EVERYTHING YOU WANTED TO KNOW ABOUT CARBON CAPTURE*

***but were afraid to ask**

ENERGY FUTURES INITIATIVE

Carbon Capture. What on earth is it?

Let's start with why we want to capture carbon dioxide: CO_2 is the gas most responsible for global warming. The level of CO_2 measured in our atmosphere is at the highest level in recorded history and can stay there for millennia. Carbon capture technologies exist but can be expensive to deploy. The challenge is finding what works and doing it cheaply.

CCS, CCUS, CDR ... What is this? Alphabet soup?

Some of these technologies are new, complicated, and developed by nerds, so there isn't a widely adopted acronym, but the ones to know are Carbon Capture and Sequestration (CCS), Carbon Capture, Utilization, and Sequestration (CCUS), and Carbon Dioxide Removal (CDR). Most scientists say that without these, there's no way we'll limit global warming to the 1.5-to-2-degree Celsius target set in the 2015 Paris Agreement – and emissions are still going in the wrong direction. Carbon capture is by no means a silver bullet solution to the climate crisis, but it's an important tool for reversing this harmful trend.

So, how do we capture carbon?

Point-Source Capture. CO_2 can be captured from power plants or industrial facilities through various techniques that prevent the gas from entering the atmosphere. The captured CO_2 can be "utilized" or "sequestered," as described below.

Direct Air Capture (DAC). CO_2 can be captured directly from the atmosphere by moving air through a machine that contains chemical filters that selectively bind to CO_2 and stop it from reentering the atmosphere. The captured CO_2 can be utilized or sequestered.

Carbon Mineralization. CO_2 can be turned into a solid mass by exposing the gas to certain rocks and minerals that naturally react with the CO_2 to form chemical bonds, which can lead to permanent storage.

Terrestrial Capture. CO_2 can be captured from the air through natural methods such as planting trees, increasing the amount of CO_2 stored in soils, or burning biomass and capturing the CO_2 from a power plant or industrial facility, where it can then be utilized or sequestered.

Marine Capture. CO_2 can be captured from the oceans through a variety of methods, including growing plants in coastal areas or adding certain minerals that chemically bond with CO_2 to form solids. Some opponents resist the notion of adding anything to the ocean.

Carbon Utilization and Recycling. CO_2 can be used directly for things like beverage carbonation or converted into valuable commercial products such as fuels, construction materials, and chemicals. This could promote a circular economy for CO_2.

Geologic Sequestration. CO_2 can be injected underground into onshore or offshore rock formations, where it becomes trapped, leading to permanent storage.

Carbon Engineering's DAC pilot plant in Squamish, Canada.

Where is carbon capture happening?

There are currently 18 point-source capture facilities operating in the world. Ten of these are in the United States and have an estimated combined capture capacity of 26 million tons of CO_2 per year. That's the same as the annual emissions from 3 million U.S. homes. There are also several CDR projects throughout the world, including for DAC and carbon mineralization.

At left, the DAC pilot plant in Squamish, Canada, operated by Carbon Engineering, captures CO_2 from the air and converts it into a liquid fuel.

The Case for Urgency

413 parts per million of CO_2 are in the air today – the highest ever recorded

1.5 million climate-related deaths per year, worldwide

435,000 species at risk of climate-related extinction at 2°C

99% of all coral reefs will be lost at 2°C warming

140 million climate refugees by 2050, according to World Bank projections

$1 trillion in climate-related costs for Fortune 500 companies

To keep warming below 1.5°C, Gen Z must limit their CO_2 emissions to 13% of what their grandparents emitted over the course of their lifetimes.

Sources

Global CCS Institute Facilities Database; Environmental Protection Agency; National Oceanic and Atmospheric Administration; Chatham House; Intergovernmental Panel on Climate Change/World Meteorological Organization; World Bank; CDP Worldwide; Carbon Brief; Climate Impact Lab.