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SUB NAME: GLOBAL WARMING AND CLIMATE CHANGE

Unit II MITIGATION MEASURE, EMISSION TARGETS AND CARBON TRADING

Introduction-reduction of Carbon dioxide emissions from power generation-Carbon credits-carbon dioxide from vehicle-miscellaneous source of carbon dioxide-uptake of carbon dioxide by vegetation

INTRODUCTION:

- Mitigation measures are means **to prevent, reduce or control adverse environmental effects of a project**, and include restitution for any damage to the environment caused by those effects through replacement, restoration, compensation or any other means

- Mitigation measures **provide for a system to reduce, avoid or offset the potential adverse environmental consequences of development activities**. Their objective is to maximize project benefits and minimize undesirable impacts.

The types of mitigation enumerated by CEQ are compatible with the requirements of the Guidelines; however, as a practical matter, they can be combined to form three general types of mitigation: **avoidance, minimization, and compensatory mitigation**

CARBON DI OXIDE:

- It is a colorless gas with a foul odor which is combustible
- It is a gas formed by the chemical combination of sulfur and oxygen.
- Carbon dioxide is a colorless,odorless,combustible gas.
- Carbon dioxide is a colorless,odorless,combustible gas formed by the chemical combination of carbon and oxygen.

Carbon dioxide is a greenhouse gas: **a gas that absorbs and radiates heat**. Warmed by sunlight, Earth's land and ocean surfaces continuously radiate thermal infrared energy (heat).

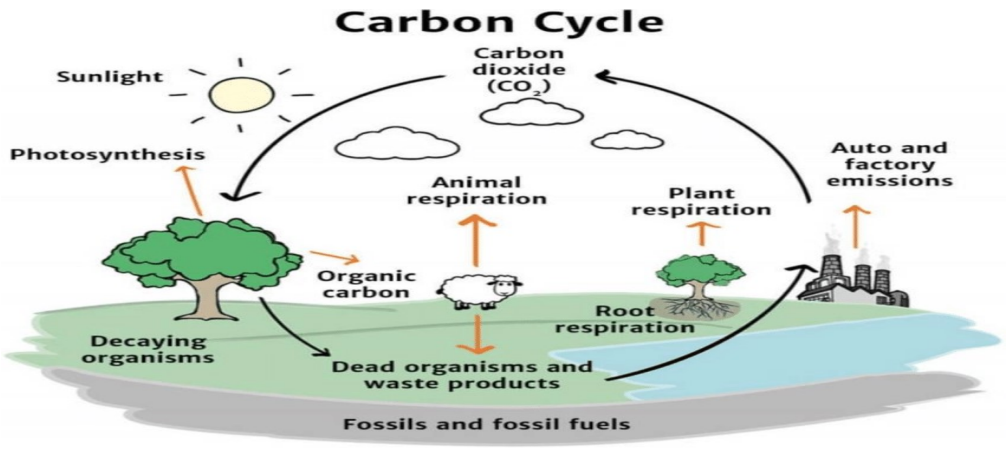
Four Stages of Carbon:

- Photosynthesis,
- Decomposition,
- Respiration and
- Combustion.

Carbon cycles from the atmosphere into plants and living things. For example, carbon is a pollutant in the atmosphere as carbon dioxide.

CARBON CYCLE:

- Carbon moves from the atmosphere to plants.
- Carbon moves from plants to animals.
- Carbon moves from plants anad animals to soils.
- Carbon moves from living things to the atmosphere.
- Carbon moves from fossil fuels to the atmosphere when fuels are burned.
- Carbon moves from the atmosphere to the oceans.



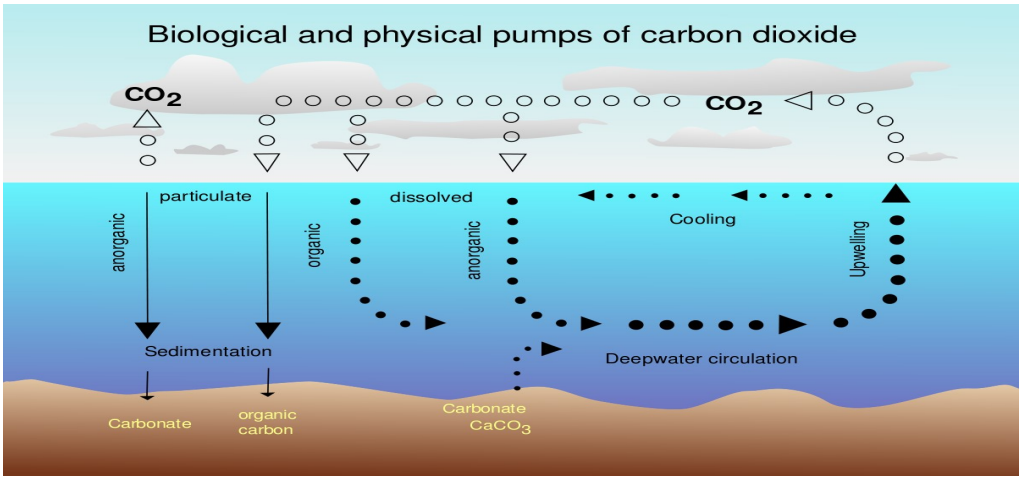
Main sources of carbon dioxide emissions There are both natural and human sources of carbon dioxide emissions. Natural sources include decomposition, ocean release and respiration. Human sources come from activities like cement production, deforestation as well as the burning of fossil fuels like coal, oil and natural gas.

Due to human activities, the atmospheric concentration of carbon dioxide has been rising extensively since the Industrial Revolution and has now reached dangerous levels not seen in the last 3 million years Human sources of carbon dioxide emissions are much smaller than natural emissions but they have upset the natural balance that existed for many thousands of years before the influence of humans.

