Why should India think again about bringing carbon capture utilisation and storage (CCUS) technology in the country?

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Introduction

As the name suggests, carbon capture utilisation and storage (CCUS) involves capturing carbon dioxide (CO_2) emissions from the coal-fired power plants or carbon-intensive industries and then make use of CO_2 (CCU) and pumping the compressed CO_2 deep underground for long-term storage (CCS). The climate crisis is breaking the back of South-Asia and many other parts of the world. As a solution, the Paris Agreement (COP 21) has suggested investing in Sustainable Development and Technological Innovation for keeping global temperatures from rising more than 1.5℃ above pre-industrial levels by 2030. Therefore, the Geoengineering methods for capture, utilisation and storage of CO_2, which is the major greenhouse gas, has been globally promoted as a climate silver bullet or a climate game-changer.

In July 2020, India decided to collaborate with the US to bring the carbon capture, utilization, and storage (CCUS) technology into India for reducing the country's emissions from coal-based energy generation. The Oil and Natural Gas Corporation Limited (ONGC) and Indian Oil Corporation (IOCL) have joined hands for launching CCUS-EOR project in IOCL's Koyali refinery in Gujarat, India. However, the commercial-scale implementation of this contentious technology is reported to require massive land and resource consumption, which is neither sustainable nor climate-friendly.

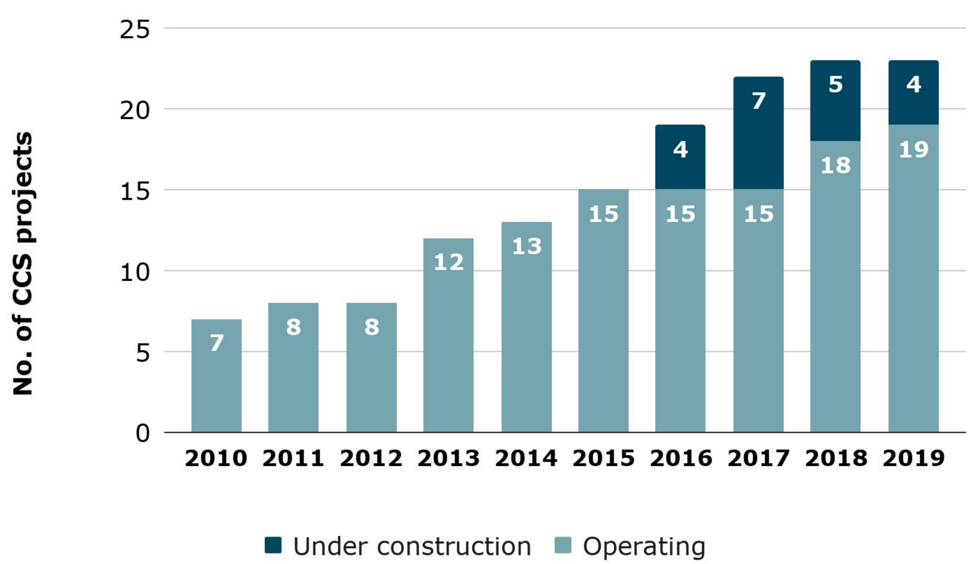

Figure 1: Status of large-scale CCUS projects around the world (Source: GCCSI 2020).

Major applications

a. **CO_2 capture:** The carbon dioxide can be sequestered either by using direct air capturing (DAC) methods such as chemical absorption processes and membrane-based technologies or by biological fixation of carbon through photosynthetic organisms such as micro-algae.
b. **CO_2 utilisation:** The innovative approaches for utilisation of captured CO_2 as a feedstock in the chemical, energy and material sectors is a field of novel research. The non-converted form is used for Enhanced Oil Recovery (EOR) and converted form as fuel and other products (see figure 1).
c. **CO_2 storage:** The deep ocean water and subsurface deposit area into the earth's crust are the two huge potential reservoirs for storage of CO_2 gas. According to the International Energy Agency (IEA), the targeted 14% of emissions reductions through carbon capture and storage (CCS) will require over 100 billion tonnes of (cumulative) storage capacity by 2060.

