Limitations of CCS and CDR

For Prelims: Limitations of CCS and CDR, COP28**,** Carbon Capture and Storage (CCS), Carbon-Dioxide Removal (CDR) technologie, Unabated fossil fuels, Carbon dioxide (CO_2).

For Mains: Limitations of CCS and CDR, Environmental pollution and degradation.

Source: TH

Why in News?

The draft decisions taken at **COP28** in Dubai, the UAE have recommended the abatement and removal of carbon emissions using **Carbon Capture and Storage (CCS)** and **Carbon-Dioxide Removal (CDR) technologies.**

- The unabated fossil fuels mean **the combustion of these fuels** without using CCS technologies to capture their emissions.
- Draft decision texts point to a need to "phase out" such unabated fossil fuels.

What are CCS and CDR?

- **Carbon Capture and Storage (CCS):**
  - CCS refers to technologies that can capture carbon dioxide (CO_2) at a source of emissions **before it is released into the atmosphere.**
  - These sources **include the fossil fuel industry** (where coal, oil and gas are combusted to generate power) and industrial processes like steel and cement production.
- **Carbon-Dioxide Removal (CDR):**
  - CDR takes the **forms of both natural means like afforestation or reforestation** and technologies like **direct air capture,** where machines mimic trees by absorbing CO_2 from their **surroundings and storing it underground.**
  - There are also **more complex CDR technologies like enhanced rock weathering,** where rocks are **broken down chemically;** the resulting rock particles can **remove CO_2 from the atmosphere.**
    - Other technologies like bioenergy with carbon capture and storage (BECCS) capture and store **CO_2 from burning biomass, like wood.**

How well do CCS and CDR need to work?

- The **IPCC's Sixth Assessment Report (AR6)** heavily relies on these **technologies for projections in achieving the goal of limiting global warming to 1.5** degrees Celsius.
- IPCC's assessed scenarios, with over a 50% chance of limiting warming to 1.5 degrees Celsius, rely on the assumption that the world can sequester 5 billion tonnes of CO_2 by 2040. This sequestration **scale surpasses India's current annual CO_2 emissions.**
- There's no pathway in AR6 to achieve the 1.5 degrees Celsius target without the **integration of CDR technologies.**

- Given current emission rates, there's a significant **risk of surpassing the 1.5 degrees Celsius threshold** within seven years. Mitigating emissions solely through direct measures (like renewable energy adoption) would be nearly **impossible at this stage, requiring substantial reliance on CDR.**

What are the Challenges of CCS and CDR?

- **Rebound Emissions Concerns:**
  - There are concerns that the **existence of CCS and CDR could inadvertently create** more room for continued emissions.
  - This phenomenon might lead to increased emissions **or prolonged reliance on fossil fuels** instead of transitioning to renewable energy sources.
- **Fossil Fuel Dependency:**
  - In some cases, CCS has been used to extract more oil by injecting captured CO_2 into oil fields, potentially prolonging reliance on **fossil fuels rather than transitioning away from them.**
- **Land Equity Concerns:**
  - CDR methods like afforestation, reforestation, BECCS, and direct air capture are constrained by their need for land.
  - Land in the Global South is often considered to be **'viable' and/or 'cost-effective' for planting trees** and deploying other large-scale CDR methods.
  - As a result, such CDR projects can adversely affect land rights of indigenous communities and **biodiversity and compete with other forms of land-use,** like agriculture that is crucial for ensuring food security.
- **Technological and Financial Hurdles:**
  - The scale-up of CCS and CDR technologies poses significant technological challenges, including **high costs, limited infrastructure**, and the need for substantial innovation to make these technologies more effective and affordable.

Way Forward

- Addressing concerns related to CCS and CDR requires a comprehensive approach involving technological advancements, policy frameworks that discourage continued reliance on fossil fuels, and strategies that ensure the responsible and sustainable deployment of CCS and CDR technologies to align with broader climate goals.
- It is important to integrate **CCS and CDR technologies within broader climate strategies** but emphasize their role as transitional solutions rather than long-term fixes.
- Ensure that their **deployment doesn't detract from efforts to decarbonize** the economy through renewable energy adoption, energy efficiency, and sustainable practices.

UPSC Civil Services Examination, Previous Year Questions (PYQs)

Prelims

Q1. Consider the following agricultural practices: (2012)

1. Contour bunding
2. Relay cropping
3. Zero tillage

In the context of global climate change, which of the above helps/help in carbon sequestration/storage in the soil?

(a) 1 and 2 only
(b) 3 only
(c) 1, 2 and 3
(d) None of them

Ans: (b)

Q2. In the context of mitigating the impending global warming due to anthropogenic emissions of carbon dioxide, which of the following can be the potential sites for carbon sequestration? (2017)

1. Abandoned and uneconomic coal seams
2. Depleted oil and gas reservoirs
3. Subterranean deep saline formations

Select the correct answer using the code given below:

(a) 1 and 2 only
(b) 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans: (d)

Q3. What is/are the advantage/advantages of zero tillage in agriculture? (2020)

1. Sowing of wheat is possible without burning the residue of previous crop.
2. Without the need for nursery of rice saplings, direct planting of paddy seeds in the wet soil is possible.
3. Carbon sequestration in the soil is possible.

Select the correct answer using the code given below:

(a) 1 and 2 only
(b) 2 and 3 only
(c) 3 only
(d) 1, 2 and 3

Ans: (d)