This is because natural sinks remove around the same quantity of carbon dioxide from the atmosphere than are produced by natural sources.This had kept carbon dioxide levels balanced and in a safe range. But human sources of emissions have upset the natural balance by adding extra carbon dioxide to the atmosphere without removing any.

Biological and Physical pumps of carbon dioxide:

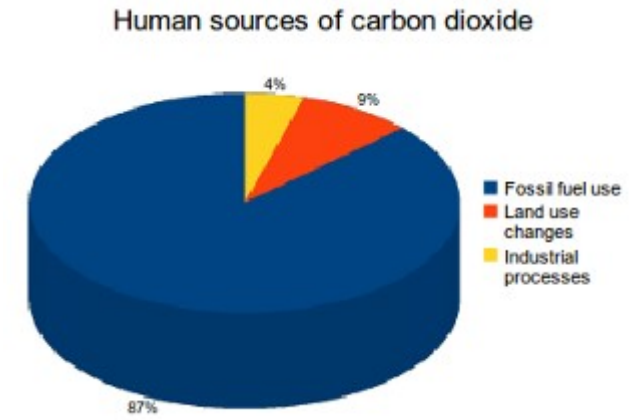
The biological pump, in essence, removes carbon dioxide from the surface water of the ocean, changing it into living matter and distributing it to the deeper water layers, where it is out of contact with the atmosphere. Three main processes (or pumps) that make up the marine carbon cycle bring atmospheric carbon dioxide (CO_2) into the ocean interior and distribute it through the oceans. These three pumps are: **(1) the solubility pump, (2) the carbonate pump, and (3) the biological pump**



Carbon Dioxide Emissions: Human Sources

Since the Industrial Revolution, human sources of carbon dioxide emissions have been growing. Human activities such as the burning of oil, coal and gas, as well as deforestation are the primary cause of the increased carbon dioxide concentrations in the atmosphere.

87 percent of all human-produced carbon dioxide emissions come from the burning of fossil fuels like coal, natural gas and oil. The remainder results from the clearing of forests and other land use changes (9%), as well as some industrial processes such as cement manufacturing (4%).



Fossil fuel combustion/use

The largest human source of carbon dioxide emissions is from the combustion of fossil fuels. This produces 87% of human carbon dioxide emissions. Burning these fuels releases energy which is most commonly turned into heat, electricity or power for transportation. Some examples of where they are used are in power plants, cars, planes and industrial facilities. In 2011, fossil fuel use created 33.2 billion tonnes of carbon dioxide emissions worldwide.

The 3 types of fossil fuels that are used the most are coal, natural gas and oil. Coal is responsible for 43% of carbon dioxide emissions from fuel combustion, 36% is produced by oil and 20% from natural gas.

Coal is the most carbon intensive fossil fuel. For every tonne of coal burned, approximately 2.5 tonnes of CO_2e are produced. Of all the different types of fossil fuels, coal produces the most carbon dioxide. Because of this and it's high rate of use, coal is the largest fossil fuel source of carbon dioxide emissions. Coal represents one-third of fossil fuels' share of world total primary energy supply but is responsible for 43% of carbon dioxide emissions from fossil fuel use.

Anything involving fossil fuels has a carbon dioxide emission ticket attached. So for example, burning these fuels releases energy but carbon dioxide also gets produced as a by-product. This is because almost all the carbon that is stored in fossil fuels gets transformed to carbon dioxide during this process.

The three main economic sectors that use fossil fuels are: electricity/heat, transportation and industry. The first two sectors, electricity/heat and transportation, produced nearly two-thirds of global carbon dioxide emissions in 2010

Electricity/Heat sector

Electricity and heat generation is the economic sector that produces the largest amount of man-made carbon dioxide emissions. This sector produced 41% of fossil fuel related carbon dioxide emissions in 2010. Around the world, this sector relies heavily on coal, the most carbon-intensive of fossil fuels, explaining this sector giant carbon footprint.

Almost all industrialized nations get the majority of their electricity from the combustion of fossil fuels (around 60-90%). Only Canada and France are the exception. Depending on the energy mix of your local power company you probably will find that the electricity that you use at home and at work has a considerable impact on greenhouse gas emissions.

The industrial, residential and commercial sectors are the main users of electricity covering 92% of usage. Industry is the largest consumer of the three because certain manufacturing processes are very energy intensive. Specifically, the production of chemicals, iron/steel, cement, aluminium as well as pulp and paper account for the great majority of industrial electricity use. The residential and commercial sectors are also heavily reliant on electricity for meeting their energy needs, particularly for lighting, heating, air conditioning and appliances.

Transportation sector

The transportation sector is the second largest source of anthropogenic carbon dioxide emissions. Transporting goods and people around the world produced 22% of fossil fuel related carbon dioxide emissions in 2010. This sector is very energy intensive and it uses petroleum based fuels (gasoline, diesel, kerosene, etc.) almost exclusively to meet those needs. Since the 1990s, transport related emissions have grown rapidly, increasing by 45% in less than 2 decades.

Road transport accounts for 72% of this sector's carbon dioxide emissions. Automobiles, freight and light-duty trucks are the main sources of emissions for the whole transport sector and emissions from these three have steadily grown since 1990. Apart from road vehicles, the other important sources of emissions for this sector are marine shipping and global aviation.

Marine shipping produces 14% of all transport carbon dioxide emissions. While there are a lot less ships than road vehicles used in the transportation sector, ships burn the dirtiest fuel on the market, a fuel that is so unrefined that it can be solid enough to be walked across at room temperature. Because of this, marine shipping is responsible for over 1 billion tonnes of carbon dioxide emissions. This is more than the annual emissions of several industrialized countries (Germany, South Korea, Canada, UK, etc.) and this sector continues to grow rapidly.

