

TECHNICAL ARTICLE

Renewables III: How Oil & Gas Can Reduce Carbon Emissions to Make Way for Renewables

The overall aim of carbon capture and sequestration (CCS) is to store carbon dioxide (CO₂) in geological formations in order to reduce the amount in the environment and lower the risk of catastrophic climate change. The rate of CO₂ emission and the amount of it in the atmosphere has been increasing steadily since the beginning of the Industrial Revolution in the early part of the 19th century. Figure 1 below shows this very clearly.

Since the change to renewable and greener forms of energy will require time, we anticipate that there will be a significant need to prevent CO₂ from getting into the atmosphere. Capturing it and storing it geologically offers an opportunity, especially since the energy industry has been doing this for nearly 40 years, not for carbon reduction but as a means of enhanced oil recovery (EOR).

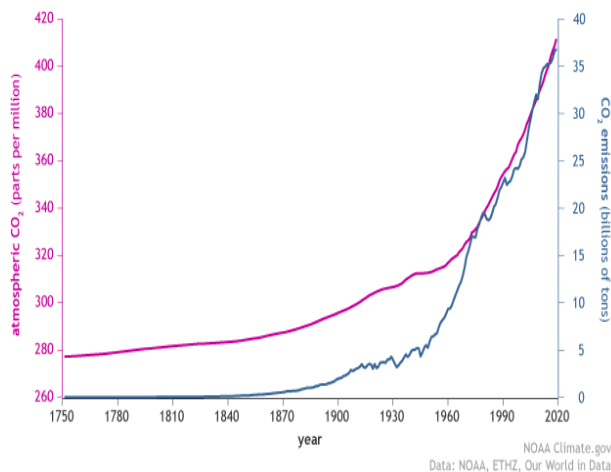


Figure 1: CO₂ in the atmosphere (ppm) and annual emissions (billions of tons) [1]

Carbon Dioxide Capturing for Sequestration

An existing process for CO₂ capture takes flue or waste gas from an industrial process, removes the CO₂ and compresses it into a supercritical fluid which can be injected into a subsurface reservoir as shown in Figure 2.

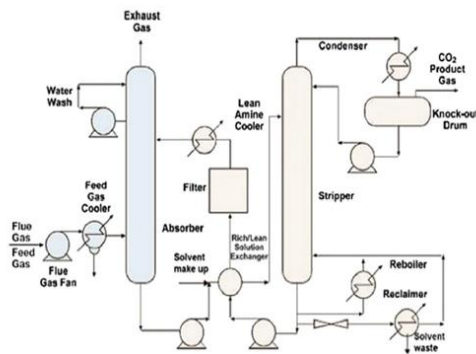


Figure 2: Amine-type post combustion CO₂ capture [3]

Another process is called Direct Air Capture. Direct Air Capture removes CO₂ directly from the atmosphere using CO₂ absorbers to convert it to a solid carbonate. Then heat and dryers send dry CO₂ to a bank of compressors for injection, as shown in Figure 3.

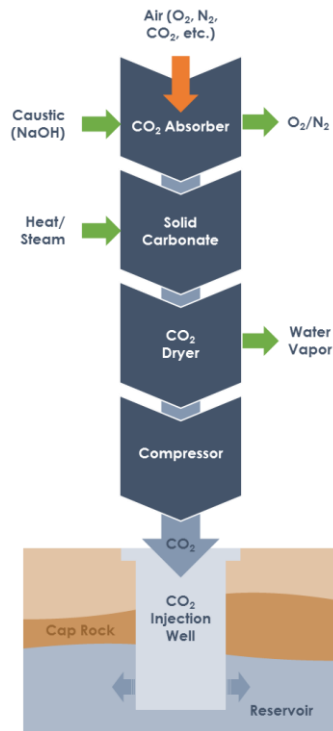


Figure 3: General Process – Direct Air Capture for CCS

Whatever the process, large portions of the system are going to handle lots of CO₂ and water. This poses substantial risks to the materials of construction, especially carbon steel and polymeric materials.

Fortunately, there are several corrosion models for CO₂ on steel that can provide reasonable and conservative predictions of long-term corrosion rates. Experienced materials and corrosion engineers can use these models to predict metal loss rates and effectively manage the risks associated with large-scale CCS.

Design & Operating Decisions

Of the options for CCS capture, post combustion capture is probably the most mature, and the process includes fairly standardized kit. But no matter what process is used, the design team will have many concerns:

- Source and properties of feed gas
- Purpose of project (sequestration alone or sequestration + utilization + EOR...etc.) and scale of the system (single vs multiple sources)
- System automation and reliability goals
- Materials for supercritical CO₂ injection (wet CO₂ is very corrosive), including careful selection of soft goods and seals
- Long-term monitoring requirements of system condition and regular evaluation of remaining life – erosion and corrosion management, including performance indicators and operating windows

This last bullet is probably the most important as the industry has relatively little experience with utility-scale carbon capture. These will need to be very large systems if they are to have any measurable impact on atmospheric CO₂.

Safe and economic long-term operation of these facilities will be crucial to their adoption and successful application to solve the dilemma of climate change and energy demand.

GATE Energy Can Help

With our decades of project design experience and our specific skills in systems and process analysis, GATE Energy's PM&E team is capable of and positioned to assist with critical design decisions. These decisions will be influenced by the need for operational systems that safely and effectively manage these large assets.

GATE Energy's Bluefin team has years of pipeline operation, inspection, and integrity management experience. These combined skill sets make GATE Energy an ideal partner for solving and managing the issues around carbon capture and sequestration.

1. **"Climate Change: Atmospheric Carbon Dioxide"**, Rebecca Lindsey, www.climate.gov, 8/14/2020.
2. **"Businesses Aim to Pull Greenhouse Gases From the Air. It's a Gamble"**, Brad Plumer and Christopher Flavelle, New York Times, 01/18/2021
3. **"Outlook of Carbon Capture Technology and Challenges"**, Tabbi Wilberforce, A. Baroutaji, Bassel Soudan, Abdul Hai Al-Alami, Abdul Ghani Olabi, *Science of the Total Environment*, (657) 3/20/2019