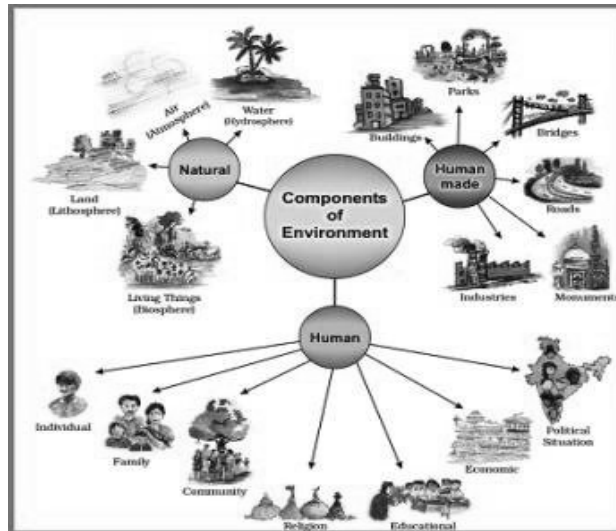




Meaning and Definition

- The term environment has been derived from a French word "*Environia*" means *to surround*.
- It refers to both **abiotic** (physical or non-living) and **biotic** (living) environment.
- The word environment means surroundings, in which organisms live.
- "*Environment is anything immediately surrounding an object and exerting a direct influence on it.*" - P. Gisbert

Components of Environment



Problems related to environment

- Deforestation*
- Forest fires*
- Ozone depletion*
- Acid rain*
- Climate change*
- Pollution*
- Overexploitation of resources*

Related environmental problems

- Population growth*
- Urbanization*
- Poverty*
- Food insecurity*
- Disease*
- Peak oil and energy security*
- Conflict and displacement*



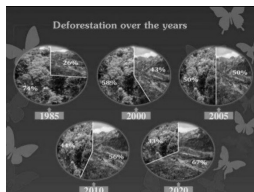


Deforestation



Deforestation is

- *An act of intentional removal of forests without the intention of reforesting it*
- **Temporary or permanent removal of vegetation** in the forest to an extent that *it no longer support its natural flora and fauna.*



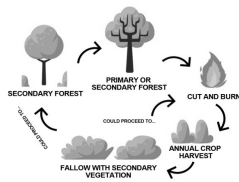
Impacts of deforestation



- *Emission of green house gases – global warming*
- *Soil erosion*
- *Loss of habitat*
- *Decline in biodiversity – some extinct*
- *Disturbed water cycle*
- *Cause floods*
- *Harm economics – Health, Monsoon, Fertilizer, Tourism, Migration etc.,*

Some facts....

- Forests cover *more than 30%* of the Earth's land surface (WWF)
- *One and a half acres* of forest is cut down every second.
- By the year 2030, we might only have 10% of Rainforests left and it can all disappear in a hundred years.
- **Half** of the world's tropical forests has already been cleared.
- Up to **28,000 species can go extinct** in the next quarter century due to deforestation.

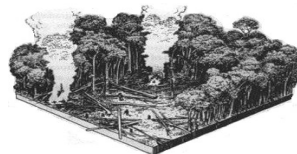


OVERPOPULATION



Causes

- *Defective and incomplete implementation of Nation Forest Policies – 1894 and 1952*
- *Shifting Cultivation*
- *Mining*
- *Encroachment*
- *Urban expansion*
- *Population growth*
- *Development Projects etc.,*



Control of deforestation

- Individual level
 - Reduce – Reuse – Recycle
 - *Chipko movement*
- Government level
 - Implementation of security measures and strict laws - prevent illegal logging.
 - EIA
 - Investing - new technologies- eco-friendly agricultural practices



- Banning inefficient agricultural practices
- Facilitating the production and use of wood alternatives - reduce the demand for timber.
- Reforestation campaigns – *Vanmahotsav*, Social Forestry
- Spread the awareness

New initiatives

- Green Raksha bandhan
- Human status to trees
- UN-REDD and REDD+



Chipko Movement

- *Nonviolent social and ecological movement* by rural villagers, particularly women, in India
- Aimed at *protecting trees and forests*
- **Origin** - Himalayan region of Uttar Pradesh (later Uttarakhand) in 1973

History



- **18th century** – Rajasthan – Amrita devi
- **1963** - China –India border conflict
- **UP** – growth in development
- Interior roads – attracted logging
- Rural villagers – dependent on forests
- Forest policies – *denied access* to villagers
- **1964** - Gandhian social activist
- **Chandi Prasad Bhatt** - cooperative organization -*Dasholi Gram Swarajya Mandal (DGSM)* - foster small industries
- **1970** - industrial logging -*severe monsoon floods* – killed >200





- **First Chipko** - village of **Mandal** in the upper **Alaknanda valley** in **April 1973**.
- Villagers - **denied**
- Larger plot allotted - *sporting goods manufacturer*.
- Villagers outraged - **Chandi Prasad Bhatt** - led villagers into the forest and **embraced the trees** to prevent logging.
- Movement – *success* - government - *canceled the company's logging permit*
- **Sunderlal Bahuguna** - spread



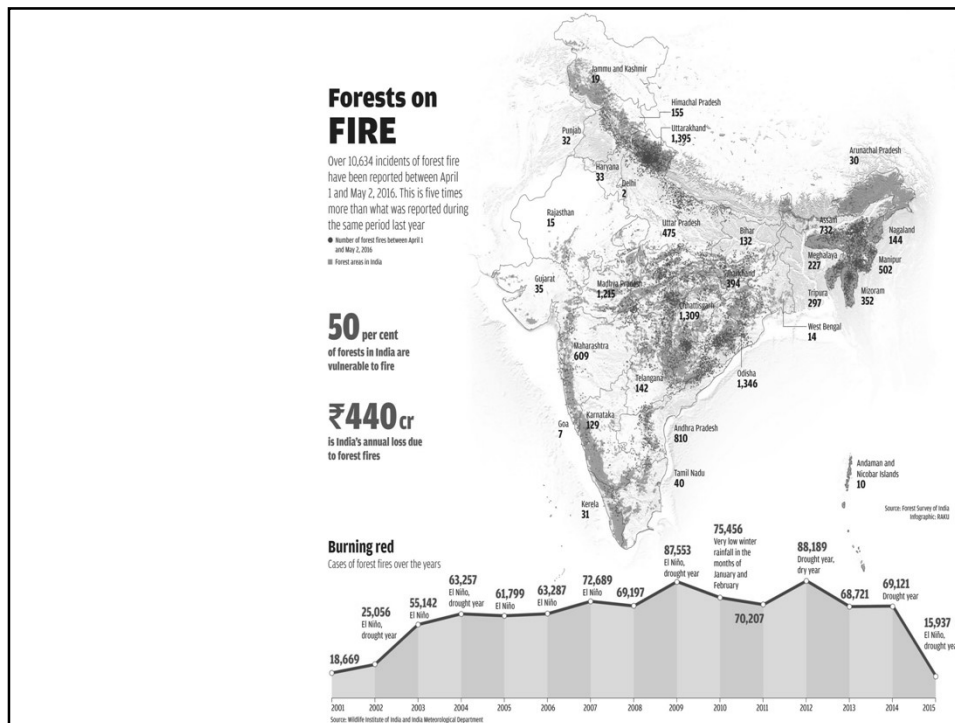
- Next major protests - **1974** - near the village of **Reni**
- More than **2,000 trees** - *scheduled to be felled*.
- **Large student-led demonstration**
- Government *summoned the men* - nearby city – compensation
- *To allow the loggers to proceed* - **met with the women of the village** (led by **Gaura Devi**) - **forced the loggers to withdraw**.
- State government - committee to investigate deforestation
- **10-year ban on commercial logging**