Global aviation accounts for 11% of all transport carbon dioxide emissions. International flights create about 62% of these emissions with domestic flights representing the remaining 38%. Over the last 10 years, aviation has been one of the fastest growing sources of carbon dioxide emissions. Aviation is also the most carbon-intensive form of transportation, so it's growth comes with a heavy impact on climate change.

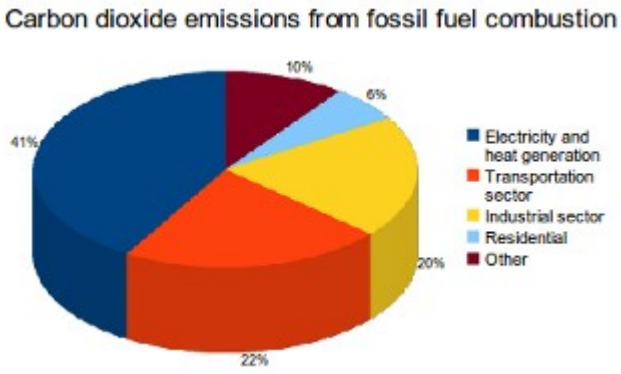


Figure 2 highlights one of the most alarming trends in today's modern economy. Emissions caused by the transportation of people and goods have grown so rapidly that it has surpassed emissions from the industrial sector, which has had a huge impact on climate change. This trend started in the 1990's and has continued ever since causing an increase in indirect emissions.

The emissions caused by the transportation of goods are examples of indirect emissions since the consumer has no direct control of the distance between the factory and the store. The emissions caused by people travelling (by car, plane, train, etc...) are examples of direct emissions since people can chose where they are going and by what method.

Since the distance travelled by goods during production is continuing to grow, this is putting more pressure on the transportation industry to bridge the gap and ends up creating more indirect emissions. What's worse is that 99% of the carbon dioxide emissions caused by transportation of people and goods all over the world comes from the combustion of fossil fuels.

Industrial sector

The industrial sector is the third largest source of man-made carbon dioxide emissions. This sector produced 20% of fossil fuel related carbon dioxide emissions in 2010.The industrial sector consists of manufacturing, construction, mining, and agriculture. Manufacturing is the largest of the 4 and can be broken down into 5 main categories: paper, food, petroleum refineries, chemicals, and metal/mineral products. These categories account for the vast majority of the fossil fuel use and CO2 emissions by this sector.

Manufacturing and industrial processes all combine to produce large amounts of each type of greenhouse gas but specifically large amounts of CO2. This is because many manufacturing facilities directly use fossil fuels to create heat and steam needed at various stages of production. For example factories in the cement industry, have to heat up limestone to 1450°C to turn it into cement, which is done by burning fossil fuels to create the required heat.

Land use changes

Land use changes are a substantial source of carbon dioxide emissions globally, accounting for 9% of human carbon dioxide emissions and contributed 3.3 billion tonnes of carbon dioxide emissions in 2011. Land use changes are when the natural environment is converted into areas for human use like agricultural land or settlements. From 1850 to 2000, land use and land use change released an estimated 396-690 billion tonnes of carbon dioxide to the atmosphere, or about 28-40% of total anthropogenic carbon dioxide emissions.

Deforestation has been responsible for the great majority of these emissions. Deforestation is the permanent removal of standing forests and is the most important type of land use change because its impact on greenhouse gas emissions. Forests in many areas have been cleared for timber or burned for conversion to farms and pastures. When forested land is cleared, large quantities of greenhouse gases are released and this ends up increasing carbon dioxide levels in three different ways.

Trees act as a carbon sink. They remove carbon dioxide from the atmosphere via photosynthesis. When forests are cleared to create farms or pastures, trees are cut down and either burnt or left to rot, which adds carbon dioxide to the atmosphere.

Since deforestation reduces the amount of trees, this also reduces how much carbon dioxide can be removed by the Earth's forests. When deforestation is done to create new agricultural land, the crops that replace the trees also act as a carbon sink, but they are not as effective as forests. When trees are cut for lumber the wood is kept which locks the carbon in it but the carbon sink provided by forests is reduced because of the loss of trees.

Deforestation also causes serious changes in how carbon is stored in the soil. When forested land is cleared, soil disturbance and increased rates of decomposition in converted soils both create carbon dioxide emissions. This also increases soil erosion and nutrient leaching which further reduces the area's ability to act as a carbon sink.

Industrial processes

There are many industrial processes that produce significant amounts of carbon dioxide emissions as a by product of chemical reactions needed in their production process. Industrial processes account for 4% of human carbon dioxide emissions and contributed 1.7 billion tonnes of carbon dioxide emissions in 2011.

Many industrial processes emit carbon dioxide directly through fossil fuel combustion as well indirectly through the use of electricity that is generated using fossil fuels. But there are four main types of industrial process that are a significant source of carbon dioxide emissions: the production and consumption of mineral products such as cement, the production of metals such as iron and steel, as well as the production of chemicals and petrochemical products.

Cement production produces the most amount of carbon dioxide amongst all industrial processes. To create the main ingredient in cement, calcium oxide, limestone is chemically transformed by heating it to very high temperatures. This process produces large quantities of carbon dioxide as a by-product of the chemical reaction. So much so that making 1000 kg of cement produces nearly 900 kg of carbon dioxide.

Steel production is another industrial process that is an important source of carbon dioxide emissions. To create steel, iron is melted and refined to lower its carbon content. This process uses oxygen to combine with the carbon in iron which creates carbon dioxide. On average, 1.9 tonnes of CO_2 are emitted for every tonne of steel produced.

