Carbon Sequestration Methods

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(Greentumble, 2019)

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CO_2 Emission

Main source:

- Fossil fuel combustion

(Fossil fuel use emits more than 80% of the carbon dioxide emitted by human activities; Deforestation and bio-metabolism account for 17% of global greenhouse gas emissions)

-fossil fuel consumption

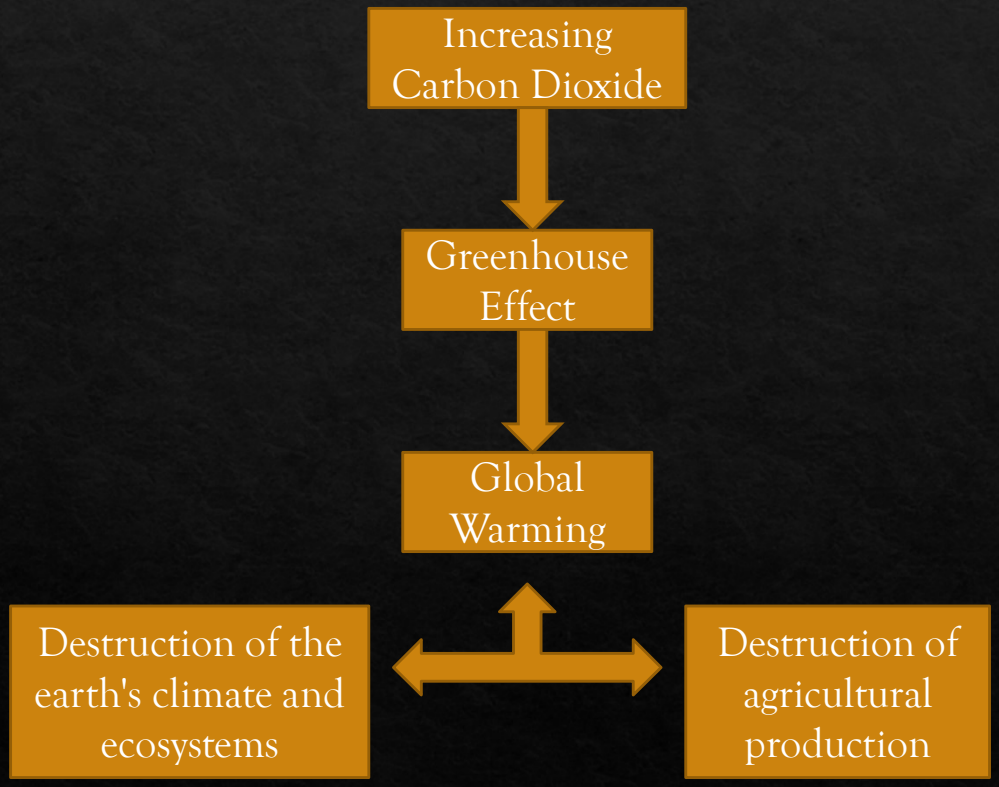
Petroleum: 42%

Coal: 37%

Gas: 22%

CO_2 Emission(Fagane, 2019)

The environmental and economical effects of carbon dioxide



Global warming (NASA, 2019)

Definition of Carbon Sequestration

Carbon sequestration is the process involved in carbon capture and the long-term storage of atmospheric carbon dioxide (CO_2) and may refer specifically to:

· The process of removing carbon from the atmosphere and depositing it in a reservoir. When carried out deliberately, this may also be referred to as carbon dioxide removal, which is a form of geoengineering.

· Carbon capture and storage, where carbon dioxide is removed from flue gases (e.g., at power stations) before being stored in underground reservoirs.

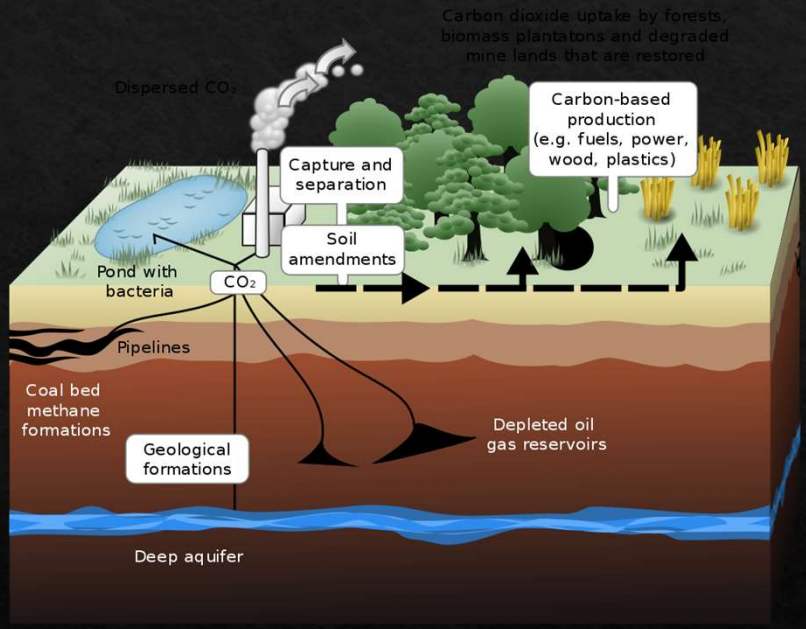
· Natural biogeochemical cycling of carbon between the atmosphere and reservoirs, such as by chemical weathering of rocks.

