Last updated July 2023

Carbon180

Carbon use

Carbon use, or carbon utilization, refers to the ways that carbon dioxide can be used to create a variety of products and services. Carbon use can help combat the climate crisis in two primary ways: by replacing higher emissions products that are currently in use and by providing a revenue stream for carbon removal projects from the sale of these products.

Carbontech, a subset of carbon use, refers to the wide variety of commercial products (building materials, chemicals, and fuels, for example) that can be made with CO_2 removed from the atmosphere via technologies like direct air capture (DAC). This term excludes enhanced oil recovery (EOR).

Today, technological carbon removal is expensive. While costs are expected to fall in the long term, turning CO_2 into valuable products can help offset those high costs in the near term. Carbontech can also play a key role in decarbonization by helping to reduce or eliminate emissions in hard-to-abate sectors. For example, electrifying aviation will be slow and difficult — but aviation fuels can be made of captured CO_2 today, significantly lowering the aviation sector's emissions.[1] Other uses of CO_2 can play similar roles across the economy.

While building materials and fuels offer the greatest emissions reduction potential, in the US, most "captured carbon" is used for EOR. That said, the majority of the carbon used for EOR is not actually captured carbon, but pulled from naturally occuring underground CO_2 deposits. While about 65 million metric tons of CO_2 is used for EOR in the US per year, only about 17 million of those metric tons are captured carbon.[2,3] EOR will potentially continue to use captured carbon in the future, though likely at much smaller volumes than carbontech.

KEY TERMS

Enhanced oil recovery (EOR)
A form of oil production that involves injecting captured CO_2 into depleted oil wells to aid in recovery and then permanently storing the injected CO_2 in the depleted well.

Read more about EOR.

Carbon use
he breadth of ways removed or captured CO2 can be used to produce economically valuable products or services (includes EOR).

Carbontech
The wide variety of commercial products that can be made with CO_2 (does not include EOR).

Siting, infrastructure, and ecosystem impacts

Carbontech facilities can be sited alongside existing industrial operations like cement plants. Many of these operations already negatively impact the public health of local communities and surrounding ecosystems, and new carbontech facilities could expand or prolong operations. Associated risks, including air pollution and decreased water quality,[4] emphasize the need for strong environmental regulations to accompany any future implementation of carbontech facilities on industrial operations, guaranteeing the prioritization of community health and well-being.

Carbontech may require transportation infrastructure to move carbon from its capture site to the facility where it will be repurposed to create an end product. The siting and building of this infrastructure, including CO_2 pipelines, can have environmental and social implications that require more research and public engagement to be fully understood.

Job creation and economic impacts

The advancement of products made with CO_2 captured from the atmosphere could lead to growth within industries spanning construction materials, fuels, plastics, chemicals, agriculture, and food manufacturing. This can spur local job creation, including for communities with disproportionately high underemployed or unemployed populations.[5]

Carbontech has substantial market potential, with an estimated $1 trillion available market in the United States and almost $6 trillion globally.[6] This immense market potential will require significant financial investment, alongside policy incentives, research and development, and infrastructure buildout, to be realized.

Costs

Products made with captured CO_2 can cost more than those that are not. For example, the estimated break-even cost for low-carbon diesel made with captured CO_2 is $7.68 per gallon,[7] compared to the national average of $4.27 per gallon[8] of regular diesel. However, costs are starting to come down for some products, including building materials. Policy support can help address these higher costs and make carbontech products competitive in the market.

Deployment

Technologies that remove carbon from the atmosphere for use in products are relatively nascent and face financial barriers to wide-scale deployment.[9] Carbontech applications that hold significant promise include construction materials, sustainable aviation fuel, carbon-based chemicals, and others.[10]

There are close to 200 carbon use projects across the world, with more projects located within the US than any other country.[11] In 2018, Virgin Atlantic and LanzaTech flew a 747 jet using sustainable aviation fuel,[12] and Coca-Cola has partnered with Climeworks, a direct air capture company, to produce carbonated beverages from captured carbon.[13] Forty-nine companies within the US are dedicated to repurposing captured carbon to produce a variety of commercial products including carbon-based watches, yoga mats, vodka, and more.[14,15] In June 2020, the Department of Energy (DOE) announced millions of dollars in funding for 11 projects to develop and test carbon use technologies.[16]