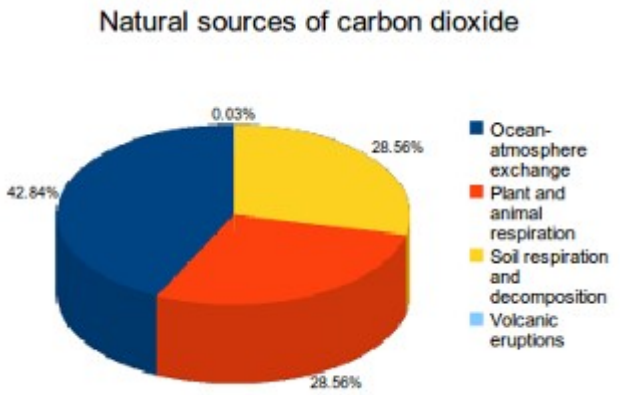
Fossil fuels are used to create chemicals and petrochemical products which lead to carbon dioxide emissions. The industrial production of ammonia and hydrogen most often uses natural gas or other fossil fuels as a starting base, creating carbon dioxide in the process. Petrochemical products like plastics, solvents, and lubricants are created using petroleum. These products evaporate, dissolve, or wear out over time releasing even more carbon dioxide during the product's life.

Carbon Dioxide Emissions: Natural Sources

Apart from being created by human activities, carbon dioxide is also released into the atmosphere by natural processes. The Earth's oceans, soil, plants, animals and volcanoes are all natural sources of carbon dioxide emissions.

Human sources of carbon dioxide are much smaller than natural emissions but they upset the balance in the carbon cycle that existed before the Industrial Revolution. The amount of carbon dioxide produced by natural sources is completely offset by natural carbon sinks and has been for thousands of years. Before the influence of humans, carbon dioxide levels were quite steady because of this natural balance.

42.84 percent of all naturally produced carbon dioxide emissions come from ocean-atmosphere exchange. Other important natural sources include plant and animal respiration (28.56%) as well as soil respiration and decomposition (28.56%). A minor amount is also created by volcanic eruptions (0.03%).



Ocean-atmosphere exchange

The largest natural source of carbon dioxide emissions is from ocean-atmosphere exchange. This produces 42.84% of natural carbon dioxide emissions. The oceans contain dissolved carbon dioxide, which is released into the air at the sea surface. Annually this process creates about 330 billion tonnes of carbon dioxide emissions.

Many molecules move between the ocean and the atmosphere through the process of diffusion, carbon dioxide is one of them. This movement is in both directions, so the oceans release carbon dioxide but they also absorb it. The effects of this movement can be seen quite easily, when water is left to sit in a glass for long enough, gases will be released and create air bubbles. Carbon dioxide is amongst the gases that are in the air bubbles.

Plant and animal respiration

An important natural source of carbon dioxide is plant and animal respiration, which accounts for 28.56% of natural emissions. Carbon dioxide is a by-product of the chemical reaction that plants and animals use to produce the energy they need. Annually this process creates about 220 billion tonnes of carbon dioxide emissions.

Plants and animals use respiration to produce energy, which is used to fuel basic activities like movement and growth. The process uses oxygen to break down nutrients like sugars, proteins and fats. This releases energy that can be used by the organism but also creates water and carbon dioxide as by-products.

Soil respiration and decomposition

Another important natural source of carbon dioxide is soil respiration and decomposition, which accounts for 28.56% of natural emissions. Many organisms that live in the Earth's soil use respiration to produce energy. Amongst them are decomposers who break down dead organic material. Both of these processes releases carbon dioxide as a by-product. Annually these soil organisms create about 220 billion tonnes of carbon dioxide emissions.

Any respiration that occurs below-ground is considered soil respiration. Plant roots, bacteria, fungi and soil animals use respiration to create the energy they need to survive but this also produces carbon dioxide. Decomposers that work underground breaking down organic matter (like dead trees, leaves and animals) are also included in this. Carbon dioxide is regularly released during decomposition.

Volcanic eruptions

A minor amount carbon dioxide is created by volcanic eruptions, which accounts for 0.03% of natural emissions. Volcanic eruptions release magma, ash, dust and gases from deep below the Earth's surface. One of the gases released is carbon dioxide. Annually this process creates about 0.15 to 0.26 billion tonnes of carbon dioxide emissions.

The most common volcanic gases are water vapour, carbon dioxide, and sulphur dioxide. Volcanic activity will cause magma to absorb these gases, while passing through the Earth's mantle and crust. During eruptions, the gases are then released into the atmosphere.

Carbon emission standards in India:

Since October 2010, **Bharat Stage (BS) III norms** have been enforced across the country. In 13 major cities, Bharat Stage IV emission norms have been in place since April 2010 and it has been enforced for entire country since April 2017.

Bharat stage emission standards (BSES) are **emission standards instituted by the Government of India to regulate the output of air pollutants from compression ignition engines and Spark-ignition engines equipment, including motor vehicles**.

Carbon credit:

A carbon credit is a permit that allows the owner to emit a certain amount of carbon dioxide or other greenhouse gases. One credit permits the emission of one ton of carbon dioxide or the equivalent in other greenhouse gases.

The carbon credit is half of a so-called "cap-and-trade" program. Companies that pollute are awarded credits that allow them to continue to pollute up to a certain limit. That limit is reduced periodically. Meanwhile, the company may sell any unneeded credits to another company that needs them.

Private companies are thus doubly incentivized to reduce greenhouse emissions. First, they must spend money on extra credits if their emissions exceed the cap. Second, they can make money by reducing their emissions and selling their excess allowances.

There are two types of credits:

- Voluntary emissions reduction (VER): A carbon offset that is exchanged in the over-the-counter or voluntary market for credits.
- Certified emissions reduction (CER): Emission units (or credits) created through a regulatory framework with the purpose of offsetting a project's emissions.3

Worldwide Carbon Credit Initiatives:

The United Nations' Intergovernmental Panel on Climate Change (IPCC) developed a carbon credit proposal to reduce worldwide carbon emissions in a 1997 agreement known as the Kyoto Protocol. The agreement set binding emission reduction targets for the countries that signed it. Another agreement, known as the Marrakesh Accords, spelled out the rules for how the system would work.[5]

The Kyoto Protocol divided countries into industrialized and developing economies. Industrialized countries, collectively called Annex 1, operated in their own emissions trading market. If a country emitted less than its target amount of hydrocarbons, it could sell its surplus credits to countries that did not achieve its Kyoto level goals, through an Emission Reduction Purchase Agreement (ERPA).

