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A STUDY OF MITIGATING CLIMATE CHANGE WITH CARBON CAPTURE AND STORAGE

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Abstract:

Carbon Capture was not taken seriously 30 years ago. New development has proven its importance. The international panel on climate change (IPCC) helps to spread awareness. Climate change is mitigated through fuels switch, energy efficiency, renewable and nuclear energy and upcoming technologies such as Carbon Capture and Storage (CCS). Carbon at its birth level is captured and stored deep underground. Most of the oil and natural gas plants are suitable choices for this upcoming technology therefore there is no need for entire plant to be built separately for CCS. Major hurdle is to spread awareness. Lack of knowledge about climate change and its problem stop policymakers to take actions immediately. In this paper the detailed study of carbon capture and storage is studied. Based on literature data it can be concluded that climate change can be mitigated by selecting appropriate carbon capture technologies.

Key Words: Carbon Capture, Climate Change, CO_2Storage & Enhanced Oil Recovery.

1. Introduction:

Earth Science Department of Oxford University reported that there was about 4 trillion tonnes of carbon in the form of coal, oil and natural gas. Over the past 250 years since industrial revolution humans have extracted half trillions. If current emission rate continues same half trillion tonnes will have been extracted in next 40 years [1]. The greenhouse gas making the largest contribution from human activities is carbon dioxide. It is released by burning fossil fuels and biomass as a fuel. A lot of research is done for carbon capture and storage. Carbon Capture and Storage (CCS) is a series of technologies for CO2 control that promises trapping up to 90% of the CO2 emissions from power stations and industrial sites. The concept of CO2 capture and storage is therefore based on a combination of known technologies applied to the new purpose of mitigating climate change [2]. Natural resources are going to be exhausted. There is need for an alternative energy source in future. None of the sources till date that are known are sufficient for the current enormous demand. Carbon released in the atmosphere has proven to be dangerous over the decades. To mitigate climate change there is a need of environmental friendly and cost effective technology.

2. Sources:

Power and industry sectors combined dominate current global CO2 emission with over 60% of entire emission. Boilers and furnaces burning fossil fuels are major sources. Coal is currently the dominant fuel in the power sector. Residential and transport sectors contribute around 30% of the global CO2 emission.

Even with an alternative energy sources such as biomass energy, bioethanol, synthetic liquid fuels production or the co-production of the liquid fuels and electricity via gasification of coal and other solid feedstocks orpetroleum residuals there is generation of concentrated streams of CO2 [2].

3. Capture:

There are four basic systems for capturing CO2 from use of fossil fuels and/or biomass:

A) Capture from Industrial Process Streams: Current examples of CO2 capture from process streams are purification of natural gas and production of hydrogen containing synthesis gas for the manufacture of ammonia, alcohols and synthetic liquid fuels. Most of the techniques employed for CO_2 capture in the examples mentioned are also similar to those used in pre-combustion capture. Other industrial process streams which are a source of CO_2 that is not captured include cement and steel production, and fermentation processes for food and drink production. CO_2 could be captured from these streams using techniques that are common to post-combustion capture, oxyfuel combustion capture and pre-combustion capture [2].

B) Post-Combustion Capture: Capture of CO_2 from flue gases produced by combustion of fossil fuels and biomass in air is referred to as post-combustion capture. Instead of being discharged directly to the atmosphere, flue gas is passed through equipment which separates most of the CO_2. The CO_2 is fed to a storage reservoir and the remaining flue gas is discharged to the atmosphere [3].

C) Oxy-Fuel Combustion Capture: In oxy-fuel combustion, nearly pure oxygen is used for combustion instead of air, resulting in a flue gas that is mainly CO_2 and H_2O. If fuel is burnt in pure oxygen, the flame temperature is excessively high, but CO_2 and / or H_2O rich flue gas can be recycled to the combustor to moderate this. Oxygen is usually produced by low temperature (cryogenic) air separation and novel techniques to supply oxygen to the fuel, such as membranes and chemical looping cycles are being developed. The power plant systems of reference for oxy-fuel combustion capture systems are the same as those noted above for post-combustion capture system [4].

D) Pre-Combustion Capture: Pre-combustion capture involves reacting a fuel with oxygen or air and/or steam to give mainly a 'synthesis gas (syngas)' or 'fuel gas' composed of carbon monoxide and hydrogen. The carbon monoxide is reacted with steam in a catalytic reactor, called a shift converter, to give CO_2 and more hydrogen. CO_2 is then separated, usually by a physical or chemical absorption process, resulting in a hydrogen-rich fuel which can be used in many applications, such as boilers, furnaces, gas turbines, engines and fuel cells [2].

4. Storage:

Storage is typically of two types geological and ocean. The subsurface is the earth's largest carbon reservoir where the vast majority of world's carbon held in coals, oil, gas, organic rich shales and carbonated rocks. Geological storage of CO_2 has been a natural process in the earth's upper crust for hundreds of millions of years.

