Clean Technology impact Assessment

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Abstract

As industrialization and technological advancement have accelerated, carbon emissions have risen as well. In response, countries worldwide are deploying multiple clean-technology initiatives. This report examines how nations have adopted Carbon Capture, Utilization, and Storage (CCUS) projects, highlights the leading players in the field, evaluates their effectiveness at reducing atmospheric CO_2, and outlines opportunities for future enhancement.

Keywords

- CCUS – Carbon Capture Utilization and Storage
- Carbon Capture Capacity - the ability to collect and process carbon dioxide (CO2) emissions, typically from industrial sources or power plants, before they are released into the atmosphere
- CO2 – Carbon Dioxide
- Mt – Million Tonnes

Findings

As illustrated in the graph below, CCUS project deployment has surged since 2020; the apparent downturn thereafter simply reflects that future projects have not yet been announced, rather than a true decline in adoption.

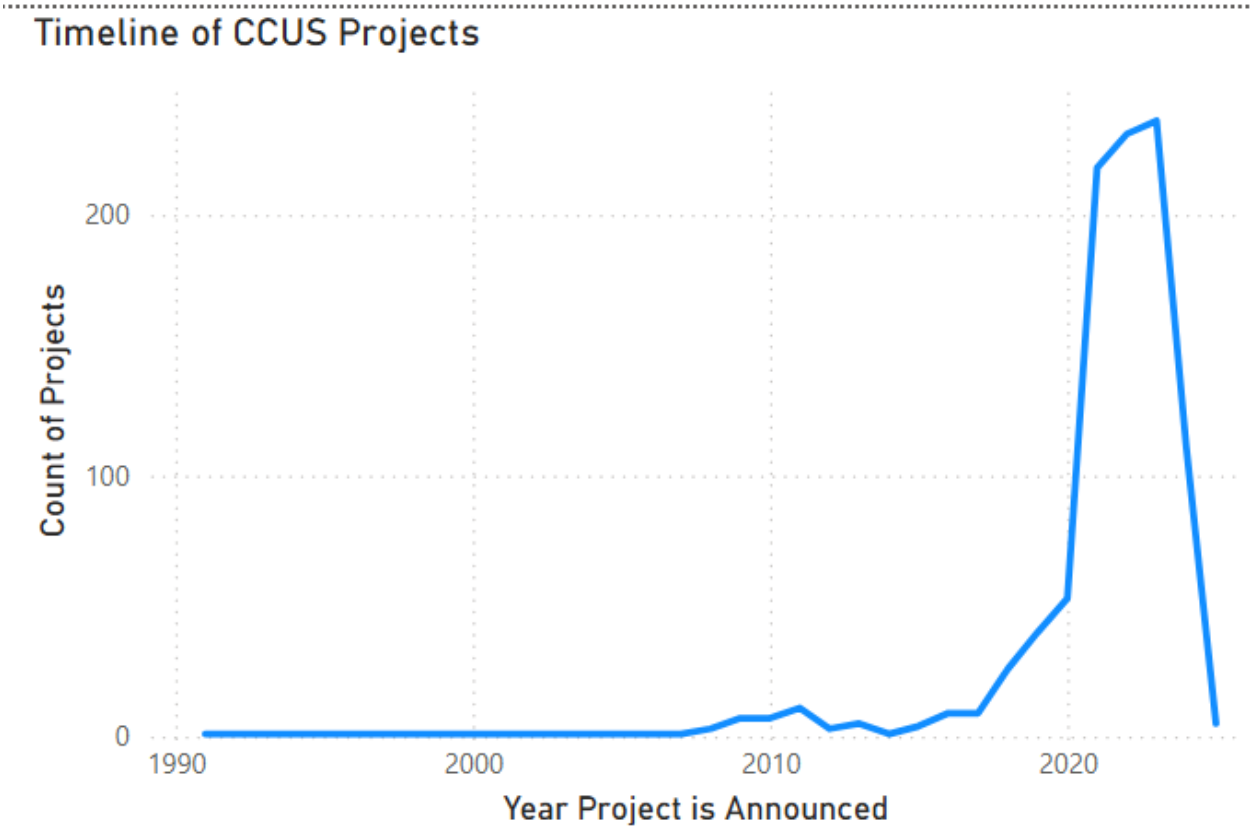

Fig 1.1 Timeline of CCUS projects

Although announced CCUS projects have surged, the vast majority remain on the drawing board: of the 1,014 projects announced worldwide, only 62 (6.1%) are currently operational, while roughly 839 (82.7%) are still in the planning phase. This doesn't imply these initiatives lack substance but rather underscores that—even with recent momentum—it will be several years before we see measurable reductions in atmospheric CO_2.