The separate Clean Development Mechanism for developing countries issued carbon credits called a Certified Emission Reduction (CER). A developing nation could receive these credits for supporting sustainable development initiatives. The trading of CERs took place in a separate market.

Carbon Trading:

Carbon trade is **the buying and selling of credits that permit a company or other entity to emit a certain amount of carbon dioxide or other greenhouse gases**.

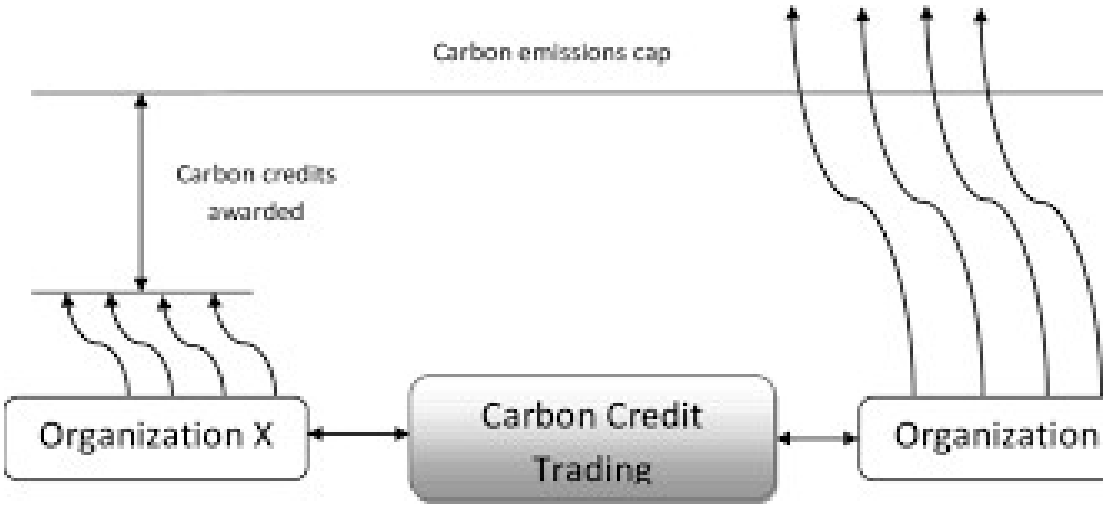
Carbon trading is **an important instrument for internalizing the external costs of air pollution**. Zero-emission wind power produces energy that contributes to the efforts to combat climate change.

Carbon trading is **the process of buying and selling permits and credits that allow the permit holder to emit carbon dioxide**. It has been a central pillar of the EU's efforts to slow climate change. The world's biggest carbon trading system is the European Union Emissions Trading System (EU ETS).

Two types of carbon market exist; **the regulatory compliance and the voluntary markets**. The compliance market is used by companies and governments that by law have to account for their GHG emissions

Carbon Trading Work:

They work **by setting an overall limit or cap on the amount of emissions that are allowed from significant sources of carbon**, including the power industry, automotive and air travel. Governments then issue permits up to the agreed limit, and these are either given free or auctioned to companies in the sector.



Benefits of Carbon Trading:

The combination of an absolute cap on the level of emissions permitted and the carbon price signal from trading helps businesses to identify low-cost methods of reducing emissions on site, such as investing in energy efficiency – which can lead to a further reduction in overheads.

The basis for the environmental benefit of selling carbon credits is that they offer "additionality," either by removing carbon from the atmosphere, such as by planting trees, or by preventing emissions from other sources, for instance by replacing coal burning with wind turbines, or protecting forests

- Sellers and intermediaries can hedge against price risk.
- There is no counterparty risk as the exchange guarantees the trade.
- The price discovery on the exchange platform ensures a fair price for both the buyer and the seller.
- Players are brought to a single platform, thus eliminating the laborious process of identifying either buyers or sellers with enough credibility.

How to co2 emissions are reduced:

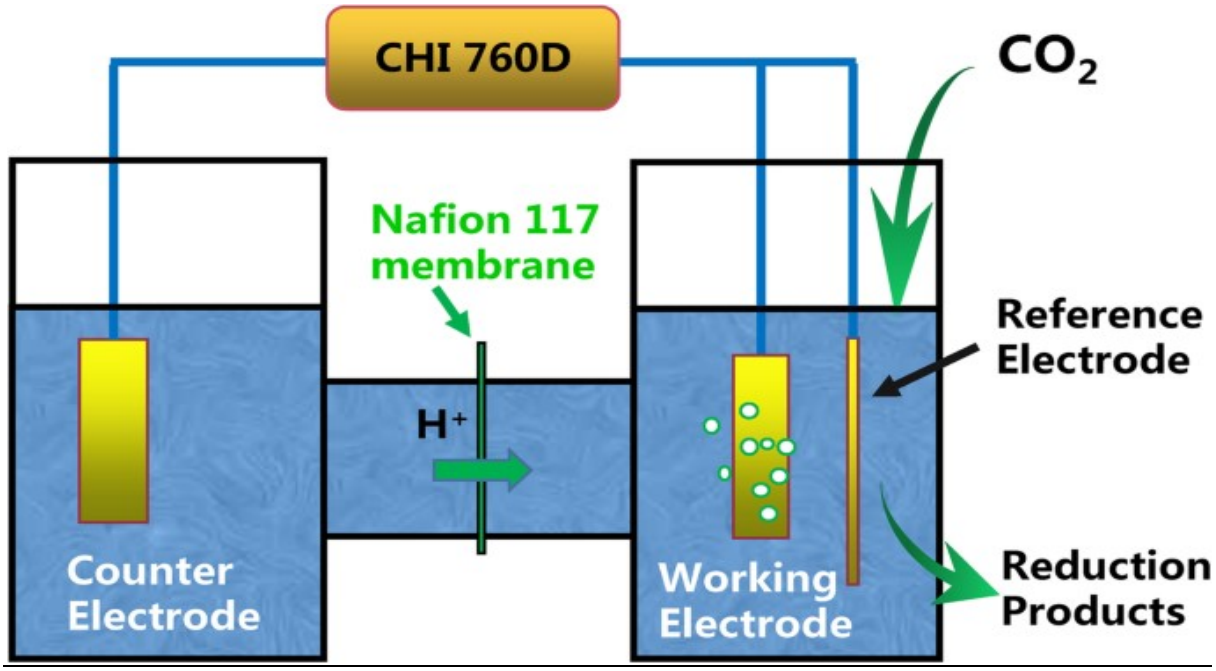
- Greenhouse gas emissions can be reduced by making power on-site with renewables and other climate-friendly energy resources. Examples include rooftop solar panels, solar water heating, small-scale wind generation, fuel cells powered by natural gas or renewable hydrogen, and geothermal energy.

