

8.9 CARBON DIOXIDE SEQUESTRATION

Over the last century, human activity had a profound impact on the environment. Fossil fuel consumption, deforestation, and other unsustainable land use practices have resulted in a dramatic increase of carbon dioxide (CO_2) and other greenhouse gas (GHG) emissions into the atmosphere. Most scientists believe the increase of CO_2 emissions has created the human-induced climate warming conditions that are currently affecting the globe. If this trend continues, climate change will be the inevitable result. The long-term effects of global temperature change are largely unknown; however, adverse effects can already be seen in certain parts of the world in the form of droughts, increased severity of storms, and flooding, particularly in the poorer regions of the globe.

The natural production and absorption of carbon dioxide (CO_2) is achieved through the earth's biosphere and oceans. However, mankind has altered the natural carbon cycle by burning coal, oil, natural gas, and wood and each of these activities has increased in scale and distribution. Carbon dioxide was the first greenhouse gas demonstrated to be increasing in atmospheric concentration.

Atmospheric levels of CO_2 have risen well over 30% from pre-industrial levels of 280 parts per million (ppm) to present levels of 418.60 ppm. Evidence suggests this observed rise in atmospheric CO_2 levels is due primarily to expanding use of fossil fuels for energy. Predictions of global energy use in the next century suggest a continued increase in carbon emissions and rising concentrations of CO_2 in the atmosphere unless major changes are made in the way we produce and use energy - in particular, how we manage carbon. One way to manage carbon is to use energy more efficiently to reduce our need for a major energy and carbon source - fossil fuel combustion. Another way is to increase our use of low-carbon and carbon-free fuels and technologies (nuclear power and renewable sources such as solar energy, wind power, and biomass fuels). The most recent alternative for managing carbon is sequestration.

Carbon sequestration refers to the provision of long-term storage of carbon in the terrestrial biosphere, underground, or oceans, to reduce the buildup of carbon dioxide (the principal green-house gas) concentration in the atmosphere. This is accomplished by maintaining or enhancing natural processes, or the development of new techniques to dispose off carbon.

The main natural sinks are (i) Oceans which take up one third of anthropogenic emissions of CO_2 , (ii) plants and other organisms that use photosynthesis to remove carbon from the atmosphere by incorporating it into biomass and release oxygen into the atmosphere, and (iii) soils which contain more organic carbon than is contained in vegetation and atmosphere together.

Enhancing Natural Sequestration

However, the natural CO_2 sequestration in the environment is not able to cope up with the increasing anthropogenic emissions, thus natural sequestration processes are enhanced. For instance, reforestation can increase the capacity of forests to act as sink. In the oceans, micrometer-sized iron particles in the form of hematite (iron oxide) or melanterite

2019 non-fossil
↓ solar, wind, hydel & Nuclear
134 GW

(iron sulphate) are added to water to increase the carbon sequestration efficiency. The addition of iron particles stimulate the growth of phytoplankton, which in turn remove significant quantities of CO_2 from the atmosphere via photosynthesis. However, phytoplankton have a complex effect on cloud formation via the release of dimethyl sulfide (DMS) that is converted to sulfate aerosols in the atmosphere, providing cloud condensation nuclei (CCN). But the effect of small scale plankton blooms on overall production of DMS is still unknown. In soil, no-till farming, cover cropping and crop rotation methods are used to significantly enhance carbon sequestration. Conversion to pastureland with good management of grazing, can also increase carbon sequestration in soils. ③

Artificial Sequestration

For carbon to be sequestered artificially (i.e. not using the natural processes of the carbon cycle) it must first be captured, or it must be significantly delayed or prevented from being re-released in the atmosphere (by combustion decay, etc.) from an existing carbon-rich material, by being incorporated into an enduring usage (such as in construction). Thereafter it can be passively stored or remain productively utilized over time in a variety of ways.

