



Case Studies: Real-world Companies that are Pioneering Direct Air Capture Technology and Market Applications of Carbon Dioxide

Direct Air Capture Technology Examples

Direct air capture ventures are demonstrating early success. The companies below are using direct air capture to remove carbon dioxide (CO₂) from the air today and are beginning to achieve efficiency gains and cost reductions thanks to research investment from government and private investors. More research is needed to drive even greater efficiency, CO₂ capture capability, and cost improvements.

Carbon Engineering - Canada

- Founded in 2009, Carbon Engineering has been removing CO₂ from the atmosphere at its pilot plant in Canada since 2015.
- Converts captured CO₂ into a useable transportation fuel. It combines CO₂ with hydrogen from water to produce clean gasoline, diesel, and jet fuel.

Achievements:

- Uses captured CO₂ to produce **1 barrel of synthetic fuel per day**.
- Captures up to **1 million metric tons of CO₂ per year** per facility—equal to the annual emissions from nearly [215,000](#) passenger vehicles.
- Awarded **5 patents**, with 5 more pending.
- In 2018 achieved estimated CO₂ capture **costs between \$94 and \$232** per metric ton of CO₂, the lowest cost projection for direct air capture to date.
 - With CO₂ capture costs at \$94 per metric ton, Carbon Engineering can produce transport fuels only slightly more expensive than today's fuels, providing a potential future competitive fuel alternative and reducing reliance on foreign oil.
- In 2019, the company, along with Occidental Petroleum, announced plans to build the world's largest direct air capture and sequestration facility in the Permian Basin in West Texas.

Climeworks - Switzerland, Iceland, Italy

- In 2017, Climeworks debuted the world's first **commercial** direct air capture machine in Switzerland, which sells CO₂ for use in food and beverages, greenhouses, and renewable fuels.
- Operates 2 other demonstration plants—one in Iceland where CO₂ is stored as rock underground, and one in Italy that converts CO₂ to methane to make clean-burning fuels.

Achievements:

- Has a commercial **partnership with car maker Audi**, which uses CO₂ to make low-carbon diesel.
- Can remove **2,500 metric tons of CO₂ per year**—[equal](#) to the annual energy use of 270 homes.

Global Thermostat - United States

- Founded in 2010, New York-based Global Thermostat uses low-cost residual heat to capture CO₂ from the air at its pilot plant in California and sells captured CO₂ for use in greenhouses, food and beverages, desalination, biofertilizers, and chemicals.

Achievements:

- Can capture up to **2 million metric tons of CO₂ per year per plant**. Technology is modular, scalable, and can be standalone or co-located with new or existing industrial facilities.
- Engaged in **commercial partnerships for CO₂ supply**, including 3 different biofertilizer producers, a water desalination facility, and industrial gas and plastics manufacturers.
- Building a plant in Huntsville, Alabama, which, once commissioned, will be the **largest** direct air capture plant in the world.
- Awarded **35 patents** worldwide.

Examples of Market Applications of Carbon Pollution

CO₂ is more than a waste product. It's a valuable commodity that is increasingly being recycled and used to make products across industries. Growing demand for CO₂ provides a commercialization pathway for direct air capture ventures, which sell CO₂ to producers and manufacturers. Below are just a few examples of companies using carbon pollution to make commercial products in the United States.



LanzaTech, IL - Biofuels and Jet Fuel

- Headquartered in Chicago, LanzaTech uses bacteria to ferment CO₂ and carbon monoxide from steel mills and gas processing facilities to create ethanol and blends it with gasoline and jet fuel.
- In 2018, the first commercial flight powered by their jet fuel—which produces up to **70 percent fewer emissions** than conventional jet fuel—was launched in partnership with Virgin Atlantic.
 - LanzaTech and partners also received funding and won a bid from the UK government to build the world's first commercial-scale facility to produce clean jet fuel in 2018.
- Opened its first **commercial waste gas to ethanol plant** in 2018, with 4 more to open by 2020.
 - This facility can produce **16 million gallons of ethanol** per year—equivalent to taking 80,000 cars off the road.



CarbonCure Technologies, Canada - Concrete

- Mixes CO₂ captured from industrial smokestacks into liquid concrete during production to create **low-cost, stronger, and cleaner concrete products**.
- The technology can be retrofitted to existing masonry and concrete plants in a single day.
- Over **65 masonry and concrete producers in 17 U.S. states** have incorporated CarbonCure's technology in their operations, and this number is growing.



Newlight Technologies, CA - Bioplastic

- Invented, patented, and commercialized a bioplastic called "AirCarbon" made from CO₂ and methane captured from farms and power plants.
- Runs a commercial site with **multi-million pounds-per-year production capacity**.
- Has **agreements to supply** millions of pounds of AirCarbon—which can compete on cost and performance with oil-based plastics—to Ikea, Dell, the Body Shop, and other clients for use in packaging, containers, bags, caps, and other products.



Solidia Technologies, NJ - Concrete

- Developed a process for using CO₂ instead of water to cure concrete, reducing the carbon footprint of concrete production by **70 percent** and water consumption by **60 to 80 percent**.
- Awarded **37 patents** worldwide.
- Has **agreements with major concrete producers** to use the technology in their manufacturing processes.
- Backed by numerous investors, including LafargeHolcim, Air Liquide, Kleiner Perkins, BASF, BP, Total Energy Ventures, the Oil & Gas Climate Initiative, and others.



Dioxide Materials, FL - Chemicals and Fuel

- Developed a high-efficiency electrolysis system that splits CO₂ into oxygen and carbon monoxide, which can be converted into chemicals and transport fuels.
- Awarded **19 U.S. patents**, and 10 patents from other countries.
- Currently developing a manufacturing process for scale-up with several partners.

BOTTOM LINE:

Direct Air Capture ventures are demonstrating success at removing CO₂ and utilizing it for commercial purposes in a rapidly expanding CO₂ market. Additional research and development will boost CO₂ removal technology, improve cost and efficiencies, and expand commercial capabilities.