CO2 be reduced into carbon:

- The electrochemical reduction of carbon dioxide is the conversion of carbon dioxide (CO_2) to more reduced chemical species using electrical energy. The first examples of electrochemical reduction of carbon dioxide are from the 19th century, when carbon dioxide was reduced to carbon monoxide using a zinc cathode.

Electro chemical Reduction:

- An electrochemical process is a chemical reaction caused by the applied electrical current
- It involves oxidation–reduction reactions where an atom or molecule is formed with the gain or loss of electrons by the charged ions.



Electrochemical reduction of carbon dioxide represents a possible means of producing chemicals or fuels, converting carbon dioxide (CO_2) to organic feedstock's such as formic acid (HCOOH),[2] carbon monoxide (CO), methane (CH_4), ethylene (C_2H_4) and ethanol (C_2H_5OH).[3][4][5] Among the more selective metallic catalysts in this field are tin for formic acid, silver for carbon monoxide and copper for methane, ethylene or ethanol. Methanol, propanol and 1-butanol have also been produced via CO2 electrochemical reduction, albeit in small quantities.

Chemicals from carbon dioxide

In carbon fixation, plants convert carbon dioxide into sugars, from which many biosynthetic pathways originate. The catalyst responsible for this conversion, RuBisCO, is the most common protein on earth. Some anaerobic organisms employ enzymes to convert CO_2 to carbon monoxide, from which fatty acids can be made.[12]

In industry, a few products are made from CO_2, including urea, salicylic acid, methanol, and certain inorganic and organic carbonates.[13] In the laboratory, carbon dioxide is sometimes used to prepare carboxylic acids in a process known as carboxylation. No electrochemical CO_2 electrolyser that operates at room temperature has been commercialized. Elevated temperature solid oxide electrolyser cells (SOECs) for CO_2 reduction to CO are commercially available.

Emission reductions of CO_2:

A combination of several of the following approaches:

End-use efficiency improvements and conservation.

- Supply side efficiency improvements.
- Capture and sequestration of CO2 in subterranean reservoirs or in the deep ocean.
- Utilization of CO2 for enhanced oil and natural gas recovery and for enhanced biomass production.
- Shift to no fossil energy sources**.**

End-Use Efficiency Improvements and Conservation:

In the residential-commercial sector:

- Lowering the thermostat in the winter (less heating), raising it in the summer (less air conditioning), better insulation, less hot water use, using fluorescent lighting, and so on.

In the industrial sector:

- The largest savings could come from reductions in direct use of fossil fuels, process modification, energy-efficient motors, better heat exchangers, and so on.

In the transportation sector:

- **Smaller, lightweight automobiles to hybrid electric-internal combustion engine or fuel-cell-powered vehicles.**

Supply-Side Efficiency Improvements:

Mean principally electricity supply by supply-side efficiency Improvements.

Options to reduce carbon emissions:

- Shift from coal to natural gas.
- Replacement of single-cycle gas-fired steam power plants with combined cycle gas turbine plants (CCGT).
- Replacement of single-cycle coal-fired power plants with gas-fired CCGT.
- Replacement of single-cycle coal-fired power plants with coal-derived synthetic gas-fired combined cycle gas turbine plants.

CO_2 Capture:

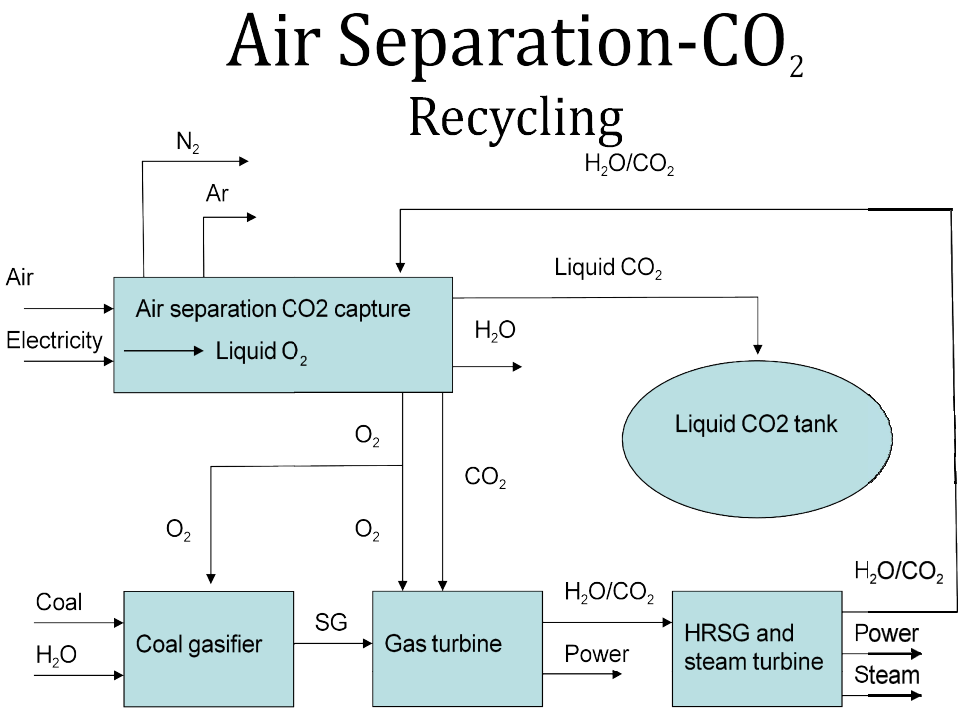
- The volume fraction of CO_2 in the flue gas of fossil fuel electric power plants ranges: 9% to 15%.
- The Capture of CO2 is quite difficult and expensive.
- The Capture of CO2 is only worthwhile in large power plants.
- So, The Capture of CO2 from all the world's large coal- fired power plants would make a significant dent in the global carbon emissions.

