

## Carbon Capture and Utilisation (CCU) Technologies

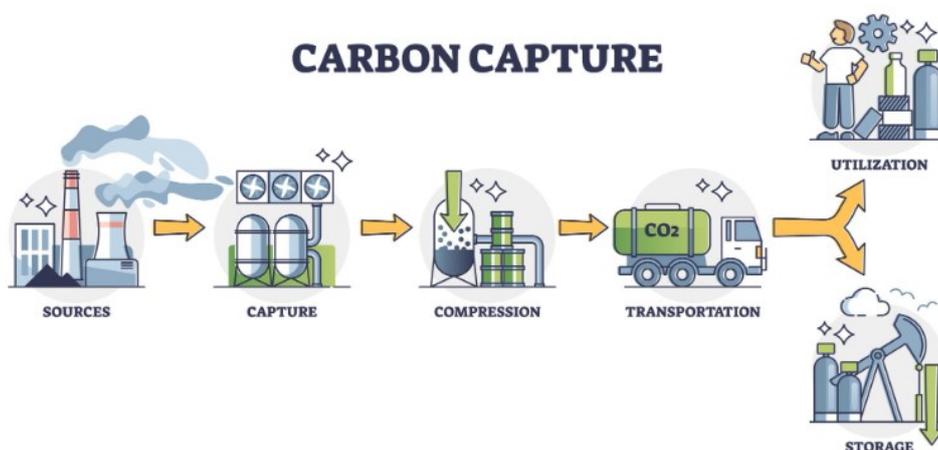
**Mains:** GS III - Environment pollution and degradation| Science and Technology

### Why in News?

Recently many countries have developed technologies to capture carbon and utilize it, and it is important to know about the CCU mechanisms.

### What is Carbon Capture and Utilisation?

- **CCU** - Carbon Capture and Utilisation (CCU) refers to a set of technologies that capture carbon dioxide emissions from industrial sources or directly from the air and convert them into useful products.
- **Process** - It removes carbon from the atmosphere and puts it into the economy as inputs for fuels, chemicals, building materials, or polymers.



- Unlike carbon capture and storage, where captured CO<sub>2</sub> is permanently stored underground rather than reused, CCU uses up the captured carbon.
- **Utilization Pathways:**
  - **Chemicals** - Converted into urea, methanol, and polymers.
  - **Fuels** - Combined with green hydrogen to produce synthetic fuels (e-methanol, aviation fuels).
  - **Materials** - Used in carbon-cured concrete and building materials.
  - **Biological** - Utilized by microalgae for biofuel production.

### Why does India need CCU?

- **Large CO<sub>2</sub> emissions** - India has consistently been the world's third-largest emitter

of CO<sub>2</sub>, with emissions driven largely by power generation, cement, steel, and chemicals.

- While renewable energy may reduce future emissions, many industrial processes are inherently carbon-intensive and difficult to decarbonise.
- **Potential of CCU** - The CCU offers a pathway to reduce emissions from these “hard-to-abate” sectors while simultaneously creating new industrial value chains.
- **Supports net zero target** - It also aligns with India’s net-zero target for 2070 and its push to build a circular, low-carbon economy.

### Where does India stand today?

- **Research funding** - India has begun supporting CCU through research funding from the Department of Science and Technology which has created a specific research and development roadmap for these technologies.
- **2030 Roadmap** - The draft 2030 roadmap for Carbon Utilisation and Storage (CCUS) presented by the Ministry of Petroleum and Natural gas has identified projects that can be used for CCUS purposes.
- **Private sector activities** - Ambuja Cements (Adani Group) is working on an Indo-Swedish CCU pilot with IIT Bombay to convert captured CO<sub>2</sub> into fuels and materials.
  - JK Cement is collaborating on a CCU testbed to capture CO<sub>2</sub> for applications such as lightweight concrete blocks and olefins.
  - Beyond cement, Organic Recycling Systems Limited (ORSL) is leading India’s first pilot-scale Bio-CCU platform, valorising CO<sub>2</sub> from biogas streams into bio-alcohols and specialty chemicals.

### What are other countries doing?

- **European Union** - The EU Bioeconomy Strategy and Circular Economy Action Plan explicitly supports CCU as a way to turn CO<sub>2</sub> into feedstocks for chemicals, fuels, and materials, linking it to circularity and sustainability targets.
- ArcelorMittal and Mitsubishi Heavy Industries, Ltd. are working with a climate tech company, D-CRBN, to trial a new technology to convert CO<sub>2</sub> captured at ArcelorMittal’s plant in Gent, Belgium into carbon monoxide which can be used in steel and chemical production.
- **United States** - The U.S. uses a combination of tax credits and funding to scale CCUs, particularly for CO<sub>2</sub>-derived fuels and chemicals.
- **UAE** - The UAE’s Al Reyadah project and planned CO<sub>2</sub>-to-chemicals hubs leverage CCU with green hydrogen.

### What are the risks ahead?

- **Cost issues** - The foremost risk in scaling CCU in India is cost competitiveness.
- Capturing, purifying, and converting CO<sub>2</sub> is energy-intensive and expensive.
- Without policy incentives, CCU-derived products will struggle to compete with cheaper, fossil-based alternatives.
- **Infrastructure readiness** - CCU requires co-located industrial clusters, reliable transport of CO<sub>2</sub>, and integration with downstream manufacturing, all of which are unevenly developed across Indian industrial regions.

- **Governance issues** - The absence of clear standards, certification, and market signals creates uncertainty for investors and limits demand for CO<sub>2</sub>-derived products.

## Reference

[The Hindu| Carbon Capture and Utilisation](#)

