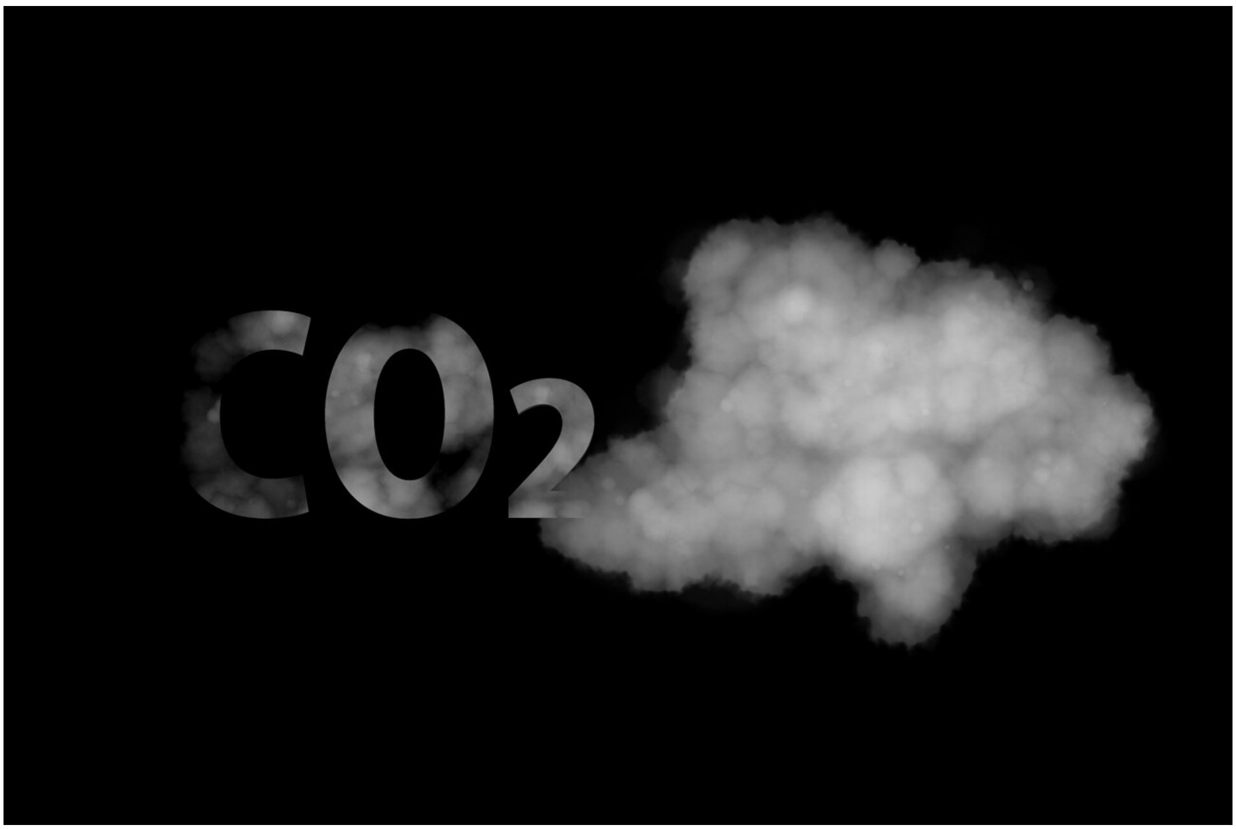
Climate: Carbon capture tech is booming, and confusing

March 15 2024



Credit: Pixabay/CC0 Public Domain

Humanity's failure to reduce planet-heating carbon pollution—at record levels in 2023—has thrust once-marginal options for capping or reducing CO_2 in the atmosphere to center stage.

Carbon capture and storage (CCS) and direct air capture (DAC) are both complex industrial processes that isolate CO_2, but these newly-booming technologies are fundamentally different and often conflated.

Thursday, a group of major energy companies including Britain's BP and France's TotalEnergies said they have awarded £4 billion ($5.1 billion) worth of contracts for a gas power plant in Britain to be equipped with CCS.

Here's a primer on what they are and how they differ.

What it is

CCS siphons off CO_2 from the exhaust, or flue gas, of fossil fuel-fired power plants as well as heavy industry.

CO_2 makes up about 12 percent of these emissions from a coal-fired power plant, while in steel and cement production it is typically double that.

CCS by itself only prevents additional carbon dioxide from entering the atmosphere.