Introduction



- Forest fire is the **most important cause** – after deforestation
- They are a recurrent phenomenon in India during fire season
- A single uncontrolled fire can ruin extensive forest areas.



Causes

Grouped into two classes:

1. Natural

- lightning, rolling stones or rubbing of dry bamboos with each other.
- Lightning is responsible for more fires (about 30%) in western countries
- India the number of fires that are caused by natural cause < 5%

2. Man – made

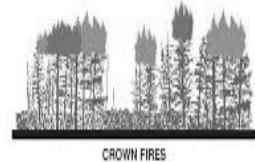
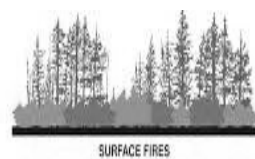
Manmade fires

- Further classified into:
 - **Carelessness/ accidental fires**
 - **Deliberately**
- **Carelessness/ accidental fires**
 - Fire burning by cart man or travelers,
 - Throwing of burning match stick,
bidi or cigarette

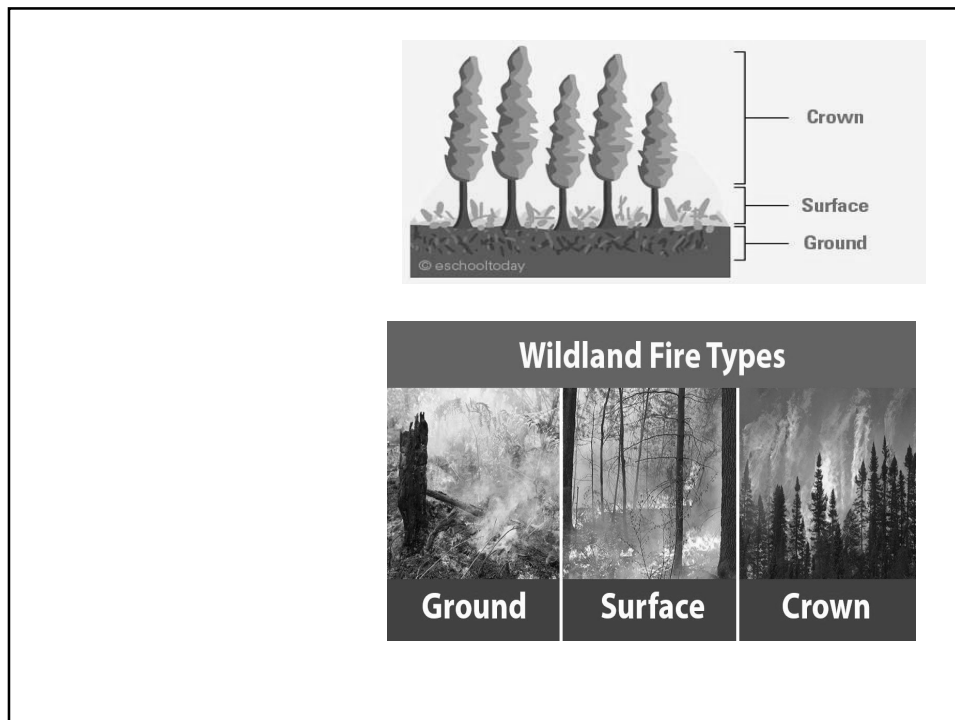
- Illicit collection of honey.
- Glowing coal pieces by trains
- Burning of grass lands in the village
- Accidental spread - fire lines
departmentally.

- **Deliberately**
 - Forest produce such as horns, etc.
 - New shoots of grass
 - Scaring away wild animals
 - Enmity with officer
 - Destroying - stumps

Classification of forest fires



- **Surface fire**
- **Ground fire**
- **Crown fire**



Damage caused by forest fires

- ✓ Damage to the trees
- ✓ Damage to regeneration
- ✓ Damage to soil
- ✓ Damage to the productive power of the forest
- ✓ Damage to the protective power of the forest
- ✓ Damage to wild animals
- ✓ Damage to the recreational and scenic value of forest

Preventive measures

Indirect measures

- ✓ Restricting the entry of persons in forests during fire season.
- ✓ Education of public opinion
- ✓ Forbidding collection of certain items of forest produce during summer
- ✓ Denial of benefits which accrue form forest fire
- ✓ Putting up notices prohibiting kindling and carrying of fire in the fire season

Direct measures



- ✓ Clearing camping sites
- ✓ Early burning
- ✓ Burning a belt round plantations
- ✓ Raising fire-breaking green belts
- ✓ Leasing out of inter space
- ✓ Clearance of fire lines
- ✓ **MODIS – A real time forest fire monitor**
 [*MODIS (Moderate Resolution Imaging Spectro Radiometer) sensor*]

National action plan on forest fires, 2018

- By MoEF&CC

Main objectives

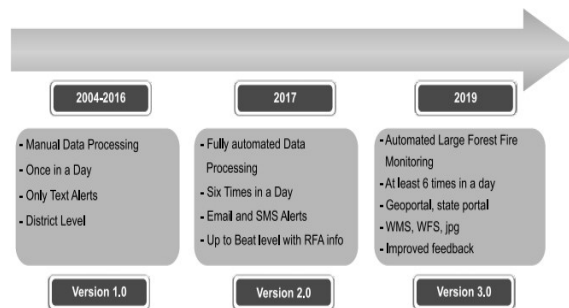
- To reduce the incidences of fires -
informing, enabling and empowering forest fringe communities
- Incentivizing them to work with the State Forest Departments

Aim

- *To reduce the vulnerability*
- *Enhancing the capabilities* of institutions
- Accelerating the *recovery after a fire incidence.*
- Proposes **nine strategies** to address the issue, including establishment of a **“Centre of Excellence on Forest Fire Management”** at FSI

