

## CARBON CAPTURE AND STORAGE

Nicolae RUSU

Department of Foreign Languages, group EE-231, Faculty of Energy and Electrical Engineering,  
Technical University of Moldova, Chişinău, Republic of Moldova

Corresponding author: Rusu Nicolae, [nicolae.rusu@en.utm.md](mailto:nicolae.rusu@en.utm.md)

Coordinator: **Ala JECHIU**, univ. as., Department of Foreign Languages, TUM

**Abstract.** Carbon capture and storage (CCS) is a rapid growing technology, a way of reducing carbon emissions, and could be the key to battle global warming. Being developed and improved upon over the years, it has proved that it is an effective way to keep carbon dioxide (CO<sub>2</sub>) away from the atmosphere, unlike other methods of creating “clean energy” like solar and wind that simply reduce our dependency on fossil fuels. CCS is based on the fact that it does not let CO<sub>2</sub> reach the atmosphere but instead it is used as a siphon to store it underground under layers of hard rock. With a track record of capturing a significant portion of CO<sub>2</sub> emissions, CCS offers a promising path forward, overall having a promising future and a lot of investors to be a part of this system as research continues to strive. CCS is playing a significant role in achieving the most efficient net-zero emission machine and for us to have a cleaner future.

**Key-words:** atmosphere, net zero, greenhouse gases, clean air, emissions.

### Introduction

Climate change is one of the biggest and most complex issue facing society today. All of human activities at the moment collectively each year put about 50 billion tons of carbon dioxide up into the atmosphere. The Earth's atmosphere is accumulating carbon dioxide, a heat-trapping gas that is causing the planet's temperature to rise, as shown in Fig. 1. To limit global temperature rises and associated climatic effects we all need to rapidly decrease the amount of greenhouse gas that we release into the atmosphere. It's much easier to keep a unit of carbon dioxide out of the atmosphere than it is to try to retrieve it once it's already there. As global demand for energy is increasing and the challenge is to meet this demand while reducing our carbon footprint, a part of the solution involves Carbon Capture and Storage (CCS) [1-3].

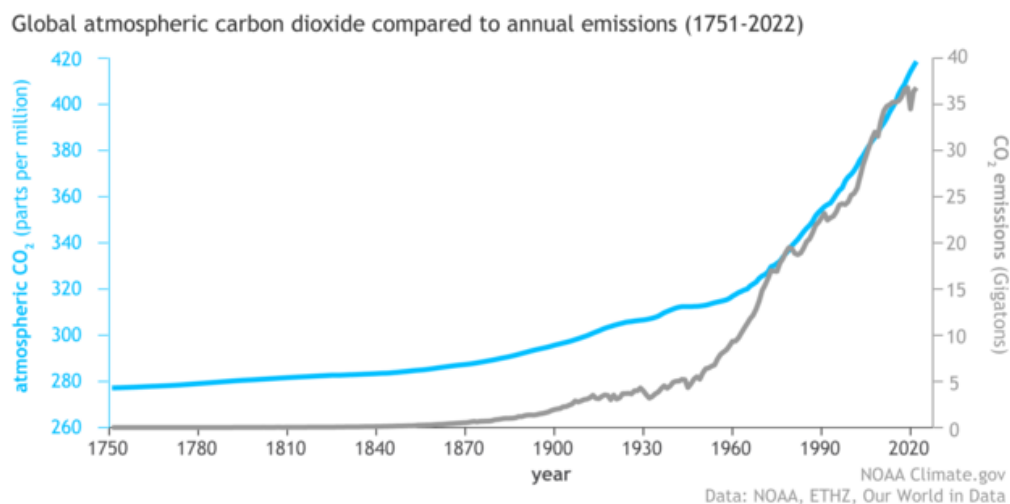


Figure 1. Atmospheric carbon dioxide [7]

## 1. The process of carbon capturing

Carbon capture is a process in which a stream of separated, pressurized, and liquified CO<sub>2</sub> is transported to long-term storage located underground into a layer of rock filled with pores and locked in under many layers of rock. Mainly there are three ways carbon dioxide is captured and stored underground: Pre-combustion, Post-combustion, and Oxy-combustion; but the most used type is post-combustion because it is the most cost-efficient, and can be retrofitted to older plants [4-5].