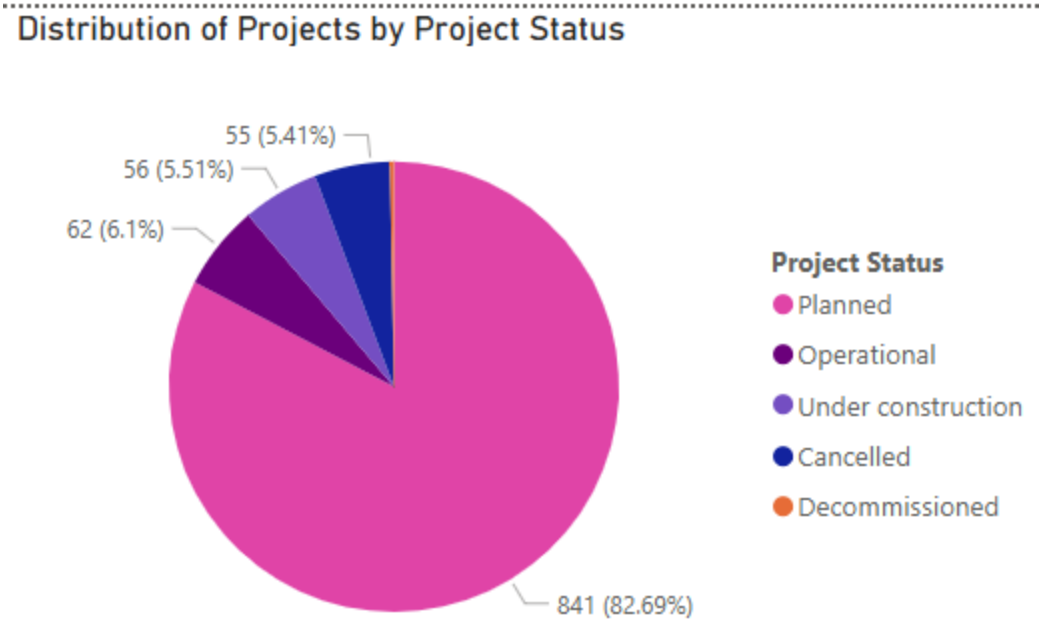

Fig 1.2 Project Status Distribution

Carbon Capture, Utilisation and Storage (CCUS) technology doesn't make carbon vanish; it captures CO_2 emissions from sources such as power plants and other industrial facilities and then either repurposes the gas or stores it securely underground, preventing its release into the atmosphere. The chart below shows the intended end uses or final forms of the captured CO_2.

