

Where Can We Store Carbon Dioxide?

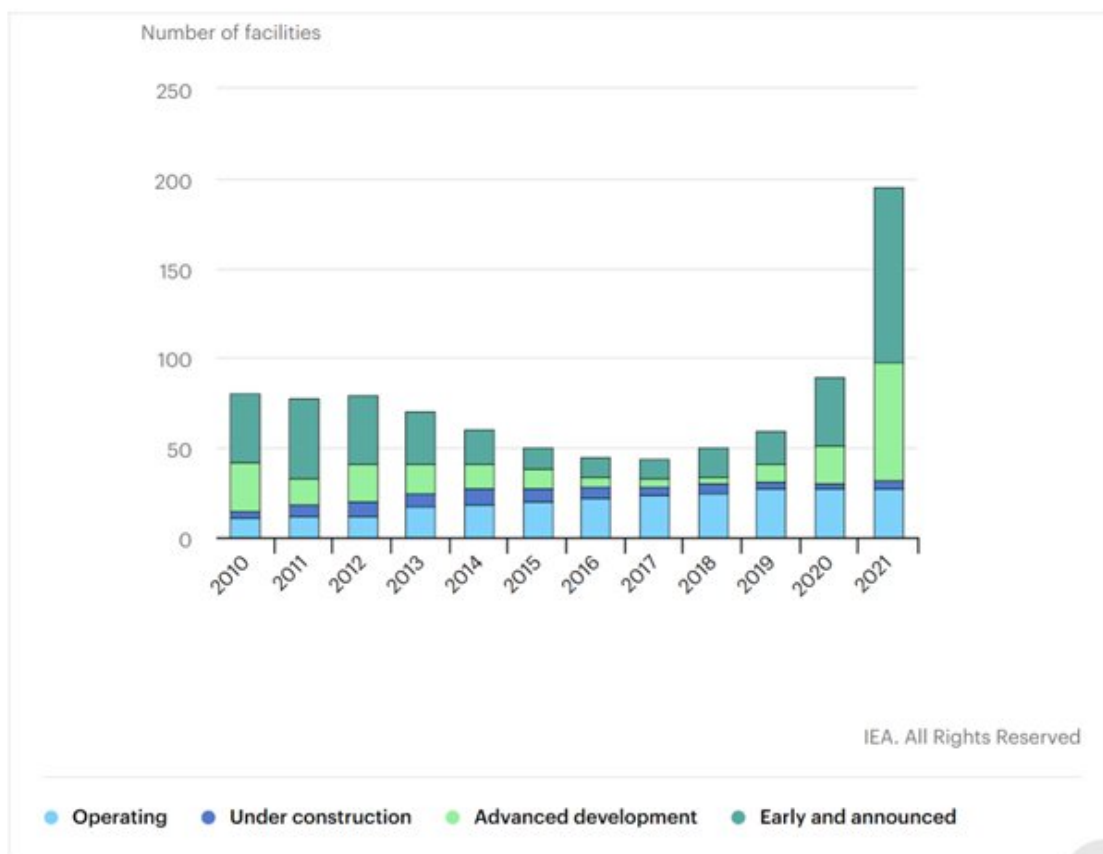
Published 25 May 2022

Christopher Gannatti, CFA

Global Head of Research

The concept of physically removing carbon dioxide (CO₂) directly from the air has gained momentum in the midst of significant, sustained global focus on climate change. We see in Figure 1 that projects focused on carbon capture, utilisation and storage that are either in 'advanced development' or 'early and announced' phases jumped dramatically in 2021. Notably, the number of 'Operating' facilities has been fairly stable in recent years.

Figure 1: Global Pipeline of Commercial Carbon Capture, Utilisation and Storage Facilities Operating and in Development, 2010 to 2021



Source: International Energy Agency (IEA), *Global pipeline of commercial, Carbon capture, utilisation and storage (CCUS) facilities operating and in development, 2010-2021*, IEA, Paris <https://www.iea.org/data-and-statistics/charts/global-pipeline-of-commercial-ccus-facilities-operating-and-in-development-2010-2021>

Historical performance is not an indication of future performance and any investments may go down in value

Eighteen plants are currently operational globally and are located in Canada, Europe and the United States. Two technology approaches are currently used to remove the CO₂ from the air¹:

1. Solid 'Direct-Air-Capture' technology makes use of solid filters that chemically bind with CO₂. When the filters are heated, they release concentrated CO₂ that can then be used.
2. Liquid 'Direct-Air-Capture' technology pass air through chemical solutions which removes the CO₂ while returning the rest of the air to the environment.

The cost of removing CO₂ from the air depends on many factors, and the current research recognises that there are not large numbers of plants operating at massive scale. As more facilities are built and capacities for removal are increased, the true cost of removing carbon from the air will become more and more accurate.

But, the question then becomes, once the CO₂ is removed from the air—what do you do with it?

A company, Climeworks, is running the Orca device, the world's largest commercial direct air capture device. The machine is located roughly 20 miles outside of Reykjavik in Iceland.

Fans, powered by geothermal electricity, suck in air. Carbon Dioxide (CO₂) bonds with a sand-like filtering substance. Once heat is applied, the CO₂ is released and mixed with water by an Icelandic company called Carbfix².