The technologies for CO2 capture from power plants:

- Air separation-CO2 recycling
- Solvent absorption
- Membrane gas separation

Air Separation-CO2 Recycling:

- **This method is based on combustion of the fossil fuel in pure oxygen, instead of air.**
- **A plant using this method requires an air separation unit.**



Schematic of an integrated coal gasification combined cycle power plant with CO_2 capture

-Heat recovery steam generator (HRSG);

Solvent Absorption:

CO_2 is soluble in some solvents:

Notably ethanolamines, e.g., monoethanolamine (MEA)

Absorption proceeds at low temperatures, whereas desorption occurs at elevated temperatures:

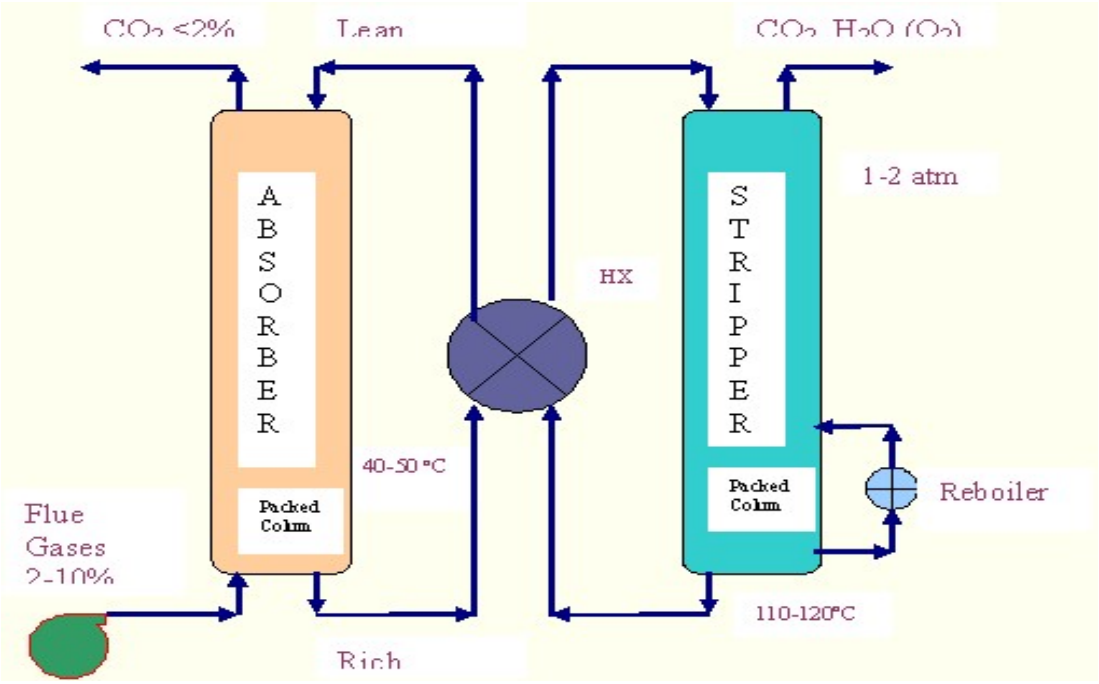
$C_2H_4OHNH_2 + H_2O+CO_2 \longleftarrow C2H4OHNH3 + HCO3 +$.

- Solvent absorption has been used for decades for producing CO2 from flue gas.

The thermal efficiency of a coal gasification combined cycle power plant with CO2 capture by MEA is 30-35% compared to 40-45% without capture, and the cost increment of electricity production is around 50%.

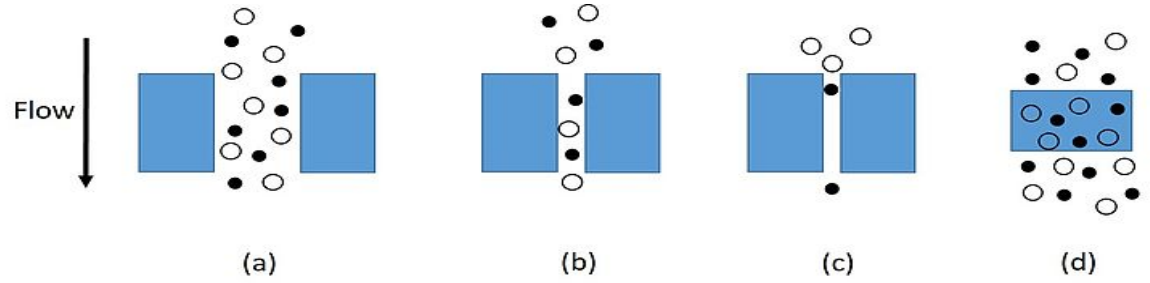
Thus, this method is less efficient and costlier than estimated for air separation CO2 recycling.

