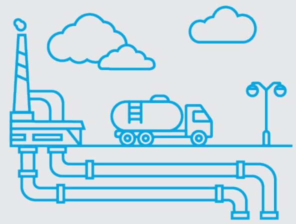
# Carbon Management 101

**Carbon capture, removal, transport, reuse, and storage technologies, commonly referred to as carbon management, are a portfolio of safe, effective, and increasingly cost-effective technologies used to manage, abate, and remove carbon emissions from industrial facilities, power plants, and directly from the air.**

Carbon management projects generally include the following steps depending on the project type.

### Carbon Capture and Direct Air Capture

Carbon capture separates carbon from industrial or power plant emissions while direct air capture removes existing carbon from the atmosphere. Carbon capture equipment can be added on to existing facilities or built into new ones.

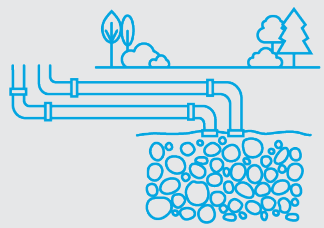


### Carbon Transportation

Captured carbon is compressed and transported to geologic formations for permanent storage or to where it can be converted for beneficial use. Over 5,000 miles of carbon pipelines operate in the US and trucks also transport carbon short distances.

### Carbon Reuse

Carbon reuse occurs when carbon is used as a building block to produce lower carbon intensive fuels, chemicals, materials or products such as concrete.



### Storage of Captured Carbon

Safe, permanent storage of captured carbon occurs in deep geologic formations, principally saline formations and depleted oil and gas fields. Permanent geologic storage also occurs through injection of captured carbon for enhanced oil recovery.

## Why is carbon management important?

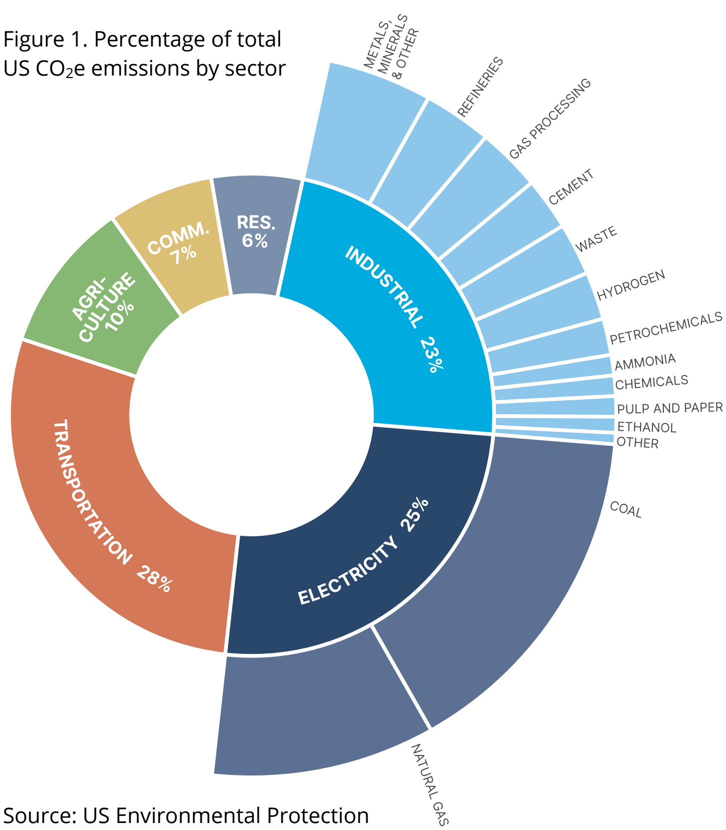
Emissions have continued to increase, despite increasing climate ambition, demonstrating that a profound transformation is needed in the way we consume energy and manufacture products. Authoritative analyses by the International Energy Agency and Intergovernmental Panel on Climate Change (IPCC) show the critical role carbon management must play in achieving US and global carbon reduction targets by midcentury.

Carbon management is particularly critical for the industrial sector. Some industries, such as steel and cement, have significant carbon emissions resulting from the chemistry of the production process itself, regardless of energy inputs. Figure 1 illustrates that emissions from the US industrial sector are as significant as the electric or transportation sectors.

**Carbon removal technologies, such as direct air capture, can help account for these sectors, while removing legacy emissions from the atmosphere.**

Deploying carbon management technologies will take a dedicated effort across stakeholders to build out the necessary infrastructure needed to create a market for carbon.

