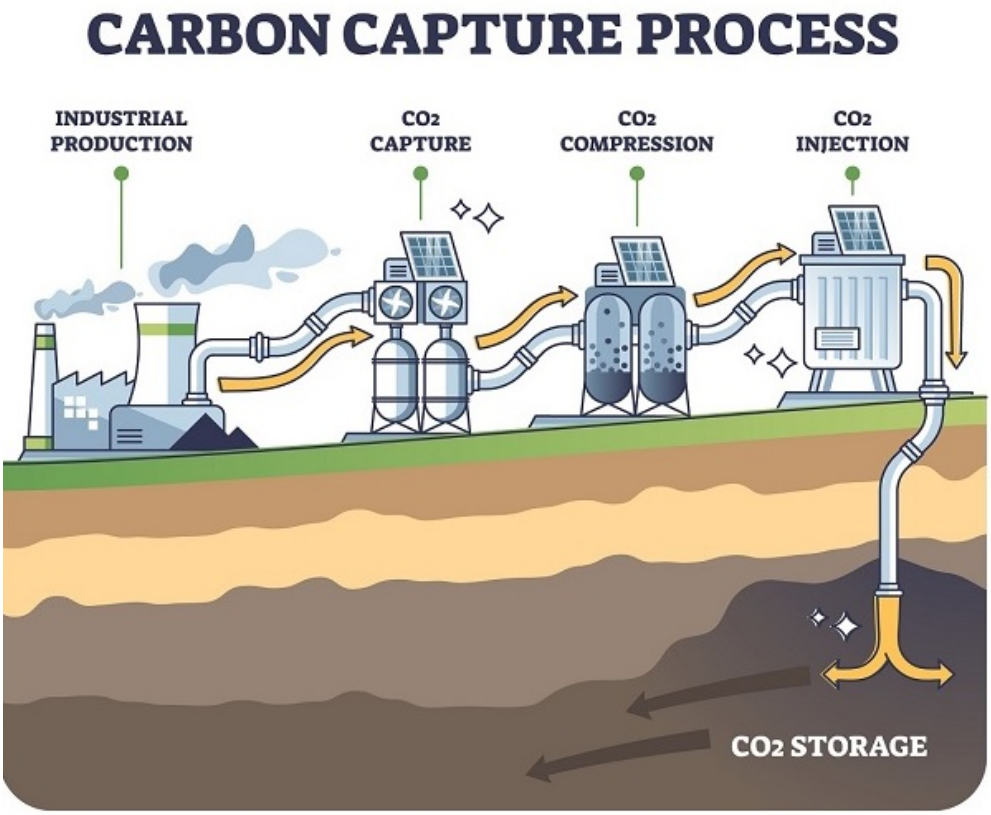
Carbon-Dioxide Removal

Why in news?

As nations gather for the COP 28 in Dubai, the question of carbon capture's future role in a climate-friendly world will be in focus.

What is Carbon Dioxide Removal (CDR)?

- **Carbon removal**- Using technologies, practices, and approaches to remove carbon dioxide (CO2) from our atmosphere through deliberate and intentional human actions.
- It captures CO2 from the atmosphere and locks it away for decades or centuries in plants, soils, oceans, rocks, saline aquifers, depleted oil wells, or long- lived products like cement.



- **Process-** CDR can be done through traditional or technological processes or both.

Process	Examples
Traditional process	• Afforestation • Reforestation • Agricultural practices that sequester carbon in soils (carbon farming)

Technological process	• Bioenergy with Carbon Capture and Storage (BECCS) • Direct Air Carbon Capture and Storage (DACCS) • Enhanced rock weathering

