DACCS

WHAT IS DACCS?

Direct Air Capture with Carbon Storage (DACCS) is a technology that uses chemical processes to capture and separate carbon dioxide (CO_2) directly from ambient air. The CO_2 is then separated from the chemicals and captured so that it can be injected into geological reservoirs or used to make long-lasting products. The chemicals are then reused to capture more CO_2.

CO-BENEFITS AND CONCERNS

+ **Co-benefit**: DACCS produces a stream of pure CO_2, which can be used to make long-lasting products in a carbon-to-value supply chain. Other industrial applications of direct-air-capture technology, such as the production of synthetic fuels, amount to carbon recycling rather than carbon removal.
– **Energy demand**: all DACCS processes require significant amounts of energy, which must be low-carbon to maximize the technology's climate impact. Diverting low-carbon energy to DACCS competes with emissions reductions.
– **Concerns about geologic storage**: transporting and injecting CO_2 into geological reservoirs raises concerns about pipelines, CO_2 leakage, seismic activity, and water pollution.

GOVERNANCE CONSIDERATIONS

- ☐ **Monitoring, verification, and reporting of sequestration**: good policies, processes, and standards need to be developed or adapted for monitoring, verifying, and reporting the reliable, long-term sequestration of CO_2.
- ☐ **Promotion of appropriate upscaling:** DACCS is unlikely to develop at scale without policy support in the form of subsidies or carbon pricing and advances in policy support for geological storage of CO_2.
- ☐ **Identification and support for appropriate niche markets**: niche markets for captured carbon, such as long-lived products and synthetic fuels, could play a role in the development of DACCS technologies, but reliance on some of these uses, especially enhanced oil recovery, threaten to undermine DACCS' environmental benefit in direct and indirect ways.
- ☐ For **cross-cutting considerations**, see the What Is Carbon Removal? fact sheet on our web site.

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TECHNOLOGICAL READINESS

There are two commercial direct-air-capture facilities in operation, but neither is currently sequestering the captured carbon: one plant in Switzerland, operated by Climeworks, pumps the CO_2 into a greenhouse to fertilize plants, while another in Canada, operated by Carbon Engineering, currently uses the CO_2 to produce synthetic fuel. The other main component of DACCS, carbon capture and sequestration (CCS), is relatively well understood, but, for economic reasons, it has struggled to move beyond demonstration projects and use in enhanced oil recovery.

POTENTIAL SCALE AND COSTS

The potential scale of carbon removal via DACCS could be very large because it requires relatively little land compared to other proposed forms of carbon removal and because it could be sited near appropriate geological reservoirs, avoiding the need for extensive pipelines. However, the potentially high costs and the need for large amounts of low-carbon energy impose practical constraints on upscaling DACCS. Cost estimates vary widely, with two recent expert assessments projecting long-run **costs of US$100–300 and US$400–1,000 per ton of CO_2**, respectively. A recent expert assessment estimates potential sequestration rates of **0.5–5 billion metric tons of CO_2 per year in 2050**, with a theoretical **longer-term potential in the tens of billions of tons per year**.

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.

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

David W. Keith et al., "A Process for Capturing CO2 from the Atmosphere," *Joule* 2, no. 8 (2018): 1573–94, https://doi.org/10.1016/j.joule.2018.05.006.

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