Post-combustion technologies, shown in Fig. 2, can be divided into multiple methods according to the type of process. The most used is the “Absorption solvent-based” method, which uses chemical absorption that relies on a reaction between carbon dioxide and amine (a compound that contains a basic nitrogen atom with a lone pair). The most used solvents are diethanolamine and alkanolamine, they absorb the CO<sub>2</sub> then separate from the amine and pressurize to turn CO<sub>2</sub> into a liquid [5].

Pre-combustion capture, shown in Fig. 3, avoids completely burning the fuel. Instead, it partially converts it into a mixture of hydrogen and carbon monoxide (synthetic gas) by gasification. Then it uses a water-gas displacement reaction to produce pure CO<sub>2</sub> and hydrogen. This method is very effective in capturing CO<sub>2</sub> due to its high concentration in the synthesis gas before combustion [5].

Oxycombustion burns fuel in pure oxygen instead of air, resulting in combustion gases with mainly CO<sub>2</sub> and water vapor. This simplifies CO<sub>2</sub> capture compared to other methods.

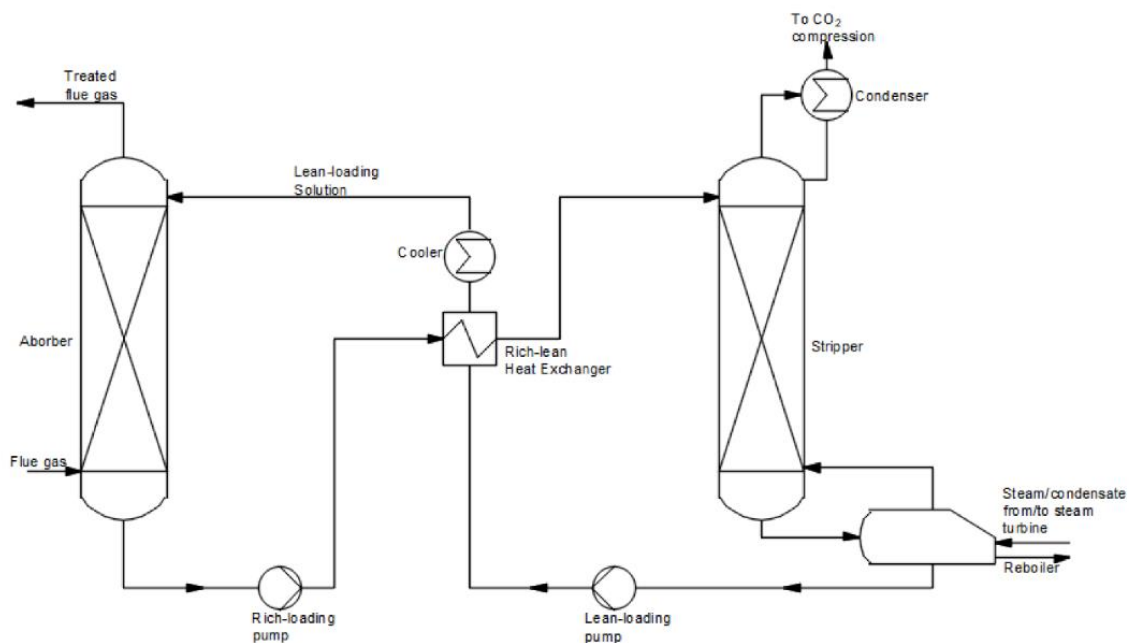


Figure 2. Post-combustion capture [5]

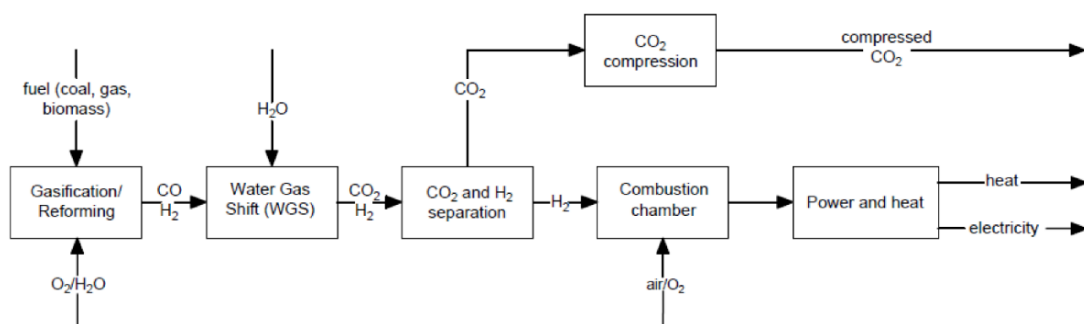


Figure 3. Pre-combustion capture [5]

## 2. The pros and cons

The carbon capture and storage technology can reduce emissions directly from industrial plants and has several advantages over other methods such as direct air capture and absorption of capturing CO<sub>2</sub> [6].