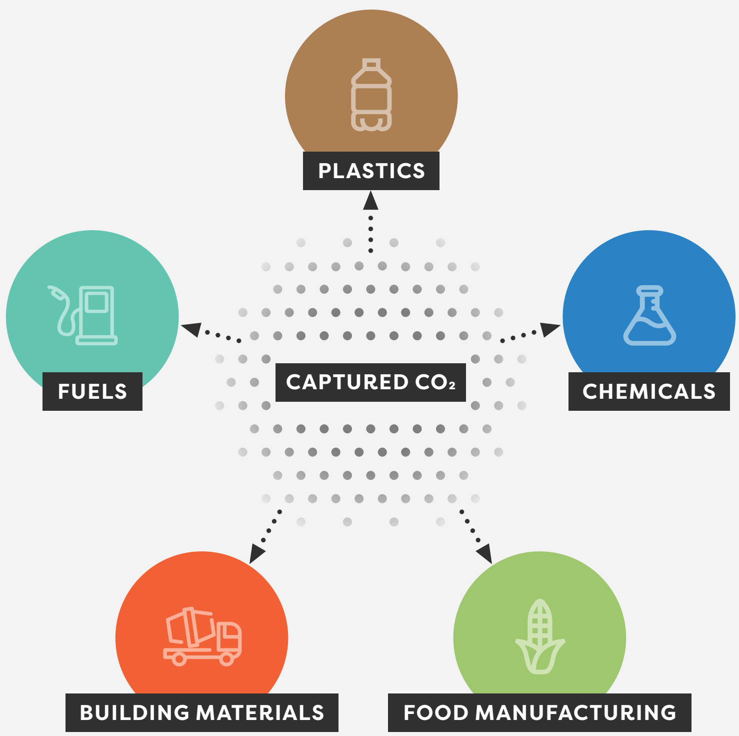
Government engagement

DOE's Carbon Utilization Program houses the majority of federal research and development (R&D) for carbon use. In addition to DOE, there are several agencies that will be vital in scaling carbon use, including the Environmental Protection Agency (EPA), the Department of Transportation, and the National Institute of Standards and Technology (NIST), among others. Federal support for carbon use has increased in recent years, with legislation like H.R. 1166/S. 383, the USE IT Act, and H.R. 3684, the Infrastructure Investment and Jobs Act (IIJA), becoming law. The USE IT Act supports the research, development, and financing of carbon utilization methods and the IIJA authorizes the development of standards and certifications for carbontech products and provides grants to state and local governments and public utilities for procuring and using carbontech products.

One promising way governments could help scale carbontech is through direct procurement of low-carbon products. Some states have already leveraged this purchasing power, most notably California through its Buy Clean initiative and Low Carbon Fuel Standard. With the help of increased federal funding allocated towards R&D, project financing, and market enablers, carbontech can become a cost-effective way to sequester carbon, provide economic opportunities, and address the climate crisis.[17]

Uses for carbon that has been removed from the atmosphere

Conversion processes (e.g., electrochemical and thermochemical) can be applied to convert captured carbon into useful products. Examples of these products include aggregates, fertilizers, and dry ice. Some products provide short-term CO_2 storage (fuels and food manufacturing) whereas others promote long-term CO_2 storage (building materials and plastics).



Endnotes

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2 Carbon dioxide enhanced oil recovery: A critical domestic energy, economic, and environmental opportunity, Center for Climate and Energy Solutions

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8 Gas Prices, AAA

9 Fact Sheet: Carbon Capture and Use, American University

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12 Richard Branson's Virgin Atlantic set to fly a 747 jet with fuel made from factory pollution, CNBC

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14 Picture It: Carbon Management across America, Third Way

15 Air Miners

16 DOE Invests $17 Million to Advance Carbon Utilization Projects, Department of Energy

17 Carbon utilization—A vital and effective pathway for decarbonization, Center for Climate and Energy Solutions

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