



Carbon Capture and Utilisation Technologies

For Prelims: CCUS Technologies, Paris Agreement.

For Mains: CCUS Technologies, Applications, Net Zero emissions by 2050, Environment Degradation, Conservation.

Why in News?

According to a study conducted by **Radboud University**, most **Carbon Capture and Utilisation and Storage (CCUS) technologies**, which **suck carbon dioxide (CO₂) from the atmosphere and convert it into fuel or other valuable products**, might fail to help the world reach [Net Zero emissions by 2050](#).

- The study noted that a majority of these systems are **energy intensive and the resultant product can also release CO₂ into the atmosphere**.
- 'Net zero emissions' refers to achieving an overall balance between greenhouse gas emissions produced and greenhouse gas emissions taken out of the atmosphere.

What are CCUS?

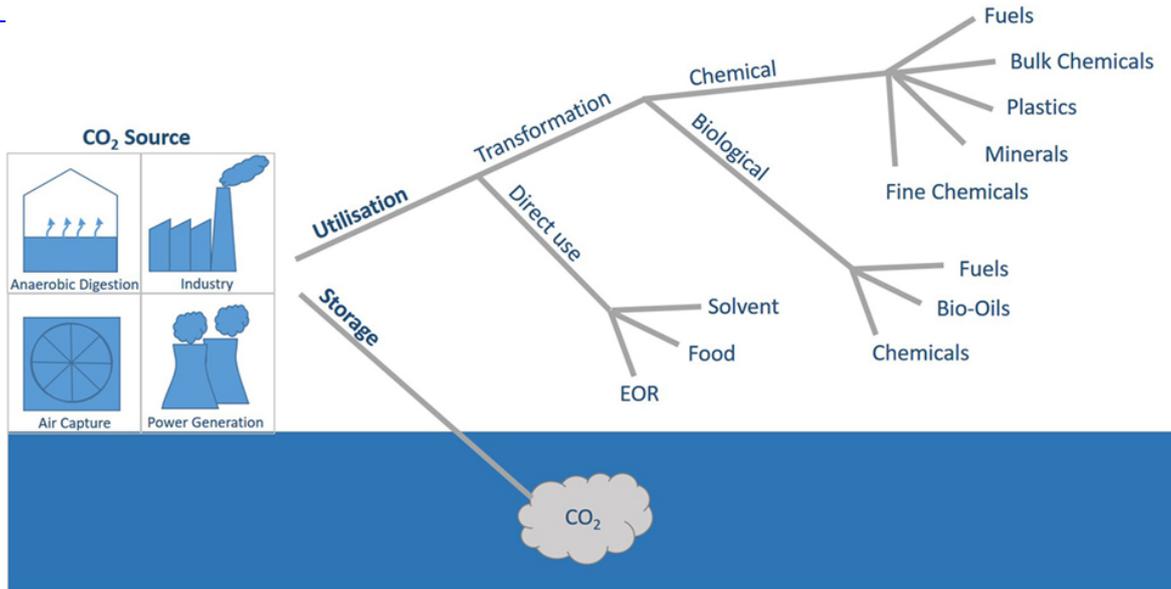
- [Carbon Capture, Utilization, and Storage \(CCUS\)](#) encompasses **methods and technologies to remove CO₂ from the flue gas and from the atmosphere**, followed by **recycling the CO₂ for utilization and determining safe and permanent storage options**.
- CO₂ captured using CCUS technologies is **converted into fuel** (methane and methanol), refrigerants and building materials.
 - The captured gas **is used directly** in fire extinguishers, pharma, food and beverage industries as well as the agricultural sector.
- CCUS technologies can play an important role in **meeting net zero targets**, including as one of few solutions to tackle emissions from heavy industry and to remove carbon from the atmosphere.
- CCUS is considered an important tool to help countries halve their emissions by 2030 and reach net-zero by 2050.
 - These goals are crucial to meet the [Paris Agreement targets](#) for restricting global warming to **2 degrees Celsius (°C)**, and preferable to **1.5°C, over pre-industrial levels**.

What are Applications of CCUS?

- **Mitigating Climate Change:** Despite the adoption of alternative energy sources and energy efficient systems to reduce the rate of CO₂ emissions, the cumulative amount of CO₂ in the atmosphere needs to be reduced to limit the detrimental impacts of climate change.
- **Agriculture:** Capturing CO₂ from biogenic sources such as plants and soil to boost crop growth in a greenhouse could work.
- **Industrial Use:** Combining CO₂ with steel slag - an industrial byproduct of the steel manufacturing process — to make construction materials compatible with the Paris Agreement goals.

- **Enhanced Oil Recovery:** CCU is already making inroads into India. For instance, Oil and Natural Gas Corporation signed a MoU with Indian Oil Corporation Limited (IOCL) for Enhanced Oil Recovery (EOR) by injecting CO₂.

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What are the Challenges associated with CCUS?

- **Expensive:** Carbon capture involves the development of sorbents that can effectively bind to the CO₂ present in flue gas or the atmosphere, which is expensive.
- **Lesser Demand for Recycled CO₂:** Converting CO₂ into useful chemicals of commercial importance, or utilizing CO₂ for oil extraction or remediation of alkaline industrial wastes, would add economic value to this greenhouse gas.
 - However, the demand for CO₂ is limited compared to the vast amount of CO₂ that needs to be removed from the atmosphere, to reduce the detrimental environmental impacts of climate change.

Way Forward

- Any viable system for storing carbon must be effective and cost competitive, stable as long-term storage, and environmentally benign.
- Countries should narrow down on the handful of technologies that show more promise and channel investment in them.
- Replacing a conventional fuel with a synthetic fuel like methanol produced via CCU is likely to be a successful mitigation strategy only if clean energy is used to capture CO₂ and convert it into synthetic fuel.

[Source: DTE](#)