Figure 1. Percentage of total US $CO_2e$ emissions by sector




Source: US Environmental Protection Agency (EPA), 2021

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## Carbon management is proven and safe

The US has over 50 years of commercial experience safely capturing, transporting, reusing, and storing carbon dioxide ($CO_2$) at large-scale, with no loss of life or significant environmental incident since projects began in the 1970s. In the US, there are 14 commercial-scale facilities with the capacity to capture and store approximately 21.4 million metric tons of $CO_2$ per year, representing nearly half of the global deployment of the technology to-date.

**Monitoring, reporting, and verification is central to deploying climate-scale carbon storage.**

$CO_2$, which is nonflammable and nontoxic, can be stored securely in suitable geologic formations by physical and chemical trapping mechanisms. Storage sites are monitored to ensure that the $CO_2$ stays underground and in place, out of the atmosphere and water resources.

The primary federal incentive for capturing and storing $CO_2$, the section 45Q tax credit, is unique in that taxpayers claiming the credit must successfully demonstrate secure geologic storage of captured or reuse $CO_2$ to claim the tax credit. This occurs through robust and transparent monitoring, reporting, and verification, or a lifecycle analysis (LCA), of the reused carbon through processes established by the Treasury and the Internal Revenue Service and overseen by the U.S. Environmental Protection Agency and Department of Energy.

**Carbon reuse occurs when captured $CO_2$ becomes an input to produce a lower carbon material.**

For example, carbon can be used in concrete, plastic or other chemical manufacturing, or even create lower carbon fuels. The market for carbon is rapidly expanding as new innovations find uses for captured carbon.

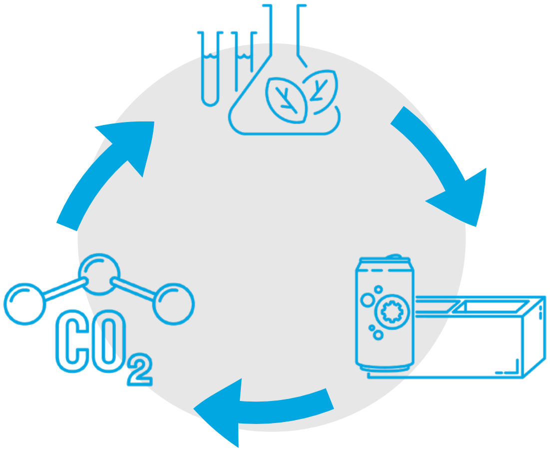
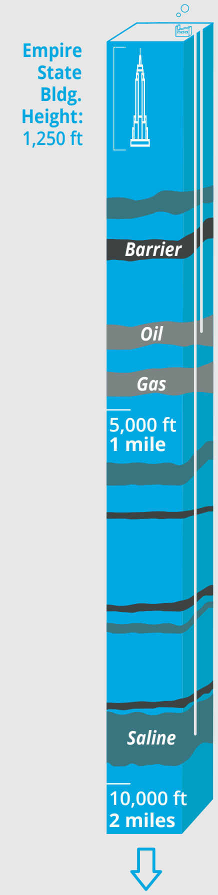



Figure 2. $CO_2$ injection and storage




$CO_2$ can be permanently stored through injection in deep geologic reservoirs, principally saline formations, or enhanced oil recovery. Stored $CO_2$ is secured by layers of impermeable cap rock barriers and other natural trapping mechanisms.

North American $CO_2$ storage potential may be as high as an estimated 22 trillion metric tons, which could store nearly 3,500 years of US $CO_2$ emissions (US Dept. of Energy Carbon Storage Atlas, 2015; US EPA, 2017).

According to the IPCC, well-selected and managed geologic sites are likely to retain over 99% of injected $CO_2$ for over 1,000 years.

Note: $CO_2$ can be stored in a variety of geologic formations at multiple depths. This diagram depicts examples of some typical injection and storage depths.

## Carbon management benefits the economy and environment by:

- Enabling full decarbonization of critical industries, notably cement and steel, which account for an estimated 12% of global emissions
- Meeting midcentury climate goals and keeping average temperatures below a two degree celsius increase globally
- Unlocking cost-effective, low-carbon hydrogen production to kickstart the broader low- and zero-carbon hydrogen economy and value chain
- Providing additional air quality benefits for nearby communities by removing co-pollutants in addition to carbon
- Retaining and creating high wage jobs in the power and industrial sectors while keeping valuable economic assets in productive use