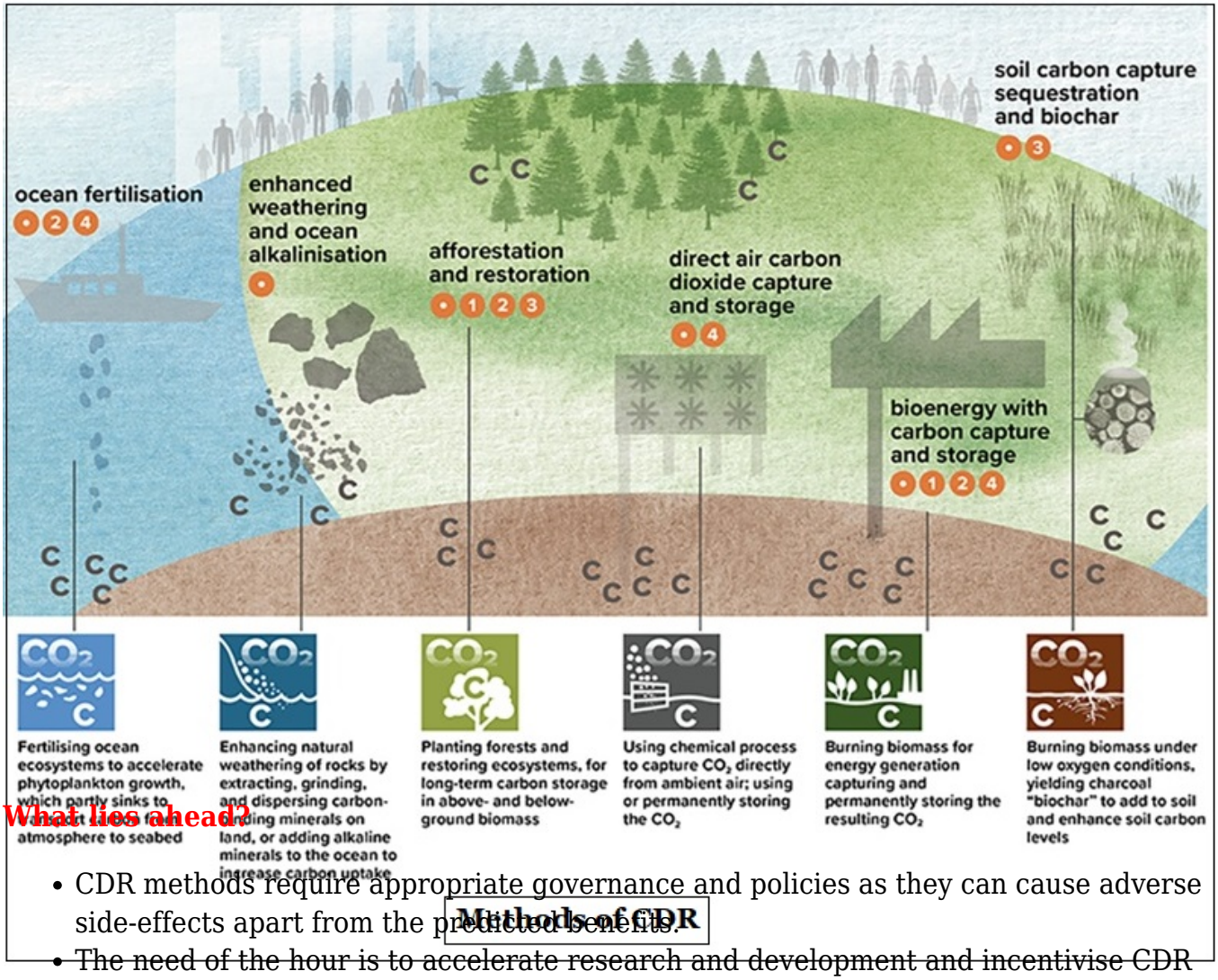
- **Forms of CDR**- The most common form of carbon capture technology involves *capturing the gas from a point source* like an industrial smokestack.
- **Carbon storage**- It includes
  - **Carbon capture and storage (CCS)** - The carbon can be moved directly to permanent underground storage.
  - **Carbon capture, utilization, and storage (CCUS**) – Carbon can be used in another industrial purpose first.

As of 2023, CDR is estimated to remove around 2 gigatons of CO2 per year, which is equivalent to 4% of the greenhouse gases emitted per year by human activities.

What are the different CDR methods?

CDR method	About	Challenges
Afforestation/ Reforestation	• Converts abandoned or degraded agricultural lands into forests. • Additional trees can sequester more carbon dioxide from the atmosphere.	• Increases the competition for land. • May limit the options for food production and biodiversity conservation.
Biochar	• A substance produced by *burning organic waste* from agricultural lands and forests in a controlled process called *pyrolysis.* • Improve soil quality, which in turn improves soil fertility, productivity and crop yield.	• Health and environmental impacts of particulate matter produced during pyrolysis. • Sourcing sustainable biomass at a scale.
BECCS	• Combines energy production, biological carbon removal and geological storage. • Uses biomass in combustion to generate energy, then captures the emitted carbon for geological injection.	• Can create *competition for land use* with food production, placing pressure on food security. • Can increase the use of fertilisers.
DACCS	• *Extracts CO2 directly* from the atmosphere, and is permanently stored in geological formation or used for other application.	• Accelerates fossil fuel extraction activities, potential CO_2 leakage from storage sites
Enhanced rock weathering	• Involves *pulverising silicate rocks* to bypass the conventionally slow weathering action.	• Energy intensive process and generates emissions.

Ocean alkalinity enhancement	• A *chemical removal method* that involves adding alkaline substances to seawater to accelerate the natural sink.	• Potential for *increased greenhouse gas emissions* and can *release by-products* like trace metals.



What lies ahead?

- CDR methods require appropriate governance and policies as they can cause adverse side-effects apart from the predicted benefits.
- The need of the hour is to accelerate research and development and incentivise CDR deployment, a political commitment, including reliable measurement, reporting, and verification of carbon flows as recommended by IPCC.

References

1. The Hindu- What is CO2 removal explained
2. The Hindu- Why carbon capture is no easy solution