On the other hand, DAC extracts CO_2 molecules already there, making it a "negative emissions" technology.

DAC can therefore generate credits for companies seeking to offset their greenhouse gas output—but only if the captured CO_2 is permanently stored, such as in depleted oil and gas reservoirs or in saline aquifers.

The concentration of carbon dioxide in ambient air is only 420 parts per million (about 0.04 percent), so corralling CO_2 with DAC is very energy intensive.

Once isolated using either CCS or DAC, CO_2 can be used to make products such as building materials or "green" aviation fuel. But some of that CO_2 will inevitably seep back into the air.

"If the CO_2 is utilized, then it is not removal," said Oliver Geden, a senior fellow at the German Institute for International Security Affairs.

State of play

The fossil fuel industry has been using CCS since the 1970s, but not to prevent CO_2 from leaching into the atmosphere.

Rather, oil and gas companies inject CO_2 into mature oil fields to extract crude that would otherwise remain inaccessible.

So far, bolting CCS facilities onto existing coal- and gas-fired power plants and then storing the captured CO_2 underground has proven technically feasible but uneconomical.

The world's largest CCS plant, the Petra Nova facility in Texas, was mothballed three years after opening in 2017.

But the looming climate crisis and generous government subsidies have revived interest in CCS for the power sector and beyond.

In the fall of 2023, there were some 40 commercial-scale facilities worldwide applying carbon capture technology to industry, fuel transformation or power generation, isolating a total of 45 million tonnes (Mt) of CO_2, according to the International Energy Agency (IEA).

If all projects in the pipeline were realized, CO_2 capture capacity would expand eight-fold by 2030, but so far only five percent of announced projects have reached the final investment decision stage.

DAC, by comparison, is brand new.

Less than 30 DAC plants have been commissioned worldwide, and those in operation only capture about as much CO_2 in a year—10,000 tonnes—as the world emits in about 10 seconds.

Scaling up

Both CCS and DAC must be massively scaled up if they are to play a significant role in decarbonizing the global economy.

To keep the mid-century net-zero target in play, CCS will need to divert 1.3 billion tonnes a year from power and industry—30 times more than last year—by 2030, according to the IEA.

DAC must remove 60 Mt CO_2 per year by that date, several thousand-fold more than today.

But the nascent industry is burgeoning with new actors. The first million-tonne-per-year plant—developed by Occidental Petroleum in Texas—is scheduled to come online in the United States next year.

Plans for at least 130 DAC facilities are now at various stages of development, according to the IEA.

"It's a huge challenge but it's not unprecedented," University of Wisconsin-Madison professor Gregory Nemet told AFP, citing other technologies, including solar panels, that have scaled up dramatically in a matter of decades.

Preparing a site to stock CO_2 can take up to 10 years, so storage could become a serious bottleneck for both CCS and DAC development.

Follow the money

Carbon capture costs $15 to $20 per tonne for industrial processes with highly concentrated streams of CO_2, and $40 to $120 per tonne for more diluted gas streams, such as in power generation.

DAC—still in its infancy—has much higher costs, ranging today from $600 to $1,000 per tonne of CO_2 captured.

Those costs are projected to drop sharply to $100-$300 per tonne by 2050, according to the inaugural State of Carbon Dioxide Removal report, published earlier this year.

As countries and companies feel the pinch from decarbonization timetables and net-zero commitments, more money—public and private—is flowing toward both CCS and DAC.

In the United States, the Inflation Reduction Act (IRA) earmarks billions of dollars in tax credits for CCS.

The earlier Infrastructure Investment and Jobs Act provides about $12 billion over five years.

Canada has extended an investment tax credit that cuts the cost of CCS projects in half.

South Korea and China are also investing heavily in the sector, with China opening a 500,000-tonne plant last month in Jiangsu Province.

In Europe, support comes at the national level and is oriented toward industry and storage, especially in the North Sea.

For DAC, a range of companies—including Alphabet, Shopify, Meta, Stripe, Microsoft and H&M Group—have collectively pledged to buy at least $1 billion of "permanent carbon removal" by 2030.

Earlier this month DAC pioneer Climeworks, based in Switzerland, announced a deal to sell carbon removal credits to two airline companies, SWISS and Lufthansa.

Citation: Climate: Carbon capture tech is booming, and confusing (2024, March 15) retrieved 28 April 2024 from https://phys.org/news/2024-03-climate-carbon-capture-tech-booming.html