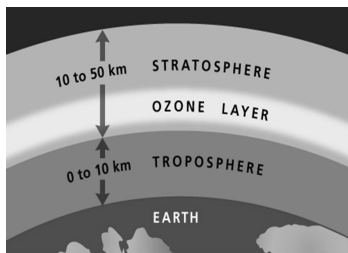
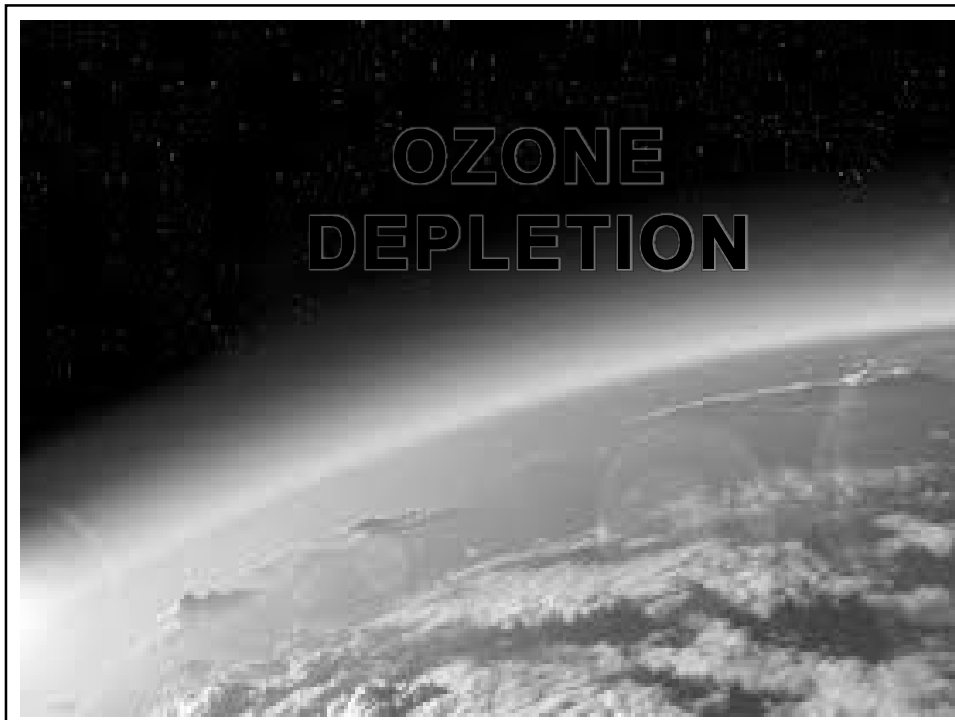
FAST 3.0

- Upgraded version of the Forest Fire Alert System version 3.0 – released by FSI Jan 2019

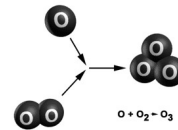


Work flow of near real time forest fire monitoring



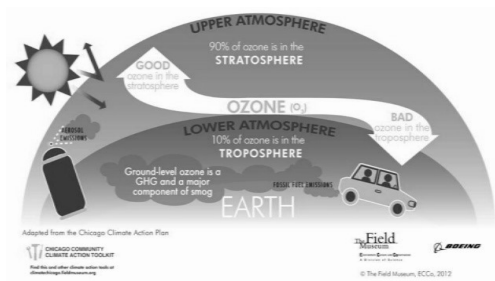


Ozone

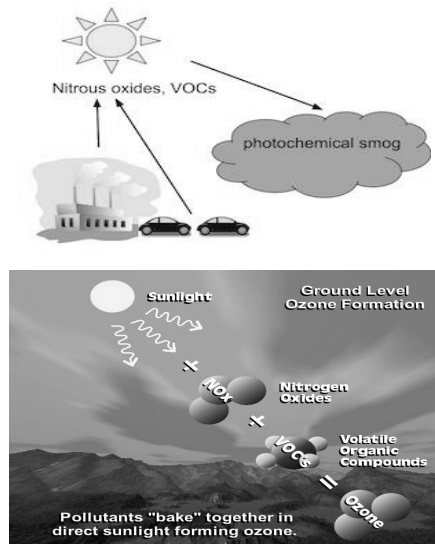


Ozone (O₃) – allotrope of oxygen

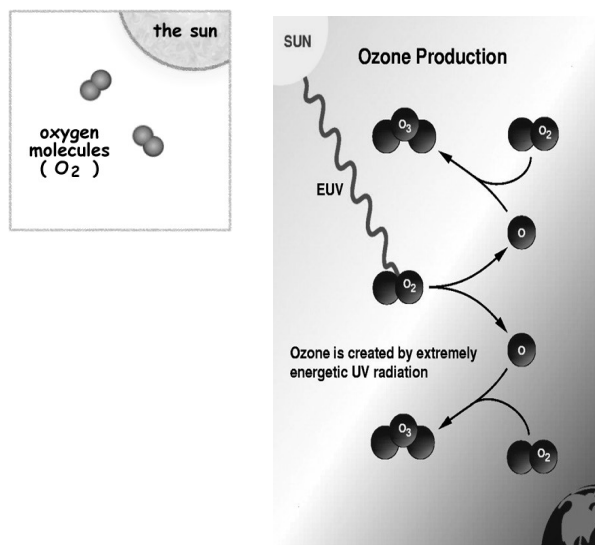
Present both in Troposphere and Stratosphere



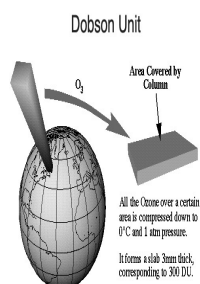
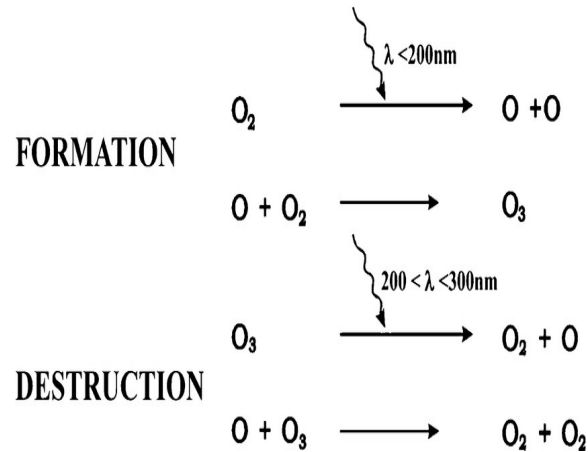
Tropospheric ozone formation



Stratospheric Ozone formation



Ozone Layer formation



- Ozone *-thicker over the poles* than over the equator

Reasons

1. There is a lack of sunlight during an arctic winter to break it down
2. Seasonal weather systems and wind patterns in the upper atmosphere push more ozone toward the poles in winter.
3. The vertical structure of the atmosphere affects thickness.