But, this technology is well established.



Membrane Gas Separation:

Membrane separation process is **a process where a membrane is used to separate the components in a solution by rejecting unwanted substances and allowing the others to pass through the membrane**. The role of the membrane is also to change the composition of a solution on the basis of relative permeation rates.



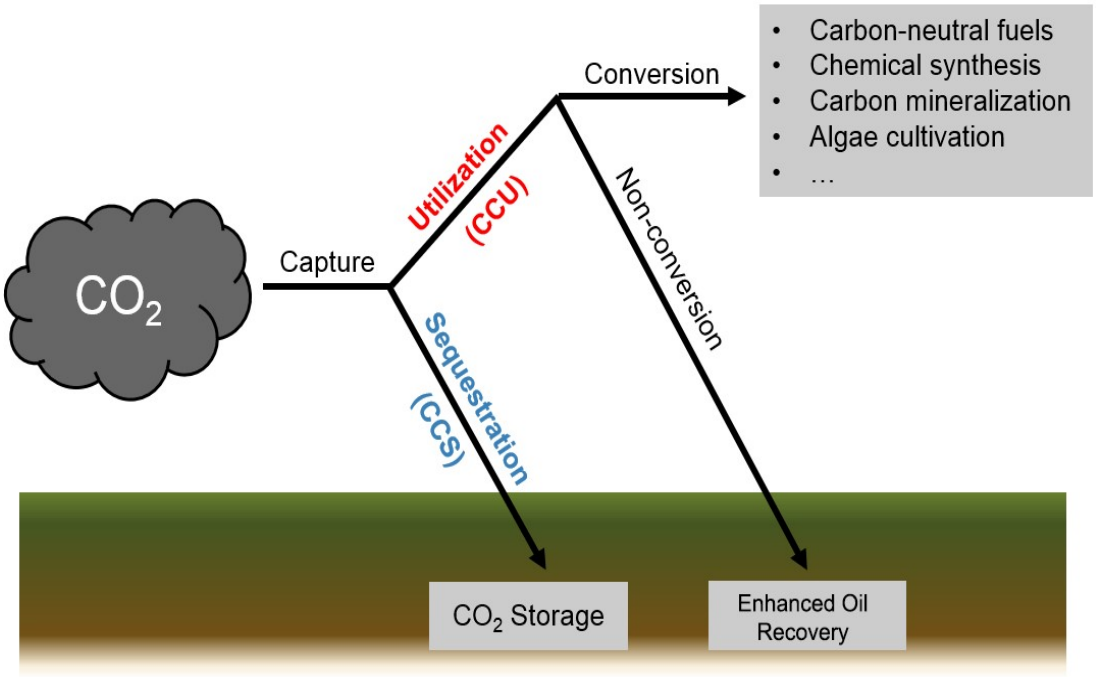
Carbon Capture:

Carbon capture, utilization and storage (CCUS), also referred to as carbon capture, utilization and sequestration, is a process that **captures carbon dioxide emissions from sources like coal-fired power plants and either reuses or stores it so it will not enter the atmosphere**.

Carbon Capture Technologies:

1. Considered the first step towards large-scale capture, CO2 is removed from exhaust gas after combustion. This technology can be retrofitted to existing equipment.
2. Pre-Combustion Decarbonisation (Hydrogen) Natural Gas is converted to hydrogen and CO2 in a reformer. The CO2 is compressed for storage and the hydrogen is mixed with air for combustion, emitting only nitrogen and water.
3. Oxy fuel

Oxygen is separated from air and then burned with hydrocarbons to produce an exhaust with a high concentration of CO2 for storage



Uptake CO2 by vegetation:

When light is abundant, plants open the pores in their leaves to take in carbon dioxide (CO_2) which they subsequently convert to carbohydrates in a process called photosynthesis. At the same time, a hundred times more water escapes through the micro valves than carbon dioxide flows in.

CO2 do plants uptake:

As a result, they likely overestimate the potential of land to draw down carbon dioxide from Earth's atmosphere. Plants and soils together currently absorb an estimated **30 percent of the CO_2 emitted by human activities each year**

The process of plants absorbing carbon dioxide:

Plants absorb carbon dioxide from the air, combine it with water and light, and make carbohydrates — the process known as **photosynthesis**. It is well established that as CO_2 in the atmosphere increases, the rate of photosynthesis increases

Vegetation regions can be divided into five major types:

Forest, grassland, tundra, desert, and ice sheet.

Climate, soil, the ability of soil to hold water, and the slope, or angle, of the land all determine what types of plants will grow in a particular region.

Carbon footprint:

The amount of carbon dioxide released into the atmosphere as a result of the activities of a particular individual, organisation or community.

For example, we produce greenhouse gas emissions from **burning gasoline when we drive, burning oil or gas for home heating, or using electricity generated from coal, natural gas, and oil**. Greenhouse gas emissions vary among individuals depending on a person's location, habits, and personal choices.

Limit your carbon footprint:

- Consume local and seasonal products (forget strawberries in winter)
- Limit meat consumption, especially beef.
- Select fish from sustainable fishing.
- Bring reusable shopping bags and avoid products with excessive plastic packaging.
- Make sure to buy only what you need, to avoid waste.

Ocean Acidification:

When carbon dioxide (CO_2) is absorbed by seawater, chemical reactions occur that reduce seawater pH, carbonate ion concentration, and saturation states of biologically important calcium carbonate minerals.

Causes of Ocean Acidification:

Ocean acidification is mainly caused by **carbon dioxide gas in the atmosphere dissolving into the ocean**. This leads to a lowering of the water's pH, making the ocean more acidic. Many factors contribute to rising carbon dioxide levels