

A REVIEW OF CO₂ EMISSIONS, CAPTURE, STORAGE, AND PREVENTION IN VARIOUS INDUSTRIAL PROCESSES

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Abstract

Carbon dioxide is Greenhouse Gas (heat trapping gas), climatic conditions changed by the percentage of CO₂ values in the atmosphere. Results increasing the temperature of atmosphere increase the sea levels, caused for floods and acidify rain falls. CO₂ releases into the atmosphere due to burning non-renewable energy sources (coal, fossil fuel), industries, automobiles etc. balancing the CO₂ levels in atmosphere and hydrosphere by the plants and phytoplankton's (which may absorb CO₂ and give O₂) these are the CO₂ primary captures. Ocean water more acidic nature due to increase CO₂% in the sea (Ocean acidification). Burning issue at present is Global warming, which is by the releases of greenhouse gases into the atmosphere etc. all are the countries focused on this topic, first one is prevention the releases of greenhouse gases and most second one is capturing the CO₂ (expensive method). Methods are used, physical, chemical adsorption methods post combustion, oxy combustion and pre combustion methods. Storage important thing, CO₂ stored in the deep oceans and deep geological formations (formations inaccessible for the escaping Carbon dioxide) capturing CO₂ in the cement industries, used in the production of clinkering, desalination of water, metal industries and oil fields.

Keywords- Nonrenewable energy sources, Greenhouse gases, Global warming, Combustion, Geological formations.

1. INTRODUCTION

World's energy is depending on Carbon (6C12). Carbon dioxide is a trace gas; CO₂ plays a significant role in the atmosphere. In Carbon cycle CO₂ swapping between the Lithosphere (rocks), atmosphere, biosphere and hydrosphere. Photosynthesis reaction in between the Carbon dioxide and water to produce carbohydrates by the plants. All most all the living organisms depend on the plants for food. CO₂ is the main source for generating carbohydrates. Carbon dioxide releases by combustion of carbon and hydrogen results produce the heat, with gaseous products, water and ash etc. For industrial uses industries to manufacture quicklime (CaO) by heating calcium carbonate (thermal decomposition reaction) at about 850°C which causes for carbon dioxide emission. Temperature of the earth averagely 15°C (59°F), allows for life to exist. Percentage of the Carbon Dioxide in the atmosphere is 288ppm (in 2000) now present 414ppm (2020), increased doubly. Temperature increased in the atmosphere due carbon dioxide levels increased in the atmosphere, caused global warming.

Pollution from fossil fuels accounts for 30.7% of the accidental deaths in India every year, according to a report. Every year, 27 lakhs of people die from inhaling toxic air. Consumption of fossil fuels died 80 lakhs of people worldwide in 2018.

Developed countries decided to decrease the CO₂ levels in the atmosphere, by the Carbon Capturing, Storage and utilization (CCS).



Figure 1 KTPS – PALONCHA

Capture the CO₂ from the source points, which are industrial areas, power generating plants by the plants on the earth, phytoplankton in the oceans. Technically developed countries different methods used to capture the Carbon dioxide, methods are post combustion, oxy combustion and pre combustion.

2. CARBON CAPTURING, TRANSPORTATION AND STORAGE

According to the 2019 analysis, globally 17 CCS (Carbon Capture and Storage) projects operating the carbon capturing and storage. It extracts about 31.5 m tons of carbon dioxide from the atmosphere each year. US in 2018 most CO₂ emitted country in the world, i.e., 5 billion metric tons of CO₂.

In UK “Drax Power Station” ambition is to Zero Carbon (completely removing CO₂ in the air by 2030). This power station captured one tone of CO₂ per day from the air. There are 51 large CCS facilities operating worldwide for CCS’s mission.

XPRIZE Elon Musk announced prize money \$100M for the project of carbon negativity or neutrality on 21 Jan 2021.

After capturing the CO₂, is compressed into the fluid, then transported into a source points with the help of pipelines, ships and storage vehicles. Finally, Carbon dioxide injected into the deep geological formations. Maintain the storage conditions in the points for long term stored CO₂.

GHGs emission by economic sector majorly emits the CO₂ by the Generation of Electricity, followed by Agriculture, forestry and other land uses, etc. (Fig-2).

GHGs releases from burning fossil fuels, industrial activities and deforestation etc. (Fig-3).