Importance of Carbon Sequestration

· Trees and Plants Absorb Carbon Dioxide and Produce Oxygen

· Preserving Forests Is Key Strategy to Help Reduce Global Warming

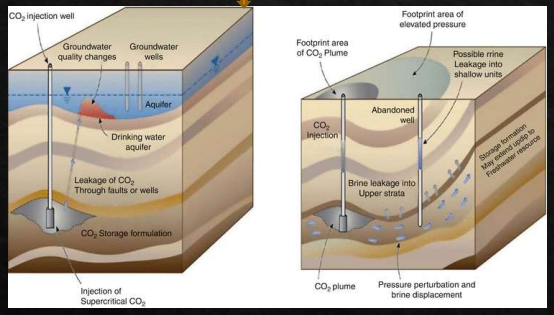
· Carbon Sequestration Can Help Mitigate Carbon Dioxide Emissions



Carbon Sequestration Process

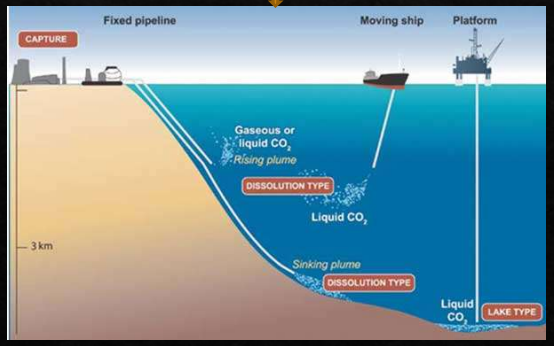
Types of Carbon Sequestration

Geological Sequestration

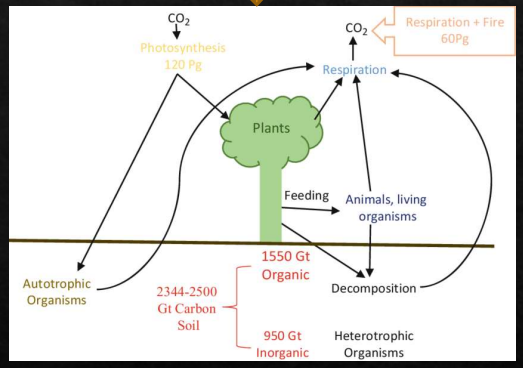


Geological Sequestration
(admin, 2017)

Ocean Sequestration

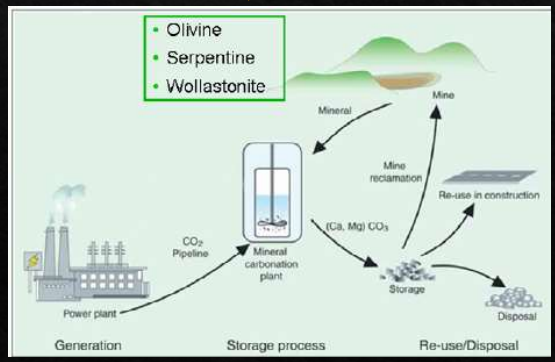


Terrestrial Sequestration



Terrestrial Sequestration
(Derrington, 2017)

Mineral Carbonation



Mineral Carbonation
(Sanna et al., 2014)

Geological Sequestration

· Geological sequestration is one of the most widely used methods of injecting CO_2 compression fluid into underground rock structures. Porous rock structures that contain or have previously contained fluids (such as natural gas, oil, and salt water) are potential sites of choice for CO_2 containment. Suitable storage structures exist in coastal and coastal sedimentary basins.

· The ideal location seal is the deep coal seam, oil field, depleted natural gas field and deep salt water bearing formation with no commercial exploitation value.

· Generally, the seal should be below 800m, and the temperature and pressure conditions at this depth can make CO_2 in a high-density liquid or supercritical state.