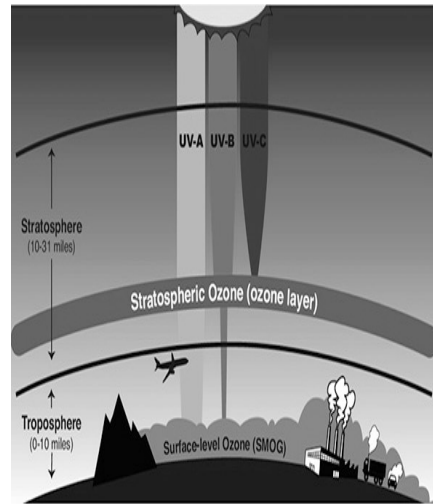
Role of ozone

- Protect the earth from harmful UV radiations

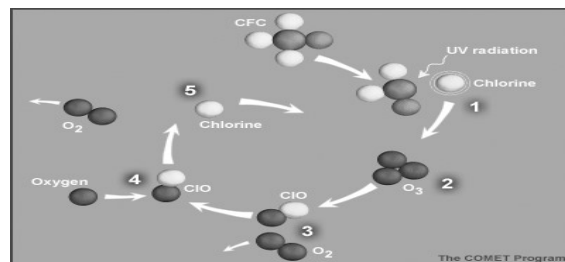
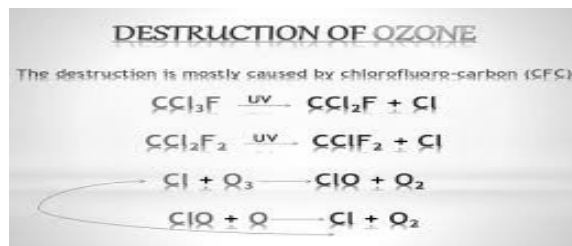
UV-A

UV-B

UV-C



Ozone depletion cycle

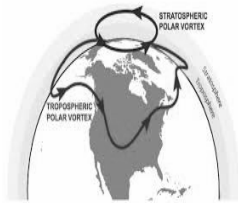


Ozone depleting substances

- **ODS** - man-made gases that destroy ozone once they reach the ozone layer.
They include
 - ✓ *Chlorofluorocarbons (CFCs)*
 - ✓ *Hydrochlorofluorocarbons (HCFCs)*
 - ✓ *Hydrobromofluorocarbons (HBFCs)*
 - ✓ *Halons*
 - ✓ *Methyl Bromide*
 - ✓ *Carbon Tetrachloride*
 - ✓ *Methyl Chloroform.*

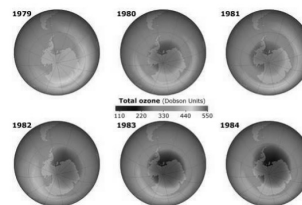
ODS uses in mans life

- ✓ Refrigerants in commercial, home and vehicle air conditioners and refrigerators
- ✓ Foam blowing agents
- ✓ Components in electrical equipment
- ✓ Industrial solvents, tyre industries
- ✓ Solvents for cleaning (including dry cleaning) and Fumigants.
- ✓ Aerosol spray propellants – pressurizing agents
- ✓ Production of plastic foams



Ozone hole formation

- **Westerlies** – accumulate ODS close to poles
- Polar winter – strong circumpolar winds - *Circumpolar Vortex*
- Polar winter set in -ODS trapped
- Stratospheric temp – dips –ice crystals formed
- Polar spring – sun shines -UV rays - Ozone hole

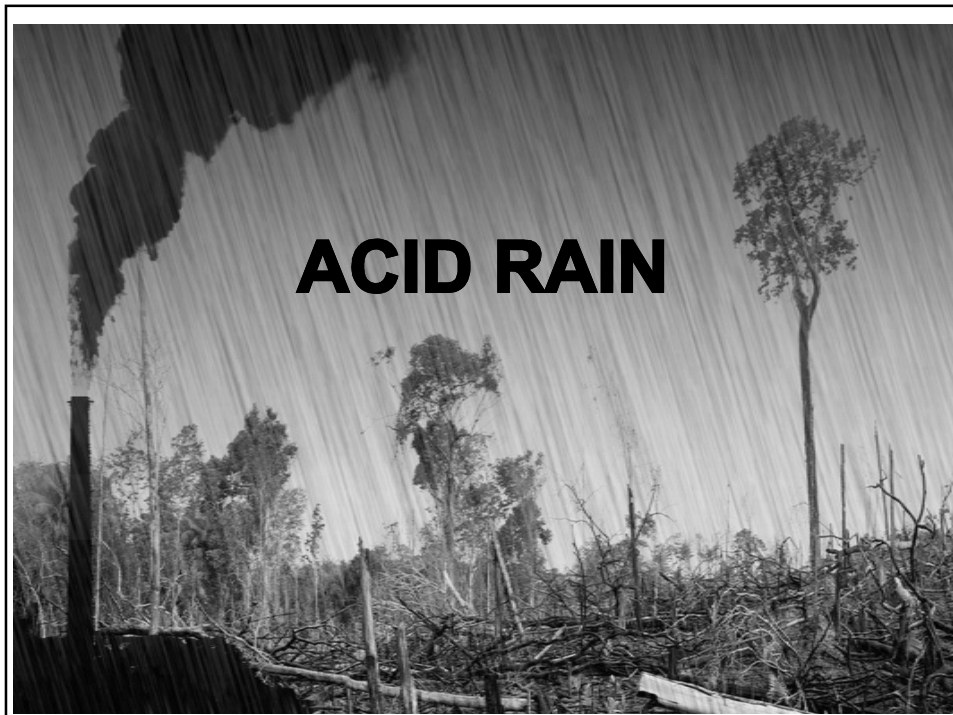


Impacts of ozone depletion

- ✓ Harm to **human health** – *DNA damage, Premature aging, Immune system damage, eye cataracts and other disorders, sunburns etc.,.*
- ✓ Adverse impacts on **agriculture, forestry and natural ecosystems**
- ✓ Damage to **marine life**
- ✓ **Animals**
- ✓ **Materials** like wood, plastic, rubber, fabrics and many construction materials are degraded by UV radiation

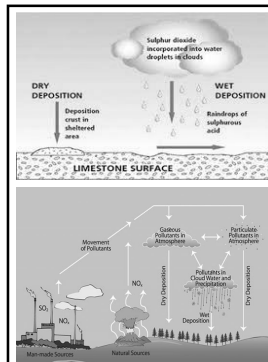
Efforts to protect ozone layer

1. Vienna convention (1985) - in force- 1988
2. Montreal protocol (1987) – in force - 1989
3. India – ozone depleting substance (regulation and control) rule, 2000 – *fully free since 2003*
4. Kigali agreement, 2016



Acid Rain

- **Acid rain** – resultant of **air pollution**
- When any type of fuel is burnt, lots of *different chemicals* are produced.
- Some of these gases *react with the tiny droplets of water* in clouds to form **acids**.
- The rain from these *clouds* then falls as *very weak acid* - **Acid rain**