① In the oceans 1986 Lake Nyos disaster at Cameroon
the carbon dioxide is directly pumped into the water at depth and is expected to form lakes of liquid CO_2 at the bottom. However, this method could have dangerous consequences. The CO_2 could react with water to form carbonic acid, although most (as much as 99%) remain as dissolved molecular CO_2 .

② The method of Geo-sequestration or geological storage involves injecting carbon dioxide directly into underground geological formations. Declining oil fields, saline aquifers, and unminable coal seams have been suggested as storage sites. Caverns and old mines that are commonly used to store natural gas are not considered, because of a lack of storage safety.

③ Biosequestration of CO_2 involves plantation of biodiesel crops such as *Jatropha curcas*, switch grass and algal species etc.

According to Kyoto Protocol CO_2 should be brought down to 1990 level for the sustainable development. Thus CO_2 and other related green house gases are being considered for the carbon trading under Clean Development Mechanism (CDM) in the stock exchanges. CDM is an arrangement under Kyoto Protocol allowing industrialized countries with green house gas reduction commitment to invest in projects that reduce emissions in developing countries as an alternative to more expensive emission reduction in their own countries. An industrialised country that wishes to get credits from a CDM project must obtain the consent of the developing country hosting the project that it will contribute to sustainable development. The project is then submitted to CDM Executive Board for approval. Once the project is approved and registered, the CDM Executive board issues credits called Certified Emission Reduction (CERs) commonly known as carbon credits where each unit is equivalent to the reduction of one metric tonne of CO_2 or its equivalent to the project participants based on the monitored difference between baseline and actual emissions. (Carbon credits are discussed in the last unit in detail).

Damodar Valley
Coalfield
Eastern India

13.6 GREEN BENCH

Environmental Pollution has become a global problem. Hence every country developed/developing are putting emphasis on ways to minimize the environmental degradation. Laws are made in many countries for the protection of the environment. The Supreme Court (Apex court) of India also felt the need to establishing the Green Benches in different High courts in various states of India to deal with the environmental issues within the state. The first Green Bench was established in the High court and started functioning in 1996. Till 2000 A.D. there are about 900 cases reported to the Green Bench.

The cases reported to Green Bench are related to various kinds of environment related issues such as:

- (a) Industries especially the small scale industries which do not have adequate pollution control system and hence cause violations to the existing norms.
- (b) Illegal filling of water bodies/lakes and direct effluent discharge into the rivers etc.
- (c) Cutting/felling of trees
- (d) Automobile emissions causing tremendous air pollution
- (e) Hazardous wastes (from hospitals etc.) which are not segregated and directly mixed with the Municipal solid waste
- (f) Ineffective waste collection system by the municipalities of various state (garbage is dumped on the streets directly).
- (g) Construction of dams (famous Narmada dam) for development and in turn causing environmental degradation and may others.

On 23rd July 2007, the centre had asked bluntly the 'Supreme Court' to wind up its Green Bench because it felt that the Bench had outlived its utility. In a special case concerning the preservation of forests the Centre felt that the hearings in the apex court clearly favoured the people who were experts in law and not in forestry. Hence it had asked the court to wind up the "Forest Bench" and dispose of the writ petitions seeking a direction to the Centre and States and to take more adequate and effective steps to conserve and increase the forest cover of the country.

13.7 CARBON CREDITS

One of the environmental threats our planet is facing today are the long term changes in the earth's temperature and climatic pattern. This is known as **Global Climate Change**. Scientists are estimating that as a result of global climatic changes, the Earth's temperature could increase by as much as six and a half degree (6.5°) Fahrenheit by the year 2100. This increase in temperature could result in the melting of glaciers, increase in the rise of sea levels to more than three feet and many other changes in the natural and human systems. To prevent this sort of disruption, on our planet efforts should be made to control global climatic changes. An important step in this process was made in 1997 when over 2500 scientists from the world agreed that emissions of the six green house

Carbon dioxide, Methane, Nitrous Oxide, Hydrofluoro carbons (HFCs), Perfluoro carbons (PFCs), Sulfur Hexafluoride (SF_6) from human activities have influenced the global climate. Thus on 16th February 2005, the 'Kyoto Protocol' finally came into force. This protocol aimed to solve the problem of global warming by setting target levels for nations to reduce the green house gas emissions to 5.2 per cent below 1990 level by the year 2012.