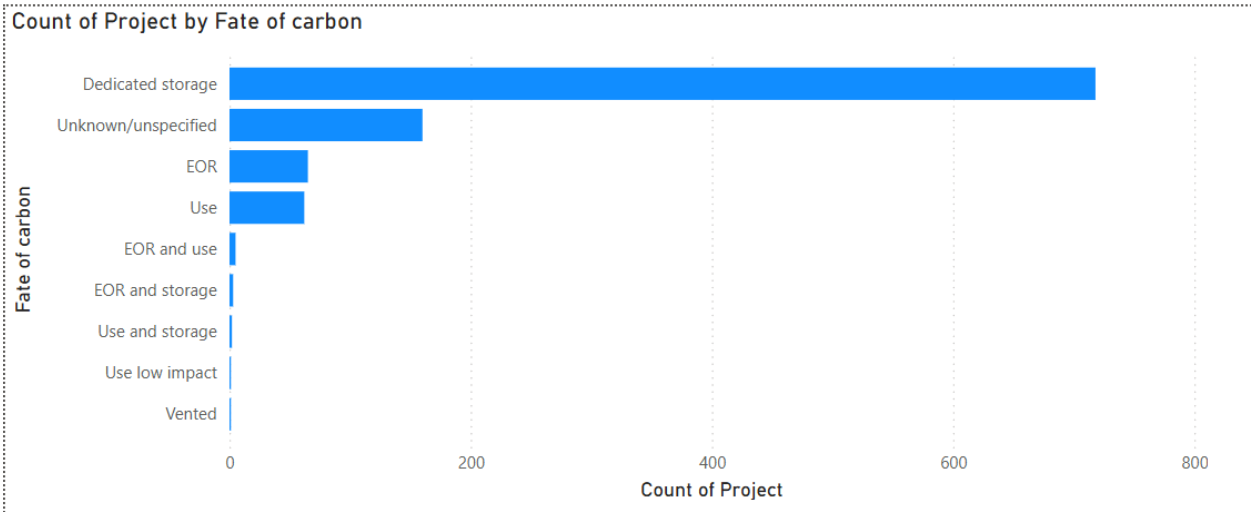

Fig 1.3 Fate of Carbon

From the bar chart we can see that majority of all the CO2 emissions captured is stored and kept underground preventing the entry of it in the atmosphere. CCUS facilities currently capture more than 50Mt of CO2 annually and around 45 commercial facilities are already in operation applying CCUS to industrial processes. In 2023, announced capture capacity for 2030 increased by 35%, while announced storage capacity rose by 70%. This brings the total amount of CO2 that could be captured in 2030 to

around 435 million tonnes (Mt) per year and announced storage capacity to around 615t of CO_2 per year.

These projects have been applied to diverse sectors but majority of them in the power and heat sector because they are one of the largest emitting industries.

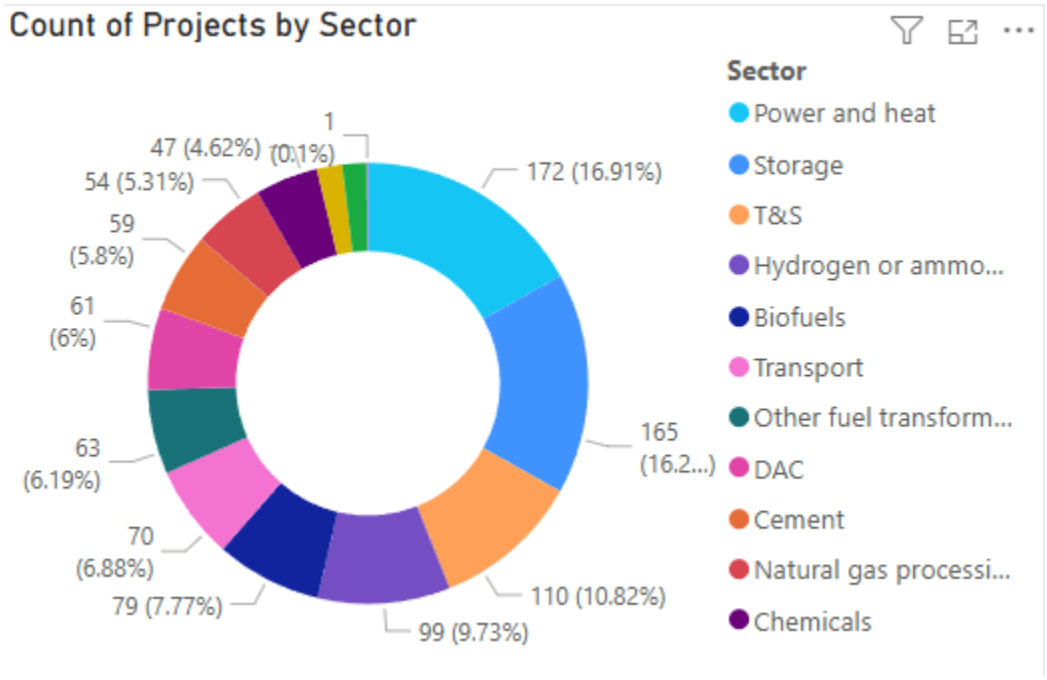

Fig 1.4 Projects by Sector

CCUS projects have seen an increased amount of popularity recently but the bulk of all these projects are primarily conducted by the United States and European Countries, whereas the remainder of the world has lagged, possible causes could be due to the lack of public funding, poor strategic signalling and lack of cross border collaboration.

Below the bar chart shows the op 22 countries with the most CCUS projects undertaken and as can be clearly seen the United States hold the bulk of that. The pie chart represents how different regions have been conducting CCUS projects, where North America hold 42.67% and Europe has 37.56% of all the CCUS projects.