Carbfix has discovered that this CO₂ mix will react chemically with basalt and turn to rock in just 2 to 3 years, as opposed to the centuries that the mineralisation process was believed to take. The notable factor here is that this represents a permanent solution³.

The Orca machine can remove 4,000 metric tonnes of CO₂ annually. However, this quantity is only about three seconds of humanity's annual global emissions, which are closer to 40 billion metric tonnes⁴.

Clearly, the question is not whether it is possible to suck CO₂ out of the air, but rather whether it can be done at a scale that would have a meaningful impact on climate change. However, this is actually a classic question⁵:

- Humanity was likely saying something similar in 1980 about the world's first commercial wind farm, which consisted of 20 turbines and an output of 600,000 watts.
- Forty years later in 2020, the world's installed wind capacity was 1.23 million times larger, at 740 gigawatts.

If Orca's removal capacity was increased at the same rate, it would yield CO₂ removal capacity of 5 billion metric tonnes by around 2060.

LanzaTech traps carbon that would be emitted during industrial processes and uses bacteria to convert the waste gas into sustainable chemicals. Companies, like the Chinese steelmaker Shougang Group Co. add LanzaTech's technology to their manufacturing process⁶.

One process being utilised actually creates fuel, with the possibility to generate hundreds of billions of gallons per year. Acetogenic microbes are used in a fermentation process that can be set up to use the CO₂ coming from 1) industrial waste gas 2) agricultural processes 3) solid waste 4) biomass, just to name a few potential sources. The principle is based on the fact that any liquid fuel must contain carbon—the microbes are able to take it from the air (CO₂) and convert it to a chemical format that can be useful as fuel⁷.

In fact, early efforts to develop synthetic aviation fuels using air-captured CO₂ and hydrogen have begun. In the Net Zero Emissions by 2050 Scenario, roughly one-third of aviation fuel demand is met with these synthetic fuels. Currently, the cost is too high—about five times the conventional options. As innovations drive costs down, these processes become more and more interesting⁸.

Conclusion: Carbon Capture, Utilisation and Storage Represents an Important Arrow in the Quiver to Combat Climate Change

2022 represents an interesting time in many technologies. Success and scalability, while not assured, is beginning to look more and more possible. Directly removing CO₂ from the air will not be a panacea—we will still have to make progress on other fronts in the battle against climate change. Still, we believe it will represent an important component of the mix in getting the world to net zero by 2050.

1 Source: "Direct Air Capture: A Key Technology for Net Zero." IEA. April 2022.

2 Source: Wilson, Peter. "Is Carbon Capture Here?" The New York Times. 31 October 2021.

3 Source: Wilson, 2021.

4 Source: Wilson, 2021.

5 Source: Wilson, 2021.

6 Source: Ramkumar, Amrith. "Carbon-Transformation Start-up LanzaTech is Going Public in \$2.2 Billion SPAC Deal." Wall Street Journal. 8 March 2022.

7 Source: https://www.energy.gov/sites/prod/files/2017/07/f35/BETO_2017WTE-Workshop_SeanSimpson-LanzaTech.pdf

8 Source: "Direct Air Capture: A Key Technology for Net Zero." IEA. April 2022.

Related blogs

+ [Waste-to-energy and implications for decarbonisation efforts](#)

+ [Decarbonisation: Using Urgency to Create Action](#)

Related products

+ [WisdomTree Recycling Decarbonisation UCITS ETF - USD Acc \(WRCY\)](#)

Important Risks Related to this Article

Important Information

Marketing communications issued in the European Economic Area (“EEA”): This document has been issued and approved by WisdomTree Ireland Limited, which is authorised and regulated by the Central Bank of Ireland.

Marketing communications issued in jurisdictions outside of the EEA: This document has been issued and approved by WisdomTree UK Limited, which is authorised and regulated by the United Kingdom Financial Conduct Authority.

WisdomTree Ireland Limited and WisdomTree UK Limited are each referred to as “WisdomTree” (as applicable). Our Conflicts of Interest Policy and Inventory are available on request.

For professional clients only. The information contained in this document is for your general information only and is neither an offer for sale nor a solicitation of an offer to buy securities or shares. This document should not be used as the basis for any investment decision. Investments may go up or down in value and you may lose some or all of the amount invested. Past performance is not necessarily a guide to future performance. Any decision to invest should be based on the information contained in the appropriate prospectus and after seeking independent investment, tax and legal advice.

The application of regulations and tax laws can often lead to a number of different interpretations. Any views or opinions expressed in this communication represent the views of WisdomTree and should not be construed as regulatory, tax or legal advice. WisdomTree makes no warranty or representation as to the accuracy of any of the views or opinions expressed in this communication. Any decision to invest should be based on the information contained in the appropriate prospectus and after seeking independent investment, tax and legal advice.

This document is not, and under no circumstances is to be construed as, an advertisement or any other step in furtherance of a public offering of shares or securities in the United States or any province or territory thereof. Neither this document nor any copy hereof should be taken, transmitted or distributed (directly or indirectly) into the United States.

Although WisdomTree endeavours to ensure the accuracy of the content in this document, WisdomTree does not warrant or guarantee its accuracy or correctness. Where WisdomTree has expressed its own opinions related to product or market activity, these views may change. Neither WisdomTree, nor any affiliate, nor any of their respective officers, directors, partners, or employees accepts any liability whatsoever for any direct or consequential loss arising from any use of this document or its contents.