BECCS

WHAT IS BECCS?

Bioenergy with carbon capture and storage (BECCS) is a carbon removal technique that depends on two technologies. Biomass (organic material) is converted into heat, electricity, or liquid or gas fuels (the "bioenergy" step), and the carbon emissions from this bioenergy are captured and stored in geological formations or embedded in long-lasting products (the "carbon capture and storage" step). Because the biomass draws carbon from the atmosphere as it grows, BECCS can be a negative emissions technology. That is, BECCS could serve to reduce the overall concentration of carbon dioxide (CO_2) in the atmosphere. However, care must be taken to ensure that emissions from the growing, harvesting, transporting, and processing of the biomass do not outweigh the captured carbon, and that the storage of captured carbon is reliable over long timescales.

CO-BENEFITS AND CONCERNS

+ **Energy**: BECCS produces energy, potentially including carbon-negative fuels for hard-to-decarbonize sectors.
− **Food security**: devoting land to bioenergy crops could raise food prices.
− **Displacement**: moving communities for land conversion threatens livelihoods, human rights, and social identity.
− **Biodiversity loss**: land conversion for growing biomass can potentially alter habitats and threaten biodiversity.
− **Water resources**: growing biomass would increase demand for water.
− **Increased fertilizer use**: fertilizer for growing biomass could further stress nitrogen-saturated ecosystems.
− **Soil carbon loss**: land conversion for growing biomass could release carbon stored in soils or existing biomass.
− **Air pollution**: combustion of biomass and biofuels creates local air pollution.
− **Concerns about geologic storage**: transporting and injecting CO2 into geological reservoirs raises concerns about pipelines, CO2 leakage, seismic activity, and water pollution.

GOVERNANCE CONSIDERATIONS

☐ **Research, development and demonstration (RD&D)**: support and guidance for RD&D is needed to promote sustainable bio-feedstocks and supply chains and reliable methods of carbon storage or utilization.
☐ **Monitoring, reporting and verification**: processes and standards need to be developed for ensuring the environmental and social sustainability of BECCS supply chains.
☐ **Agricultural policy**: creative agricultural policies and processes can support sustainable biomass production and sourcing on large scales.
☐ **Finance**: mechanisms such as cost-sharing can promote global benefits by helping to manage local costs of BECCS projects.
☐ For **cross-cutting considerations**, see the What Is Carbon Removal? fact sheet on our web site.

BECCS

TECHNOLOGICAL READINESS

Bioenergy and biofuels are already widely used. The other component technology for BECCS, carbon capture and sequestration, is relatively well understood, but, for economic reasons, it has struggled to move beyond demonstration projects for saline sequestration and limited commercial projects that use CO_2 in enhanced oil recovery. Efforts to combine the two technologies remain limited: there are a small number of pilot projects around the world, and the American agribusiness firm Archer Daniels Midland operates a small-scale commercial facility in Decatur, Illinois, with support from the U.S. Department of Energy.

POTENTIAL SCALE AND COSTS

Estimates for the potential scale of BECCS vary widely. A recent expert assessment estimates potential sequestration rates of **0.5–5 billion metric tons of CO_2 per year in 2050** with the **possibility of much higher rates by 2100**. Scenarios compiled by the Intergovernmental Panel on Climate Change (IPCC) in their Fifth Assessment Report project the sequestration of around 12 billion metric tons of CO_2 per year by 2100, though such projections have met with intense skepticism. Cost estimates also vary widely, with a recent expertassessment projecting costs of **US$100–200 per ton of CO_2** sequestered.

FURTHER READING

Sabine Fuss et al., "Negative emissions—Part 2: Costs, Potentials and Side Effects," *Environmental Research Letters* 13, no. 6 (2018): 063002, https://doi.org/10.1088/1748-9326/aabf9f.

Wil Burns and Simon Nicholson, "Bioenergy and Carbon Capture with Storage (BECCS): The Prospects and Challenges of an Emerging Climate Policy Response," *Journal of Environmental Studies and Science* 7, no. 4 (2017): 527–34, https://doi.org/10.1007/s13412-017-0445-6.

Mathilde Fajardy and Niall Mac Dowell, "Can BECCS Deliver Sustainable and Resource Efficient Negative Emissions?" *Energy & Environmental Science* 10, no. 6 (2017): 1389–1426, https://doi.org/10.1039/c7ee00465f.

For more fact sheets on carbon removal,
visit www.american.edu/sis/carbonremoval/factsheets

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