



CARBON MANAGEMENT

Carbon Management offers solutions to leverage existing infrastructure and processes while preventing emissions by making use of carbon that would otherwise be emitted to the atmosphere.



CARBON MANAGEMENT METHODS: CAPTURING CARBON

Direct Air Capture (DAC)

- CO₂ is captured from air as a gas and can be either used on-site, stored, or transported
- Can combine captured carbon with renewable hydrogen to produce renewable natural gas (CH₄)¹
- Equipment requires water, electricity, and a source of heat
- Can offset carbon emissions, but it's currently more expensive than extracting it from concentrated sources of CO₂²

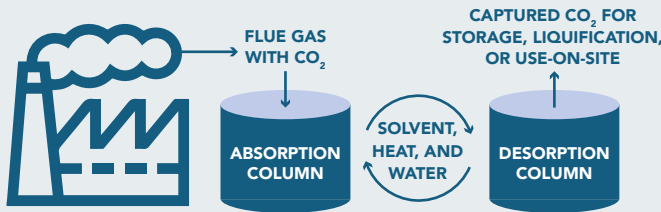


Figure 2: Representation of Chemical absorption using flue gas (Source: ICF)

Chemical Absorption

- Chemical solvent used to bind directly with CO₂
- Can be used as part of direct air capture, but it is typically applied post combustion
- As fuels are combusted, they create flue gas, containing high concentration of CO₂. This is known as "point source" capture
- Up to 90% of emissions can be eliminated from its emission source³

Direct Separation

- High efficiencies and low operating costs. Separates CO₂ from flue gas emissions using waste heat from processes such as cement manufacturing
- Requires no chemical solvents and gas is never mixed with other combustion gases
- Cement industry is responsible for 7% of total carbon emissions.⁴ Direct separation has potential to reduce CO₂ emissions by up to 60%⁵



CARBON MANAGEMENT METHODS: UTILIZING CAPTURED CO₂

Mineralization

- Convert CO₂ into solid minerals through exposure to certain types of rocks
- The only utilization method that completely eliminates carbon emissions
- Commonly used in the production of pearlsh
- Permanently sequesters CO₂, reduces material, and increases concrete strength by 10%⁶

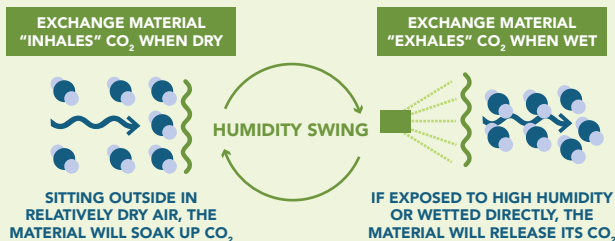


Figure 5: Direct air capture to utilize carbon in greenhouses. Source: Carbon Capture and Utilization Training Manual, ESC Feb 28, 2023

Greenhouse Gassing

- Use captured CO₂ for greenhouses
- Adds air from the atmosphere with a fan (DAC) or spreading the captured CO₂ via pipeline
- Direct pipelines yield higher CO₂ concentrations but are often more energy intensive
- Far less energy and zero combustion compared to other greenhouse gassing practices

Production of Fuels

- Hydrogen produced with renewable energy can be combined with captured carbon to derive a synthetic methane which is considered carbon neutral
- Pyrolysis is a thermal process that separates natural gas into hydrogen and a useful byproduct known as carbon black

1. How does direct air capture work? | World Economic Forum (weforum.org)
 2. Direct Air Capture - Energy System - IEA
 3. The Chemistry of Carbon Capture – Hadron (imsa.edu)

4. Concrete: the world's 3rd largest CO₂ emitter (phys.org)
 5. Simulation of direct separation technology for carbon capture and storage in the cement industry - ScienceDirect
 6. These Companies are Turning CO₂ into Concrete.. Could it be the Solution to Construction's Emissions Problem? | This Is Construction