The Kyoto Mechanism

The Kyoto Protocol has three innovative mechanisms for reducing the green house gas emissions. They are:

(i) Joint Implementation (ji)

It is a project based mechanism in which the developed countries (Annexure 1 countries) can reduce their emission targets through joint projects with other Annexure 1 developed countries. Here the investors could be Government companies, Private sectors etc. which will participate in the project activities of the host country to generate **Emission Reduction Units (ERUs)** to use them for compliance with targets under the Kyoto Protocol.

(ii) Clean Development Mechanism (CDM):

This mechanism is established by Article 12 of the Kyoto Protocol for project based emissions reduction activities in the **developing country**. The main objective of the mechanism is to meet the sustainable development needs of the host country which is a developing country. This would also help in reducing the emissions level of green house gases of the developed country which has invested in the projects in the host country.

(iii) International Emission Trading (IET):

In this mechanism, a country may allocate permits to individual companies for the emission of a certain quantity of green house gases allotted by the Kyoto commitments. If a country is incapable of meeting its target, it could buy permits from other countries. Similarly companies within a country that can reduce there emissions limits to a level lower than the allowed limit can 'sell' or 'trade' their excess **carbon credits** to other polluting countries.

As discussed in Unit-8, Carbon credits, as defined by the Kyoto Protocol are one metric ton of carbon dioxide emitted. The current prices of credits range from 25 Euros to 29 Euros. e.g. DMRC (Delhi Metro Rail Corporation) earned 4.2 crores of carbon credits by selling 82,000 CER's in 2008, for using regenerative braking system that reduces 30% electricity consumption.

Carbon Credits for Indian Scenario

India being a developing country is exempted from the requirement of adhering to the Kyoto Protocol. However it can sell the carbon credits to the

developed countries. The sectors which can generate the carbon credits are projects in wind mills, Bio-diesel, Co-generation, Bio-gas, afforestation etc.

The protocol is designed not only to reduce the climatic ill effects of the industrialization but identify the economic beneficiaries (i.e. the developing countries) and make them more accountable in the damage control.

Carbon Trading and Carbon Credits

Carbon trading is part of the large emission trading which is a method to control pollution by using economic incentives. In emission trading a central authority such as a government or an international body like the European Union sets a limit on the amount of the emitted pollutants. The allowance to emit pollution is called 'credit' and if the pollutant emitted is carbon dioxide, it is called carbon credit. If an industry or a company exceeds its emission level it will have to buy the extra allowance or credits from the countries which pollute less.

Merits of Carbon Credits

The following are the advantages of carbon credits:

- This allows the total quantum of emissions to be controlled without having to micromanage emissions by each firm.
- This concept penalizes the party polluting the environment by making it pay for the credit while the seller is rewarded monetarily.

Demerits of Carbon Credits

- Instead of policies that reduce emission, strict regulations, and penalties for polluters, this trading provides elaborate get out clauses for the biggest polluters.
- Carbon trading is a new form of colonialism where the developed countries would continue to pollute the atmosphere by buying the credits from the developing countries.
- Licences and credits will have no value without effective enforcement as the industries or companies may find it far less expensive to corrupt inspectors than to purchase emission licenses.

Markets Set up for the Trading

Different markets have been set up for different emissions. For carbon trading, the European Union is the largest multinational trading centre where all the 27 members of the union are involved. The programs covered under this, caps the amount of carbondioxide that can be emitted from large installations such as the power plants. The markets to reduce the acid rain is in the US where trading of nitrous oxide takes place. Markets for other pollutants tend to be smaller and more localised.