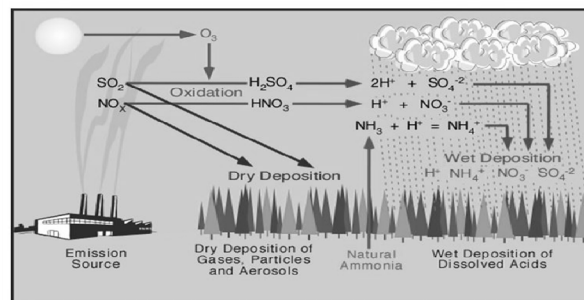
Types – Wet and Dry

Wet deposition

- Acid chemicals in the air - *blown* into areas where the *weather is wet* – acids *fall to the ground* in the form of **rain, snow, fog, or mist**.
- As this *acidic water* flows over and through the ground, it affects a *variety of plants and animals*

Dry deposition

- Areas where the weather is dry - acid chemicals - incorporated into dust or smoke - fall to the ground through dry deposition- sticking to the ground, buildings, vegetation, cars, etc.
- Washed from these surfaces by rainstorms, through runoff. This runoff water makes the resulting mixture more acidic.



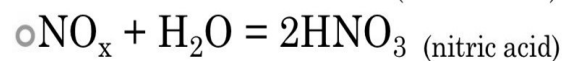
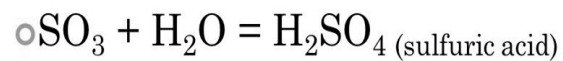
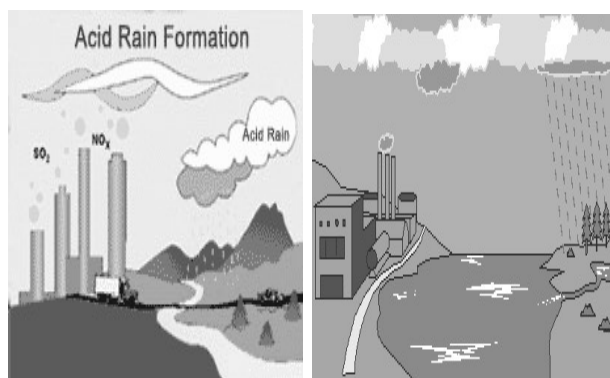
Acidic gases-sources

- **SO_x (Sulphur oxides)**
 - Fossil fuel burning
 - Power plants
 - Smelting of metal sulphide ores
 - Industrial production of sulfuric acid in metallurgical, chemical and fertilizer industries
 - Volcanoes, seas and oceans
 - Decomposition of organic matter.

Acidic gases-sources

- **NO_x (Nitrogen oxides – NO, NO₂ and N₂O)**
 - Fossil fuel burning
 - Lightning
 - Biomass burning
 - Forest fires
 - Oceans
 - Power plants.

Acid Rain Formation

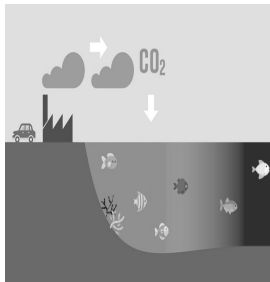


Impacts of acid rain

- ✓ Surface waters (rivers, lakes etc.,) and aquatic flora and fauna
- ✓ Soil acidification
- ✓ Impact on forests and vegetation
- ✓ Impacts on human health
- ✓ Buildings and Urban environment

Efforts to combat Acid rain

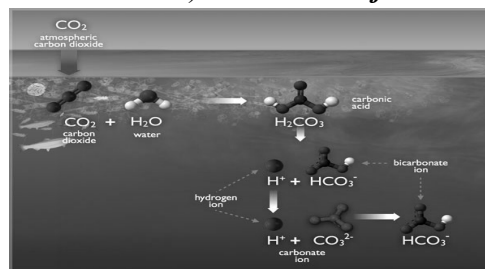
- ✓ Alternate source of energy
- ✓ Pollution control measures - Use of low sulphur fuel or natural gas or washed coal
- ✓ Spraying mixture of water and powdered limestone into the smokestack – Wash away sulphur
- ✓ Catalytic converters – in vehicle engine\
- ✓ Strict enforcement of environment laws
- ✓ Bio-remediation plants – factories and industries



Introduction

- It is the ongoing decrease in the pH of the Earth's oceans, caused by the uptake of *carbon dioxide (CO₂)* from the atmosphere.
- An estimated **30–40%** of the carbon dioxide from human activity released into the atmosphere dissolves into *oceans, rivers and lakes*.
- Reacts with the water to form **carbonic acid**.

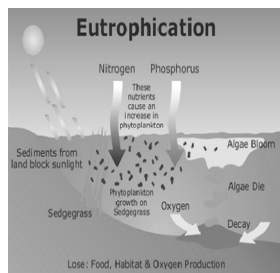
- Some of these extra carbonic acid molecules react with a water molecule to give a *bicarbonate ion* and a *hydronium ion*
- Increases ocean acidity (H⁺ ion concentration) -***Ocean acidification***



Other causes

Eutrophication

- Leads to large plankton blooms
- Blooms collapse and sink to the sea bed
- Subsequent respiration of bacteria decomposing the algae - decrease in seawater oxygen and an increase in CO₂
- Decline in pH



- **Eutrophication** - response to the addition of nutrients such as *nitrates* and *phosphates* naturally or artificially, fertilising the aquatic ecosystem.
- Eutrophic water body is a body of water rich in nutrients and so supporting a dense plant population, the decomposition of which kills animal life by depriving it of oxygen.

Effects of Ocean Acidification

- Increasing acidity depresses metabolic rates and immune responses in some organisms.
- Seawater absorbs CO_2 to produce carbonic acid, bicarbonate and carbonate ions.
- Decrease in pH level- increase in the concentration of carbonic acid and bicarbonate ions, causing a decrease in the concentration of *carbonate ions*.

- The decrease in the amount of carbonate ions available makes it more difficult for marine calcifying organisms, such as **coral** (calcareous corals) and **some plankton** (calcareous plankton), to form biogenic calcium carbonate.
- **Commercial fisheries** are threatened because acidification harms calcifying organisms which form the base of the Arctic food webs.
- Increasing acidity accentuates **coral bleaching** as corals are very sensitive to changes in water composition.