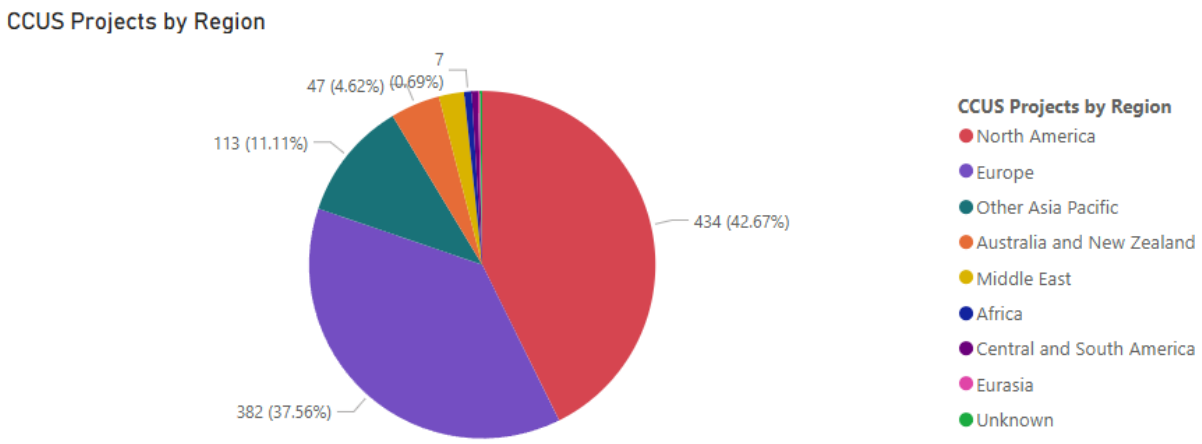

Fig 1.5 Projects by Region

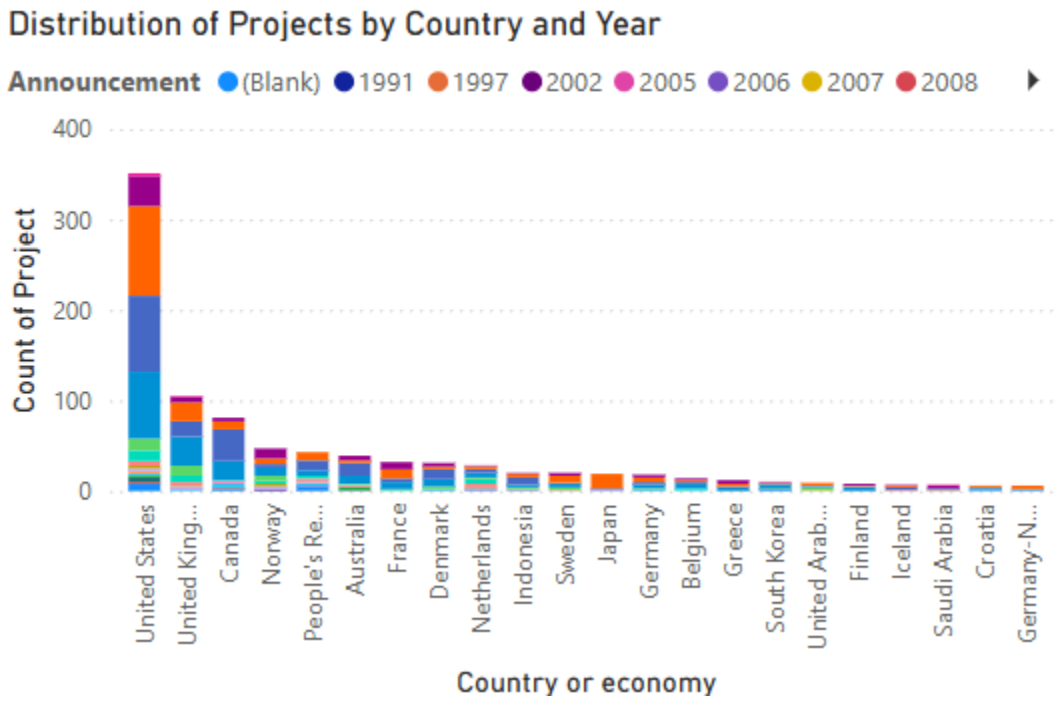

Fig 1.6 Distribution of projects by Country and Year

Conclusion

Momentum is growing in applications that are key for reaching net zero but actual final investment decisions are lagging. Momentum behind CCUS has been growing since around the start of 2018. Since February 2023 project developers have announced ambitions for 115 Mt CO_2 per year of additional capture capacity by 2030. While the bulk of projects are being

carried out by the United States, the other nations and the US need to increase their project management to ensure planned projects become operational to achieve the desired results.

References

- International Energy Agency (IEA) https://www.iea.org/energy-system/carbon-capture-utilisation-and-storage

Tools and Technologies

- Python (pandas, matplotlib, seaborn) – Data processing & visualization
- Power BI – Interactive dashboards for emissions trends
- Excel – Data cleaning & formatting