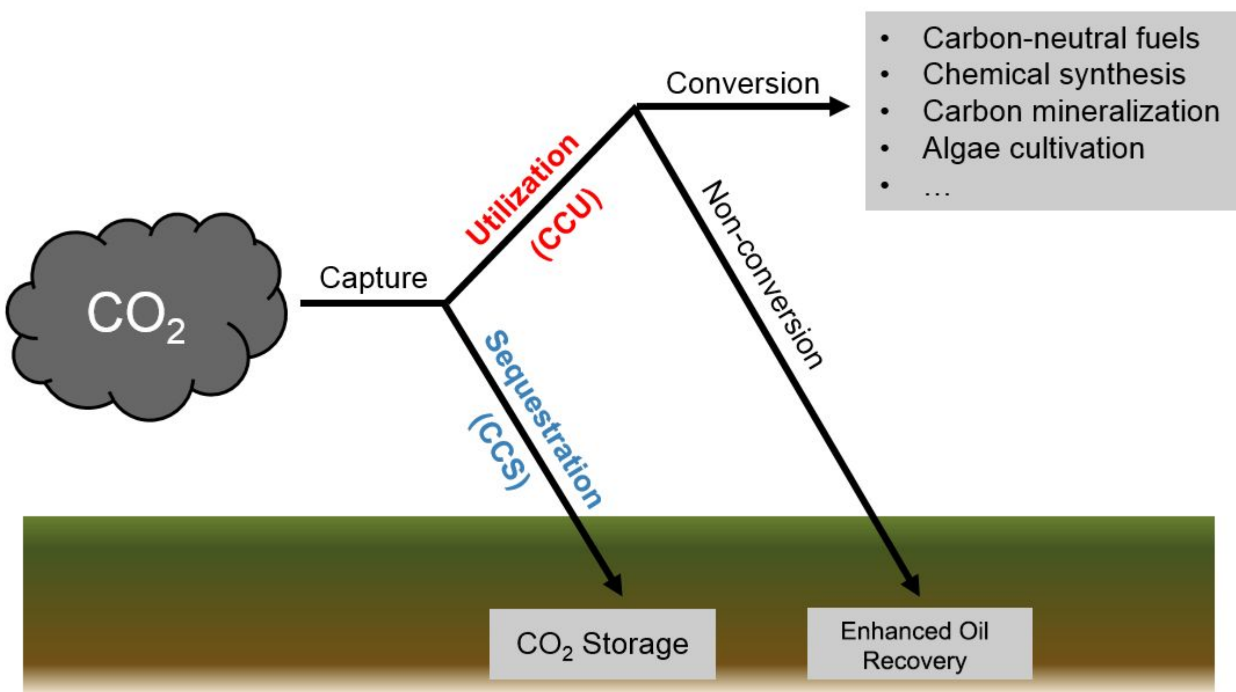

Figure 2: An illustration of the applications of Carbon Capture Utilization and Storage (CCUS) technology. (Image Credit - Wikimedia Commons)

Major challenges

a. **Social issues:** The carbon abatement through CCUS technologies will allow the use of fossil fuels by power generation sector and other carbon-intensive industries. Therefore, the synergistic effects of other pollutants such as Mercury, SO2, NOx and dust on the health of local communities and their surrounding environment will remain unchanged.
b. **Economic issues:** There is a wide range of financial costs of CCUS technologies, depending on the capital and operation of CO_2 capture, transport and subsurface injection. Research for a suitable storage site is a long and costly process. The clean coal technology undermines the coal's ability to compete with solar and other renewable sources by adding $60 per ton cost for CO2 capture. Thus, CCUS projects may face the risk of closure due to economic downturns.
c. **Environmental issues:** Storing CO_2 in a safe and stable manner will require an efficient and timely audit for leakage rates of CO_2 back to the atmosphere from potential land-based and marine sequestration reservoirs. The transportation of captured CO_2 and pumping into oil and gas reservoirs for EOR will further push for more use of these fossil fuels and will release the CO_2 back into the atmosphere. Thus, full environmental monitoring of this process through experts is necessary before using CCUS technology to mitigate climate change.

Table 1: Details of unsuccessful projects (Source: IEEFA, 2018).

Name	Location	Project type	Year of commissioning	Why has it failed?
Boundary Dam/SaskPower	Saskatchewan, Canada	Carbon Capture and Storage-Enhanced Oil Recovery (CCS-EOR)	2014	Not economically sustainable
Petra Nova/NRG Energy	Texas, US	Carbon Capture and Storage-Enhanced Oil Recovery (CCS-EOR)	2017	Energy-intensive and high operational cost
Kemper/Southern Co.	Mississippi, US	Integrated coal gasification combined cycle (IGCC)	2014	Water intensive and high operational cost

Edwardsport/Duke Energy	Indiana, US	Integrated coal gasification combined cycle (IGCC)	2013	Poor and expensive operating performance

Conclusion

The protection of human societies and the environment against the negative impacts resulting from rapid climate change globally require to achieve the 45% greenhouse gas emissions (GHG) reduction target by 2030 and net-zero by 2050. Since the proposed carbon capture and storage technology is carbon-intensive in itself, the CO_2 removal through the CCUS projects is an ineffective, expensive and non-eco friendly approach to mitigate climate change. Therefore, India should focus on IPCC's low energy demand (LED) scenario for limiting peak warming to below 1.5°C, which encourages countries to invest in sustainable alternatives to CCUS technologies for a holistic response to climate change, as follows:

1. Restoring forests and other ecosystems for increasing natural sequestration of carbon dioxide:
    a. Ecosystem restoration
    b. Natural regeneration
    c. Avoiding conversion of Natural ecosystems
    d. Responsible use of forests

2. Transforming the food system and conserving biodiversity for reducing carbon emissions:
    a. Demand - consumers should focus on healthy diets, reducing food miles and reducing food waste.
    b. Supply - producers should focus on ecological livestock production methods, agroforestry and reducing chemical fertiliser use.

3. Respecting the land rights of indigenous communities and revitalising indigenous knowledge to mitigate climate change.
4. Financing energy efficiency and establishing nationwide energy efficiency goals to reduce energy intensity (energy used per unit of gross domestic product), just like Mexico.