



What is Direct Air Capture?

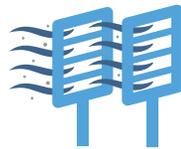
There is a growing global appetite for clean technologies and products with reduced emissions, which present market opportunities where American businesses can get ahead. The IRS final guidance for the updated 45Q tax credit will accelerate [investment](#) in and deployment of carbon capture and utilization projects. As Congress examines additional legislative efforts to complement the tax credit, this explainer aims to describe carbon dioxide removal and direct air capture and their importance to the American energy portfolio.

Carbon dioxide removal refers to efforts to remove carbon dioxide, or CO₂, from the atmosphere and store it long-term. There are two approaches:



Land-Based – CO₂ storage in plants and soils

- Afforestation
- Reforestation
- Soil Carbon Sequestration
- Accelerated Weathering



Technological – Uses technology to separate CO₂ from air for storage in rocks or materials

- Direct Air Capture and Storage
- CO₂ Mineralization
- Bioenergy with Carbon Capture and Storage

Direct air capture and storage is an emerging carbon dioxide removal strategy that uses advanced technology to capture and store or utilize carbon dioxide directly from the ambient air. Direct air capture is distinct from carbon capture and utilization, which uses similar processes to capture CO₂ from point sources, such as power plants, that contain higher concentrations of CO₂ than the air.

Direct air capture technology works. Commercial projects are already drawing CO₂ from the air today for sale and use. Examples of current direct air capture technology include three companies operating facilities and successfully ramping up operations:



Global Thermostat

- A U.S. company with pilot plants in California and Alabama with plans to build two commercial plants in Sapulpa, Oklahoma and a technology test center near Denver, Colorado.
- Uses waste heat to capture CO₂ and sells pure CO₂ for use in building materials, fuels, etc.
- 35 patents awarded to date



Carbon Engineering

- Operating a pilot plant in British Columbia. It was recently announced that Shopify, a Canadian e-commerce company, would pay Carbon Engineering to store the CO₂ captured from this plant.
- In 2020, Carbon Engineering announced that it would license its DAC technology to 1PointFive (a joint venture between Oxy Low Carbon Ventures and Rusheen Capital Management) so it could build a DAC plant in the Permian Basin in West Texas capable of capturing one million tons of CO₂ per year.
- The Permian Basin plant will be used for DAC-EOR and geologic storage.



Climeworks

- Fourteen commercial and demonstration plants across Europe, with contracts for CO₂ supply and removal services
- At the Iceland plant, the CO₂ is stored through mineralization (i.e., stored as rock underground)
- Working on an “air-to-fuels” approach to sell captured CO₂ as renewable diesel and jet fuel

A CO₂ market exists and direct air capture can help fill the need. The market for CO₂ is growing and will incentivize investment in and improvement of carbon extraction and utilization technology, including direct air capture. The global market for CO₂ is projected to reach [\\$9.3 billion](#) in 2025. Direct air capture technology will help meet these needs. The ability to sell or convert CO₂ into useful products also provides a commercialization pathway for direct air capture.

Below are examples of commercial entities that are using captured CO₂ today:



Concrete and Cement: CO₂ is injected in concrete to produce stronger and lower cost building materials

- Solidia Technologies – New Jersey
- Blue Planet – California
- CarbonCure – Canada
- Calera – California



Raw Materials: CO₂ is used to produce precursors for plastics, chemicals, feedstocks, and more

- Novomer – Massachusetts
- New Sky Energy – Colorado
- Carbonfree Chemicals – Texas
- Covestro – Germany



Synthetic Fuels: CO₂ is processed to produce gasoline and biofuels

- Opus 12 – California
- Carbon Recycling International – Iceland
- Greyrock Energy – California
- Dioxide Materials – Florida



Oil Production: CO₂ is used to improve yield from mature fields through enhanced oil recovery

- Denbury Resources Inc. – Texas & North Dakota
- Occidental Petroleum – New Mexico & Texas

More federal research funding is needed to unleash innovations in direct air capture technology.

- Private sector investment in direct air capture research in the United States has primarily been through angel investments by high-net worth individuals and limited federal funding from the Department of Energy's Office of Fossil Energy.
- The private sector tends to underinvest in breakthrough energy research because energy technologies are often capital-intensive and take years to develop before they can be deployed broadly.
- Decades of federal energy research has filled a crucial investment [gap](#) and helped improve technology cost and performance for many of today's energy technologies, including advanced combustion engines, lithium-ion batteries, and solar panels, that have generated billions in economic returns and energy savings for consumers. Federal support will be just as crucial for direct air capture and storage.

BOTTOM LINE:

More federal research investment is needed in direct air capture and storage technology, which can operate at large scale, spur further advances in materials science and manufacturing, and facilitate business growth as market opportunities for CO₂ expand.