Technical capacity projections for global CO_2 sequestration, unit: Gt		
Types of sequestration sites	Minimum assessed potential	
Petro and gas field	675	900
Unworkable seam	3~15	200
Deep saline aquifer	1000	About 10000

Issues of geological sequestration:

· Difficult to seal up

· CO2 has the potential to go deep underground into fresh water and acidify it, causing heavy metals to melt in

· Affects surface soil composition

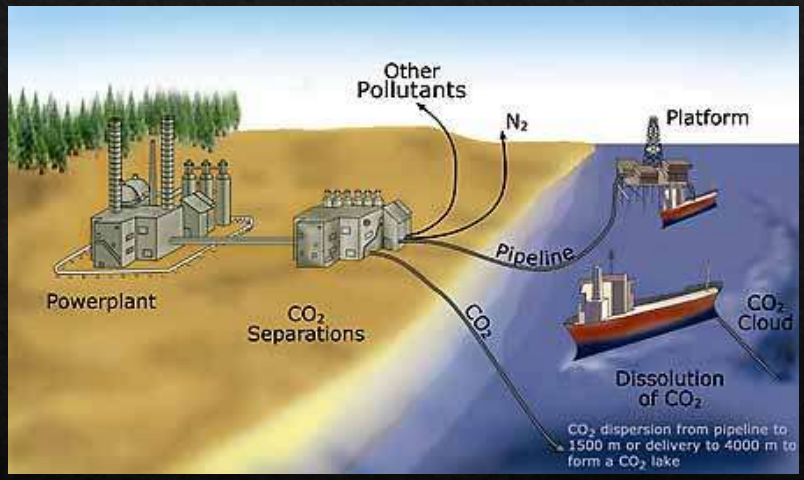
· As the CO2 recovery and separation injection will reduce the power plant efficiency and

· increase the cost of electricity

· There could be a leak problem

Ocean Sequestration

- Carbon is naturally stored in the ocean via two pumps, solubility and biological and there are analogous man made methods, direct injection and ocean fertilization, respectively.
- At the present time, approximately one third of human generated emission are estimated to be entering the ocean.



Terrestrial Sequestration

- The process through which CO2 from the atmosphere is absorbed naturally through photosynthesis and stored as carbon in biomass and soils

Mineral Carbonation

- Mineral carbonation sequestration utilizes carbon dioxide to chemically react with alkali and alkaline earth oxides (such as $MgCO_3$ and CaO) to convert carbon dioxide into solid inorganic carbonates (such as MgCO3 and CaCO3) so that carbon dioxide is fixed. The reaction formula is as follows.

$$(Mg, Ca)_xSi_yO_{x+2y} + xCO_2 \rightarrow x(Mg, Ca)CO_3 + ySiO_2$$

Current Problems

1. Security issues

· Safety is the key to CO_2 sequestration project. A large amount of CO2 leakage will cause significant environmental harm.

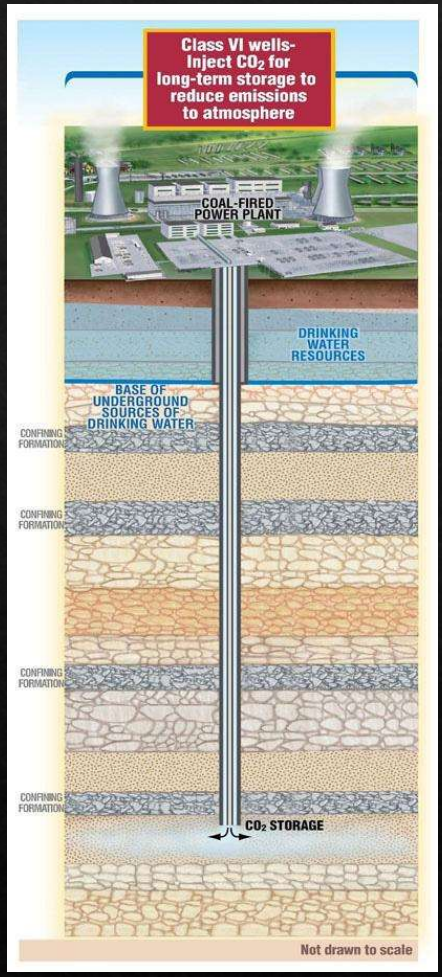
For example, in 1986, a volcanic eruption at the bottom of Lake Nyos in Cameroon suddenly released a large amount of CO_2 that had accumulated in the lake, causing more than 1,700 people and a large number of animals within a 25km area to suffocate to death.

CO2 Leakage of Lake Nyos in Cameroon

Current Problems

2. Economic problems

- The depth of the injection well controls the cost of storage, and the deeper the well, the higher the cost



Injection well (UIC, 2020)

Current Problems

3. Legal issues

- So far, only a few countries have specific laws and frameworks for CO_2 sequestration.
- The regulatory framework and responsibility for any CO2 storage site will need to clarify the role and financial responsibility of industry and government after the site is closed and permanently decommissioned.
- Long-term liability issues such as CO2 leakage into the atmosphere and environmental impacts remain unresolved.

Expectation

- Strengthen international cooperation and technical exchange on CO_2 storage

- In the context of the current shortage of international oil resources, sequestration technology is more attractive, and more experience in carbon sequestration should be accumulated

- Relevant government departments shall formulate relevant technical guidance and laws

Thank you !

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