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Carbon Sequestration: Engineering, Capturing, Storage, Trapping YouTube Lecture Handouts for Competitive Exams

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Ways to reduce atmospheric carbon

- Reduce emissions
- Store the carbon in terrestrial, oceanic and aquatic ecosystem

CO₂ absorbs IR rays, as its concentration increases, average temperature of Earth's lower atmosphere rises (global warming)

Sink:

Process that removes GHG from atmosphere

Carbon capture was first used in Texas in 1972 as a method to enhance oil recovery.

Sequestration

Carbon capture and long-term storage of carbon and CO₂ to mitigate global warming

Can be natural or anthropogenic

Natural Carbon Sink

Forest

Growth of replacement vegetation on cleared land

Land-management practices that absorb carbon

Ocean

Iron fertilization encourage phytoplankton growth, which removes carbon from the atmosphere for at least a period of time

Fertilize ocean with urea, a nitrogen rich substance, to encourage phytoplankton growth

Seaweed grows very fast and can theoretically be harvested and processed to generate biomethane, via Anaerobic Digestion to generate electricity or as a replacement for natural gas.

Geoengineering

- *Carbon Capture & Storage (CCS)* – 3-stage process - capture, transport and store - carbon dioxide is first separated from other gases contained in industrial emissions.
- It is then compressed (dense, fluid, supercritical state) and transported to a location that is isolated from the atmosphere for long-term storage.

Three Methods for Capturing and Separating CO₂

- *Precombustion capture*: Before the fuel is burnt, the fuel is converted to syngas, and then the syngas to hydrogen and CO₂. Hydrogen is separated from CO₂ so the hydrogen can be used as fuel.
- *Post-combustion*: After the fuel is burnt, CO₂ is separated from nitrogen using chemical sorbents such as monoethanolamine.
- *Oxyfuel combustion*: Burning fuel in pure oxygen so no nitrogen is present in the captured gases

Suitable Storage Locations

- Deep saline formations (sedimentary rocks whose pore spaces are saturated with water containing high concentrations of dissolved salts)
- Depleted oil and gas reservoirs or deep, un-minable coal beds - Geological Sequestration
- Deep ocean - Sub sea floor Sequestration

It can also include use of artificial trees and scrubbing towers

Geologic Sequestration Trapping Mechanisms

- *Hydrodynamic Trapping*: CO₂ can be trapped as a gas under low-permeability cap rock (as natural gas is stored in gas reservoirs) .
- *Solubility Trapping*: CO₂ can be dissolved into a liquid like water or oil.
- *Mineral Carbonation*: CO₂ can react with minerals, fluids, and organic matter in a geologic formation to form stable compounds; largely calcium, iron, and magnesium carbonates.

Reuse

- Paper Filler
- House building material

- Solar Gasoline

Concern: *Leakage* of carbon from reservoirs but properly managed geological storage is very likely (that is, 66 – 90 percent probability) to retain 99 % of its sequestered CO₂ for over 1,000 years along with high *financial* costs.

Carbon sequestration activities have been supported through *CDM (Clean Development Mechanism) under Kyoto protocol* with a focus on afforestation, reforestation, improved forestry or agricultural practices, and revegetation

-Manishika

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