Ocean Acidification on Cloud Formation

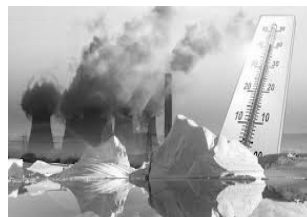
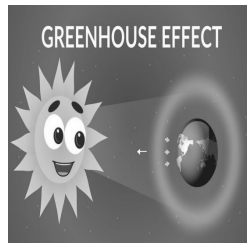
- The majority of sulphur in the atmosphere is emitted from the ocean, often in the form of *dimethylsulfide (DMS)* produced by phytoplankton.
- Some of **DMS** - enters the atmosphere and reacts to make **sulphuric acid**, which clumps into aerosols, or microscopic airborne particles.
- Aerosols seed the formation of clouds, which help cool the Earth by reflecting sunlight.
- But, in acidified ocean water, phytoplankton produce *less DMS*.
- Reduction of sulphur - *decreased cloud formation - raising global temperatures*



Definition

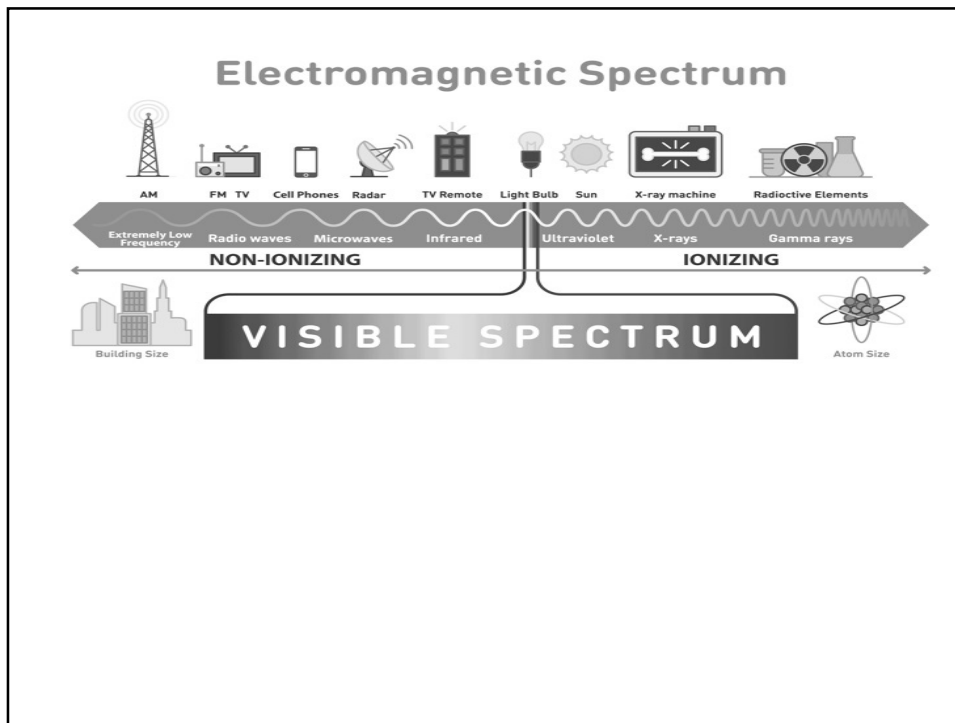
- *any change in climate over time, whether due to natural variability or as a result of human activity (IPCC)*
- *a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods (UNFCCC)*

Green house effect, Global warming and Climate change



Green House effect

- Term for the role the atmosphere plays in helping to warm the Earth's surface. Atmosphere - largely transparent to incoming solar radiation, (shorter wave lengths).
- Much of this incoming radiation is absorbed by the Earth's surface - the hot surface of the earth then re-emits heat energy at long-wave infrared rays.



Green House Effect

- It is term for the role the atmosphere plays in helping to warm the Earth's surface.

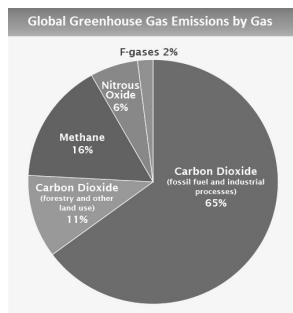
reflected light
Sun
atmosphere
IR absorbed and re-radiated
infrared (IR) radiation
absorbed by surface

Solar radiation powers the climate system.
SUN
Some solar radiation is reflected by the Earth and the atmosphere.
About half the solar radiation is absorbed by the Earth's surface and warms it.
Infrared radiation is emitted from the Earth's surface.
The Greenhouse Effect
Some of the infrared radiation passes through the atmosphere but most is absorbed and re-emitted in all directions by greenhouse gas molecules and clouds. The effect of this is to warm the Earth's surface and the lower atmosphere.

The sun rays hit the ground. Some of the rays reflect back and radiate out of the green house. The ground radiates back heat (infrared radiation). Some of the infra red radiation heats up the Green house roof. The roof radiates the heat back in to the Green house interior.

The Greenhouse Effect

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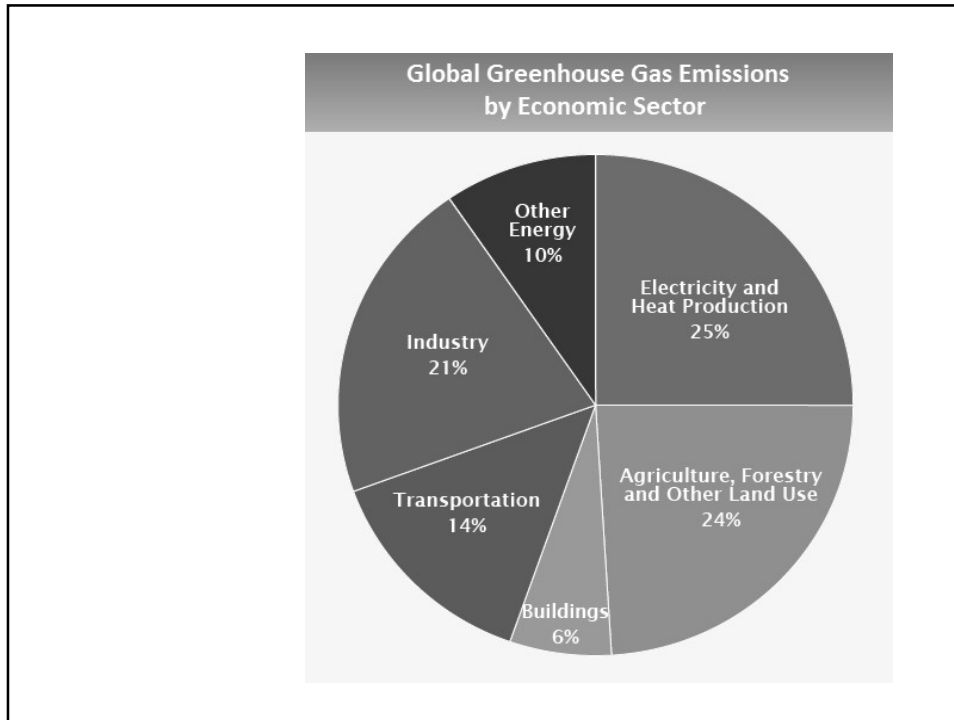


Green House Gases (GHG's)