With the advantage of reducing emissions directly at the source, it facilitates the need to construct intricate systems to collect CO<sub>2</sub> from the atmosphere, being able to remove as much as 20% of the total CO<sub>2</sub> from industrial production facilities. With that advantage, other pollutants can be removed at the same time, reducing the levels of nitrogen oxide and sulfur dioxide during the oxyfuel combustion process [6].

With the presence of pros, there are bound to be cons that contradict the ideal process of carbon capture. The cost of CCS is high, with the implementation of CCS systems in the industry the cost of electricity rises to compensate for the money spent on maintaining and implementing them. One report from Utah estimates a 65% increase in the cost of electricity after the installation of CCS systems. Long-term storage capacity is uncertain; It is estimated that not all countries have a suitable storage capacity to implement CCS systems, needing a lot of land mass to have underground reservoirs to store the CO<sub>2</sub> [6].

## 3. The future of CCS

“In 2020, the market for CCS technology was valued at around \$1.9 billion. The CCS market is predicted to reach \$7.0 billion by 2030, which would reflect a Compound Annual Growth Rate of 13.8% from 2021 to 2030” [9]. With this projection of increased budget for CCS it is certain that it has potential to be the No. 1 technology for preventing CO<sub>2</sub> to reach the atmosphere. Another certainty is the misuse of captured CO<sub>2</sub>, being bought by large oil companies to get a hold of unreached oil from beneath underground. For the better of our society it is best to handle the secured CO<sub>2</sub> with care and stored accordingly.

## Conclusion

CCS is a promising technology and is an alternative to removing CO<sub>2</sub> and preventing it from getting into the atmosphere to mitigate climate change. While still in development, it also presents some advantages in the future of “green energy”. For instance, capturing CO<sub>2</sub> directly at the source, keeping the system simple and easy to implement in older factories, however, this method presents itself as being expensive. For future practice, the overall efficiency of capturing and storing CO<sub>2</sub> emissions can be improved, and it is estimated that using CCS globally can be extracted up to 100 billion tons of CO<sub>2</sub> per year.

## References:

- [1] Carbon Capture & Storage - How It Works [online]. [accessed 02.03.2024]. Available: <https://www.youtube.com/watch?v=EyPI20h9kx0&list=LL&index=5>
- [2] Carbon capture and storage research at the British Geological Survey [online]. [accessed 02.03.2024]. Available: <https://www.youtube.com/watch?v=7j3OTLmaE-g>
- [3] Carbon capture technology explained [online]. [accessed 03.03.2024]. Available: <https://www.freethink.com/series/seachange/carbon-capture-technology>
- [4] Carbon capture and storage [online]. [accessed 03.03.2024]. Available: [https://en.wikipedia.org/wiki/Carbon\\_capture\\_and\\_storage](https://en.wikipedia.org/wiki/Carbon_capture_and_storage)
- [5] Methods and Techniques for CO<sub>2</sub> Capture [online]. [accessed 03.03.2024]. Available: <https://encyclopedia.pub/entry/19427>
- [6] Carbon Capture and Storage (CCS) Pros and Cons [online]. [accessed 05.03.2024]. Available: <https://www.treehugger.com/carbon-capture-and-storage-ccs-pros-and-cons-5120005>

- [7] Climate Change: Atmospheric Carbon Dioxide [online]. [accessed 05.03.2024]. Available: <https://www.climate.gov/news-features/understanding-climate/climate-change-atmospheric-carbon-dioxide>
- [8] The future potential for Carbon Capture and Storage in climate change mitigation [online]. [accessed 06.03.2024]. Available: <https://www.sciencedirect.com/science/article/abs/pii/S0959652614009536>
- [9] The Feasibility and Future of Carbon Capture and Storage Technology [online]. [accessed 06.03.2024]. Available: <https://earth.org/the-feasibility-and-future-of-carbon-capture-and-storage-technology/>