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Q7

What is Carbon Capture, Utilization and Storage (CCUS)? What is the potential role of CCUS in tackling climate change?

UPSC Civil Services Mains 2025 · GS III · 10 marks · Environment and Conservation

Conservation, environmental pollution and degradation, environmental impact assessment.

Core demand of the question

- **Define CCUS:** capture, use, store
- **Give climate role:** **hard-to-abate** industry, not a licence for endless coal
- **State Indian potential and limits:** cost, storage geology, moral hazard

Revision summary

CCUS is capture of carbon dioxide, then use in products or storage in deep rock.

It is most justified in cement, some steel and fertiliser, where electrons cannot easily replace the process.

The IPCC counts it in net-zero pathways, including possible negative emissions with bioenergy.

Costs, energy penalty and unproven large Indian stores are the brakes.

Using CCUS to justify endless new coal is a climate risk, not a climate policy.

Introduction

- **Some carbon dioxide is easy to avoid: a solar panel instead of a new coal plant for daytime power. Some is not: cement, some steel, fertiliser. Carbon capture, utilisation and storage** is the family of technologies that **grabs CO₂** from a flue or the air, **uses** it or **buries** it. It is a climate tool. It is also an excuse if it is used to keep dirty plants alive forever.

Body

What CCUS is

Capture means chemical or physical separation of CO₂ from a chimney or from ambient air (**direct air capture**, still costly). **Utilisation** means turning it into urea, chemicals, or pushing it into old oil wells to squeeze more oil (which can cancel the climate gain). **Storage** means a deep saline aquifer or a depleted field, monitored so the gas stays down. A full chain is what the letters promise.

Role in climate

The IPCC treats CCUS as **needed for net zero** in **hard-to-abate** sectors and for possible **negative emissions** if paired with bioenergy. It is **not** the cheapest way to clean a power sector that can use sun, wind and storage. For India, a honest role is **cement and some industrial clusters**, plus **research**. A dishonest role is a new coal fleet "with capture someday".

- **Limits: energy penalty** (capture eats power), **cost**, **few proven Indian storage sites** at scale, and **public trust**. Utilisation in urea can be real; utilisation as a PR gas is not storage.

CCUS can **shave residual emissions**. It cannot replace a renewable build-out. That is its potential and its ceiling.

Flow diagram

Flue or air -> Capture
Capture -> Use: urea chemicals
Capture -> Store in rock
Store in rock -> Net residual cut

Conclusion

CCUS captures carbon, uses it or stores it underground. It matters for cement and other stubborn emissions. It is a poor substitute for clean power, and a dangerous delay if it is only a slogan on a coal plant.

Facts & figures

Hard-to-abate

Sectors such as cement where process emissions are chemical, not only from burning coal for electricity.

Direct air capture

Machines that pull CO₂ from ambient air; still expensive compared with not emitting.

Enhanced oil recovery

Pumping CO₂ into oil fields to lift more oil; climate gain depends on whether that extra oil is burned.

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