **Energy production:** burning biomass to produce biochar produces energy, which can be used for heat or electricity.
− **Reversibility:** the carbon captured via biochar can be released if the soils are disturbed.
− **Difficulty of measurement:** monitoring and verifying the permanence of carbon removal via biochar could be difficult.

POTENTIAL SCALE AND COSTS

The potential and cost of using biochar at large scale remain somewhat unclear. One recent expert assessment estimates that biochar could **sequester 0.5–2 billion tons of carbon dioxide ($GtCO_2$) per year by 2050** at a cost of **\$30–120 per ton of CO_2.** A second expert assessment estimates a global potential of **1.8–4.8 $GtCO_2$ per year** at costs of **\$18–166 per ton of CO_2,** but about half of that potential would depend on purpose-grown biomass rather than waste biomass. The broader academic literature envisions sequestration rates between 1 and 35 $GtCO_2$ per year with estimates of the cumulative potential ranging from 78–477 $GtCO_2$ this century. Further research is needed to refine global and regional estimates of biochar's cost and potential.

TECHNOLOGICAL READINESS

Biochar is a relatively mature technology. At present, its use for carbon removal is mainly limited by cost and the availability of pyrolysis facilities to produce biochar. Additional research is needed to improve our understanding of biochar's efficacy, permanence, and co-benefits for different kinds of biomass feedstocks and across a range of different conditions.

BIOCHAR

GOVERNANCE CONSIDERATIONS

- □ **Encouraging adoption:** good agricultural extension efforts and incentives would be needed to encourage widespread adoption, especially on small farms.
- □ **Monitoring, verification, and reporting:** processes, standards, and technologies need to be developed to reliably measure carbon sequestration.
- □ **Sustainable biochar production:** policies would be needed to promote and ensure that biomass is sourced and processed sustainably.
- □ For **cross-cutting considerations**, see the What Is Carbon Removal? fact sheet on our website.

FURTHER READING

Fuss, S., et al. 2018. "Negative emissions—Part 2: Costs, Potentials and Side Effects," Environmental Research Letters 13: 063002. doi 10.1088/1748-9326/aabf9f.

Nair, V.D.., et al. 2017. "Biochar in the Agroecosystem–Climate-Change–Sustainability Nexus." *Frontiers in Plant Science* 8. doi 10.3389/fpls.2017.02051.

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

Smith, P. 2016, "Soil carbon sequestration and biochar as negative emission technologies." *Global Change Biology* 22:1315–24. doi 10.1111/gcb.13178.

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

INSTITUTE *for* CARBON REMOVAL LAW AND POLICY

200520