- Carbon dioxide (CO₂)
- Methane (CH₄)
- Nitrous oxide (N₂O)
- Fluorinated gases (F-gases)
 - HFCs
 - PFCs
 - SF₆

GHG sources

Types of Greenhouse Gases		
GHG Categories	GWP Value*	Major Sources
Carbon dioxide (CO ₂)	1	Fossil fuel combustion, deforestation
Methane (CH ₄)	25	Landfills, rice paddies, digestive tracts of cattle and sheep
Nitrous oxide (N ₂ O)	298	Fertilizer, animal waste
Hydrofluorocarbons (HFCs)	Varies (up to 14,800)	Semiconductor manufacturing and other industrial processes
Perfluorocarbons (PFCs)	Varies (up to 12,200)	Same as HFCs, plus aluminum smelting
Sulfur hexafluoride (SF ₆)	22,800	Electrical transmission systems, magnesium and aluminum production



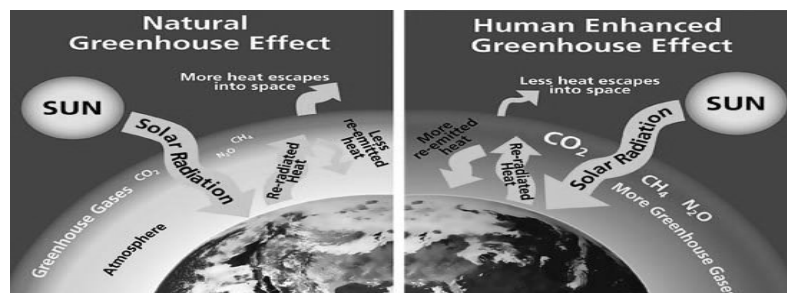
GHG Protocol

- It was build on a *20-year partnership* between **World Resources Institute (WRI)** and the **World Business Council for Sustainable Development (WBCSD)** – 1990’s
- It works with governments, industry associations, NGOs, businesses and other organizations.
- It *establishes comprehensive global standardized frameworks to measure and manage greenhouse gas (GHG) emissions from private and public sector operations, value chains and mitigation actions.*

- GHG protocol also acts as an *international accounting tool for government and business leaders to understand, quantify and manage greenhouse gas emissions.*
- Hundreds of cities across the globe have committed to using the GHG Protocol for Cities.
- It provides *webinar, e-learning and in-person training and capacity-building* support on its standards and tools
- It offers companies and organizations to apply for **“Built on GHG Protocol” mark** - recognizes sector guidance, product rules or tools that are in conformance with GHG Protocol Standards.

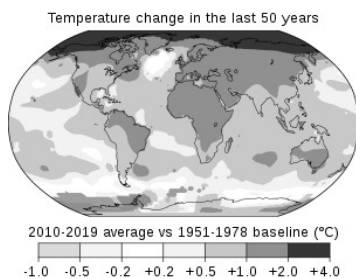
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Types of GHE



Global Warming

- It is the rise in *average temperature* of the earth's atmosphere and oceans over time.
- More scientifically, global warming means *accelerated warming of the Earth's surface due to anthropogenic (human activity-related) releases of greenhouse gases due to industrial activity and deforestation.*



- The global warming studies tell us that the global *temperature has continuously been rising* since the late 19th century largely due to human causes.



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Intergovernmental Panel on Climate Change (IPCC)



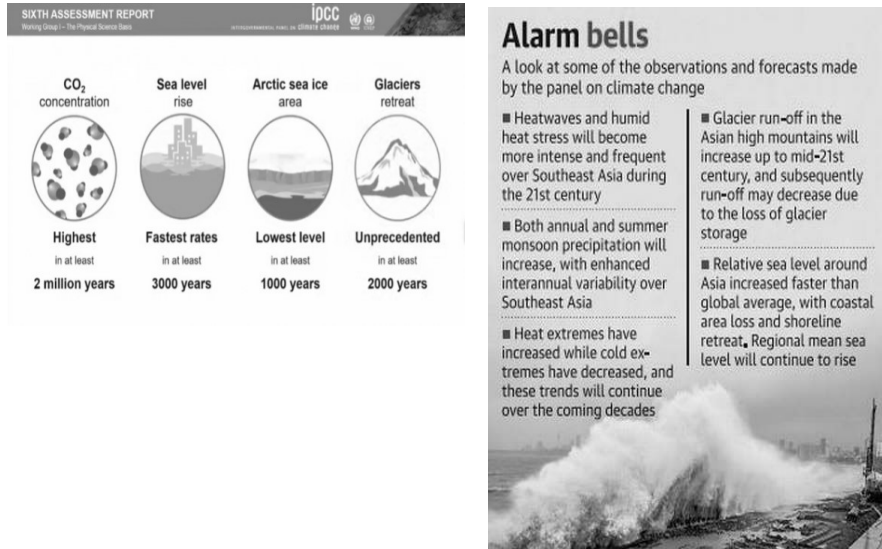
- Formed -1988
- Provide policymakers with regular assessments of the *scientific basis of climate change, its impacts and future risks, and options for adaptation and mitigation.*
- AR - most *comprehensive scientific evaluations* of the state of earth's climate.
- By **three working groups** of scientists.
- First -1990

Fifth Assessment Report (AR-5) of IPCC

Table: The warmest years on record

Rank	Year
1	2016 > 2015 ≥ 2014
2, 3 (tie)	2010, 2005
4	1998
5, 6 (tie)	2013, 2003
7	2002
8	2006
9, 10 (tie)	2009, 2007

