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Carbon Capture and its prospects in India

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CO2, in an appropriate concentration, in the atmosphere is essential for life on Earth. CO2 concentration plays an important part in photosynthesis, which in turn drives the food chain on the Earth. Anthropogenic carbon production mainly from wood-burning and other sources were at equilibrium with natural carbon uptake processes till the industrial revolution. The situation changed with the industrial revolution as the concentration of atmospheric CO2 started increasing. It has well exceeded the maximum limit of ~ 350 ppm, just as the excess of anything turns hostile.

The major repercussions of the rising atmospheric reservoir of CO_2 are the rising sea levels and mean global temperature. A perpetual increase from the current levels will only result in severe consequences in future. There will be an acute pressure on the existing land to host the ever-growing population, as rising sea levels will submerge the highly populated coastal areas of the world. Concentrated efforts need to be taken now if such hazardous projections must be nullified.

At COP26 summit in Glasgow, Hon'ble Prime Minister Shri Narendra Modi announced the Panchamrit to mitigate climate change including achieving net zero by 2070. This calls for unprecedented transformation of all the sectors for a developing economy like India, whose emissions are yet to peak.

This situation needs to be addressed fast in three possible ways:

(i) Opting for alternate sources of clean energy

(ii) Reducing the intensity of CO_2 production by focusing on cleaner forms of combustion or to choose cleaner fuel

(iii) Focus on the development of efficient carbon capture and sequestration technologies

The adoption of renewable energy is hindered by several social, economic, technological, and regulatory barriers. This poses a pressing concern from ecologic and environmental perspectives as coal combustion is a chief source

of CO_2. In such a global and Indian scenario, the only method, besides using clean energy sources and policy interventions, is **carbon capture and sequestration**.

CCS / CCUS processes capture carbon dioxide. The captured CO2 is then transported to a suitable site for its final long-term storage (i.e., geological or ocean storage) or is used for Enhanced Oil/ Gas Recovery or it is converted into other components and products, such as chemical feedstock's, fuels or building materials, which are otherwise typically derived from fossil-based resources. Integration of carbon-based materials in buildings and construction could prove to be a safe sequestration option above ground.

India's energy demands are dependent on fossil fuels which come at the cost of voluminous CO_2 released. The hard-to-abate' industries account for 20-30% of the global emissions and mainly consist of cement, petrochemical and steel industries. These industries heavily depend on fossil fuels. Even though the world is pushing towards cleaner forms of energy, low per capita income, and high coal reserves still render coal-generated power to be the cheapest in India. Even though alternatives like solar and wind are gradually coming up, coal would continue to be the main source of power for India in 2030. Thus, carbon capture and storage is a necessary technology that should be developed in the country soon.

Indian organizations have made international collaborations. India holds a substantial geological sequestration potential in its basaltic rocks, coal seams, depleted oil reserves, soils, deep saline aquifers, and sedimentary basins. The next 10-15 years would be very crucial for India to attain technological advancement to deploy large-scale CCS projects. India's emission projection stands at 5.3 BT by 2030. Such figures cannot be thwarted without mainstream CCUS infrastructure retrofitted in the hard-to-abate industries. The infrastructure of these industries serves as the backbone of the Indian economy and cannot be replaced easily.

CCS can decrease the carbon footprint of fuels by ~ 90% and act as a transition technology for its decarbonization, when applied to an existing emitter. This will allow the use of fossil fuels until they are replaced by relatively cleaner energy sources. It will be beneficial, particularly for India being a coal-dependent country.

CCS would also enable a “just transition”, which would create new jobs in the net-zero industry, allowing re-use or continued use of available infrastructure and deferring their shut-down costs. The private, public, and social benefits of this technology in mitigating global warming outweigh its cost and thus CCS as a critical option in tackling climate change.

Clean Development Mechanism (CDM) can substantially tackle the economic issue of CCS in India. CDM is an important clause that allows a symbiotic relationship between the developed and the developing countries. The mechanism allows the developed countries to set up emission reduction projects and undertakings in the developing countries. This allows the developed countries to procure Certified Emission Reduction (CER) credits to their name. These credits allow them to reach their emission reduction targets. This mechanism satisfies the twin aim of both the developed and the developing countries involving an interchange of skill, knowledge, and technology

An estimate by the IEA state that to meet the Paris agreement goals, an additional investment of USD 9.7 trillion, by 2050 would be required in Carbon capture, utilization and storage (CCUS) deployment. A special report by Intergovernmental Panel on Climate Change, IPCC (2018) reviewed 90 scenarios to restrict global warming to 1.5 °C. Together, they need to meet very high levels of permanent sequestration compared to today.