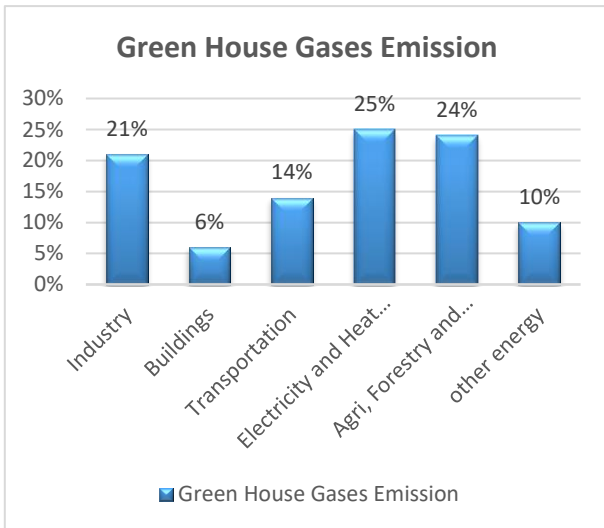


Figure 2 Greenhouse gases emission

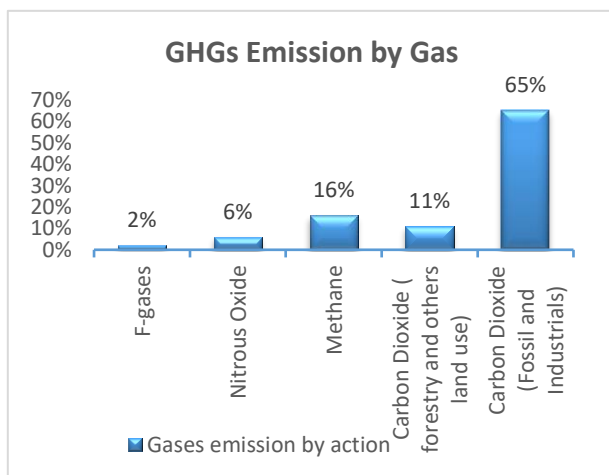


Figure 3 Gases emission by action

Carbon dioxide comprises 74% of GHGs emission, CO₂ emission from the burning fossil fuels, generation of electricity and heat, transportation, manufacturing and consumption. 7% of carbon dioxide emissions from human activities are mainly deforestation and so on. 41% grown of GHGs emission from 1990 to 2016 recorded annually. 30% of the GHGs releases into the atmosphere for generating electricity by using nonrenewable sources. The equivalent emissions of CO₂ in 2019 were 59.1 gigatons. It is highest record. In the year 2020 emission of carbon dioxide fall down due to pandemic situation.

In (Covid-19) pandemic situation 2020 has been shut down the industries, transportation facilities and record fall in fossil fuel emission in 2020. Decreasing the usage of fuels is the reason for decrease the emissions of GHGs

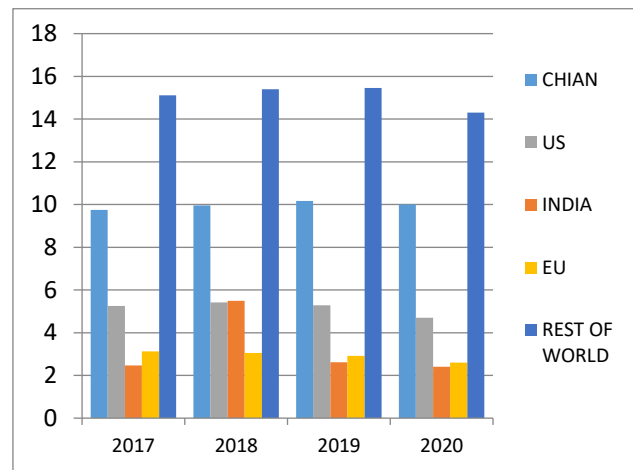


Figure 4 Global CO2 emission in gigatons from fossil fuel by region 2017-2020 in. (Global Carbon Project)

3. GHGS EMISSION CALCULATION

GHGs Emission (CO₂, CH₄, N₂O) = 0.001 × (Fuel Usage × High Heat Value × Emission Factor)

CO₂ equivalent = GWP × GHGs (in tons)

Where- GWP is Global Warming Potential.

GWP, Determine the ratio of heat trapped by one unit mass of the specific GHGs to that of one unit mass of CO₂ over a specified time period.

CCS project capacity increased by 33% in 2019.

IEAR reports, CCS aims to absorb 400 million tones of CO₂ emission a year by 2025.

Primarily to catch the carbon dioxide by using existing power plants-post combustion carbon dioxide separated from the captured gas. Industrial appliances of emission CO₂, involves gasifying fuels and separating out the carbon dioxide.

It is the way to catch the CO₂, fuel is burning with the pure oxygen, which results high concentrated stream of CO₂ emission. Carbon separation techniques followed by membrane, absorption, adsorption oxy fuel combustion, chemical looping combustion etc. It’s compressed into a fluid and transported to storage sites by the pipelines, ships and vehicles.

4. STORAGE POINTS

The best way to capture carbon dioxide into the deep geological formations, storage sites in the underground, coal fields (not mining area), saline formations, oil gas fields, and mineral sites.

Choose coal fields because carbon dioxide attaches to the surface of the coal.

Saline aquifers, brine (NaCl) not used for humans, so easy to store carbon dioxide and it has also large potential storage volume.

Storage point of view trapping mechanism plays significant role because prevent the CO₂ escape, such as structural trapping, mineral trapping, solubility trapping, and residual trapping.

Another way to degrade the CO₂ percentage which is stored into the containers with the algae, bacteria etc. it is geochemical injection method.

Mineral storage point, in this way unfortunately carbon dioxide releases which reacts (exothermal reaction) with available metal oxides to produce carbonates. A long time ago limestone formed in this manner.

An important aspect is monitoring the storage sites.

- Monitor geological storage sites
- Surface monitoring
- Seismic nature monitoring near the storage points
- Monitoring the changes in the geological formations.

Utilizations of captured CO₂:

- Chemical synthesis
- Algae cultivation
- Carbon – neutral fuels
- Carbon mineralization (to produce methane gas)
- Concrete building materials.
- Liquid fuels.

5. CONCLUSION

Global warming is to reach 1.5°C between 2030 and 2052. Human activities caused for 1.0°C of global warming. Effects of climate change on human beings and natural systems. Regarding this strongly I suggested that capturing of carbon dioxide and sequestration.

Reducing the uses of fossil fuels is the major thing to control the emission of carbon dioxide. Change from diesel/petrol vehicles to Electric vehicles. Can it save us? Not surely, but increasing the earth's life and constantly maintain the climatic conditions by reducing the carbon dioxide emission and capturing the CO₂. Carbon dioxide levels increased in the atmosphere results climate change, acid rains, greenhouse effect, rising the sea levels and human health impacts.

Globally, forests store CO₂ almost a third of the world's emissions. Afforestation is the solution to decrease the carbon dioxide levels in the air.

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