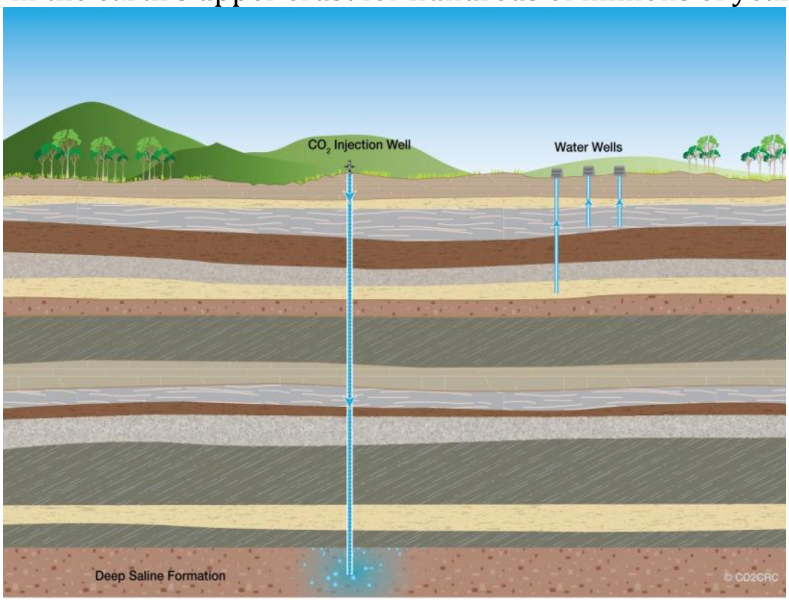

Figure 1: Geological Storage[5]

To geologically stored CO2, it must be compressed, usually to a dense fluid state known as 'supercritical'. Depending on the rate the temperature increases with depth until 800m [6].

Geological storage of CO2 can be undertaken in variety of geological settings in sedimentary basins. A number of pilot and commercial CO2 storage are underway or proposed as shown in Figure 1 [5].

The engineered injection of CO2 into subsurface geological formation was first undertaken in Texas, USA, in early 1970s as part of Enhanced Oil Recovery (EOR) [7].

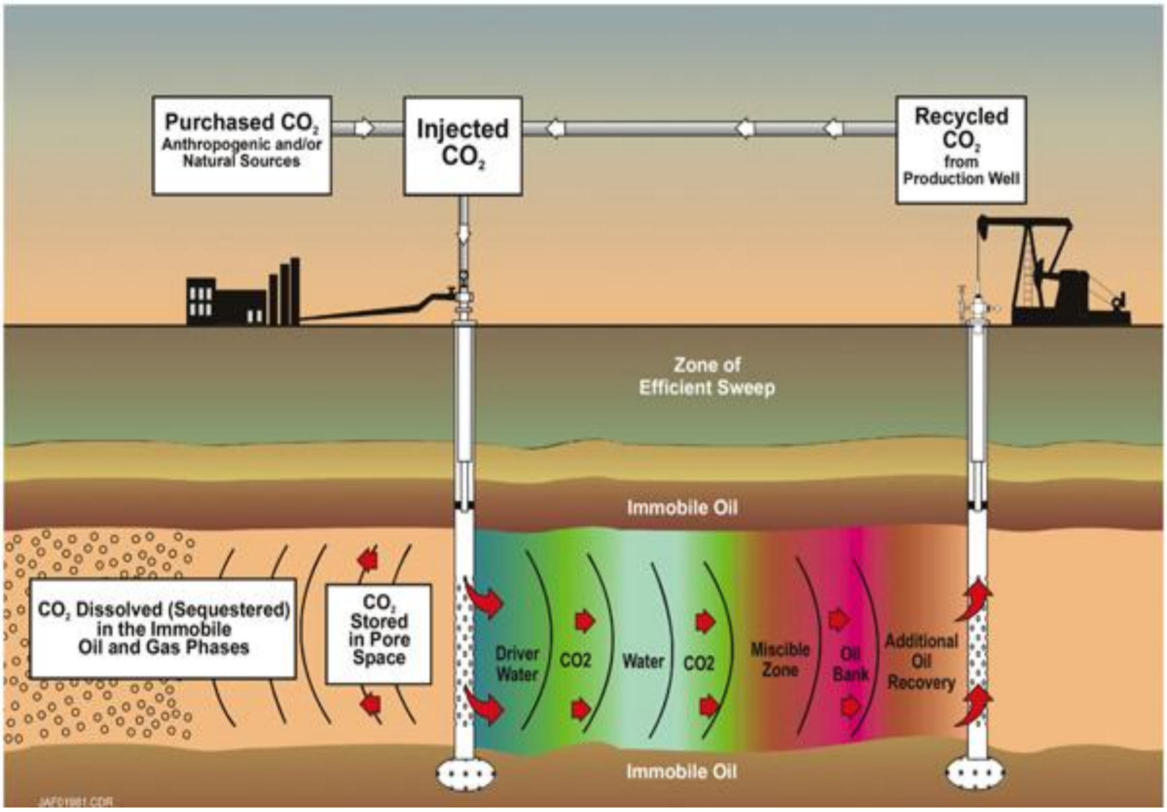

Figure 2: The Rangeley, Colorado, CO2-EOR project[7]

Opportunities for EOR have increased interest in CO2 storage EOR through flooding offers potential economic growth from incremental oil production. Depleted oil and gas reservoirs are primary candidates for CO2 storage for several reasons [8]. There are two main methods for EOR using CO_2: one uses just CO_2, whilst the other process uses alternate injection of CO_2 and water, to move the oil through the reservoir and towards production wells. The latter process is expected to be used in the majority of fields due to the payback time generally being shorter.

5. Conclusion:

Carbon Capture and Storage is a promising technology in the fight against climate change. Project as big as CCS needs government interventions, support and public awareness. Critics of climate change may find high risk and high cost pertaining CCS but with no effective option left it will be too late in future to act and restore balance if necessary steps are not taken.

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