Sixth Assessment Report (AR-6) of IPCC



Highlights of AR-6

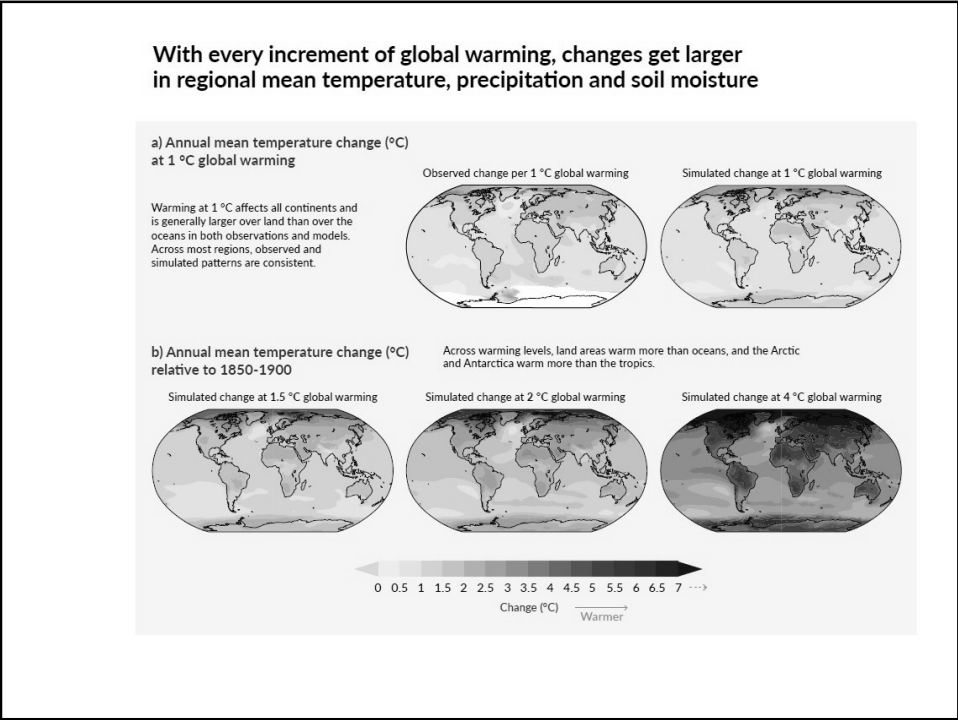
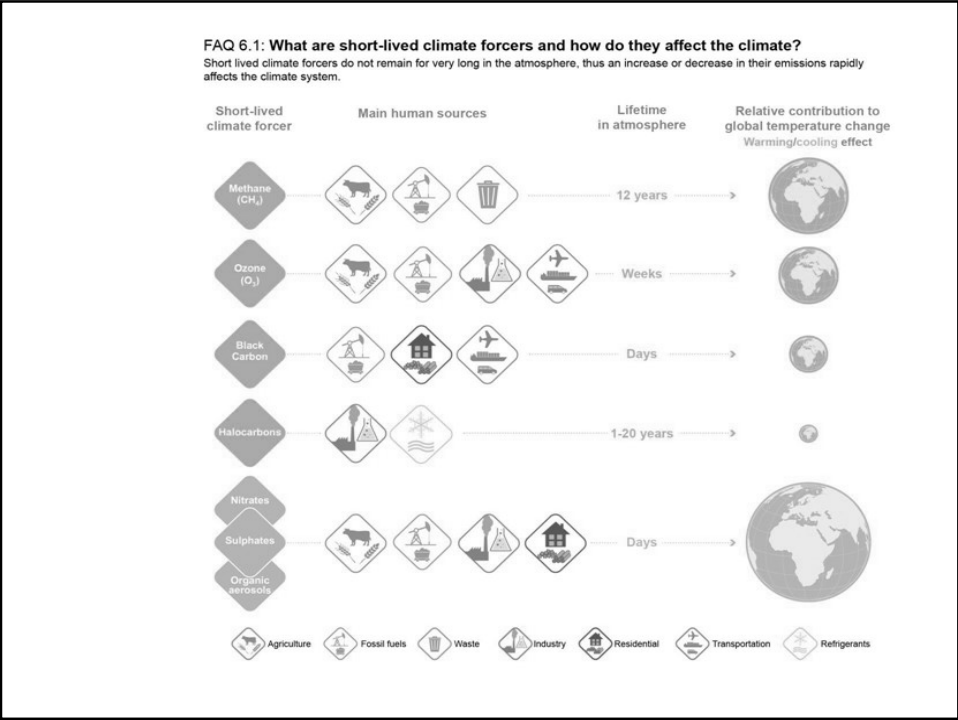
- The combined contribution to global warming by **natural factors**, such as the sun and volcanoes, is now estimated to be **close to zero** (negligible).
- Carbon dioxide** has been and will continue to be the *dominant cause of global warming* under all greenhouse gas emissions scenarios.
- If greenhouse gas emissions are halved by 2030 and **net zero** by 2050, global warming can be stopped.

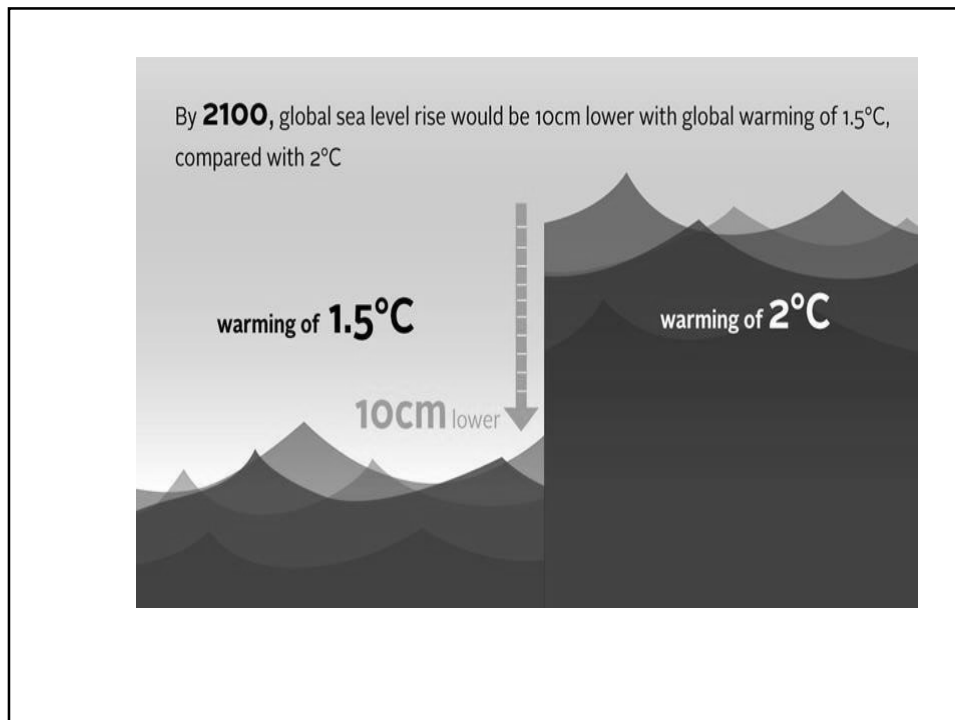
Highlights of AR-6

- ✓ Last decade was *hotter than any period of time* in the past 1,25,000 years.
- ✓ Global surface temperature was **1.09°C higher** in the decade between 2011-2020 than between 1850-1900.
- ✓ Arctic Sea ice is at its **lowest level** in more than 150 years
- ✓ Sea levels are rising faster than at any time in at least the last 3,000 years – *raised by 20cm since 1990*
- ✓ Glaciers are declining at a rate unprecedented in at least 2,000 years.

Highlights of AR-6

- ✓ CO₂ Concentrations - the highest in at least two million years.
- ✓ Humans have emitted 2,400 billion tonnes of CO₂ since the late 1800s - world has already depleted **86%** of it's available carbon budget.
- **Methane and nitrous oxide** (2nd and 3rd major contributors of warming respectively) levels are their highest in at least 800,000 years.
- **CH₄** stays in the atmosphere only for a fraction of time compared to CO₂, but is far more efficient at trapping heat.



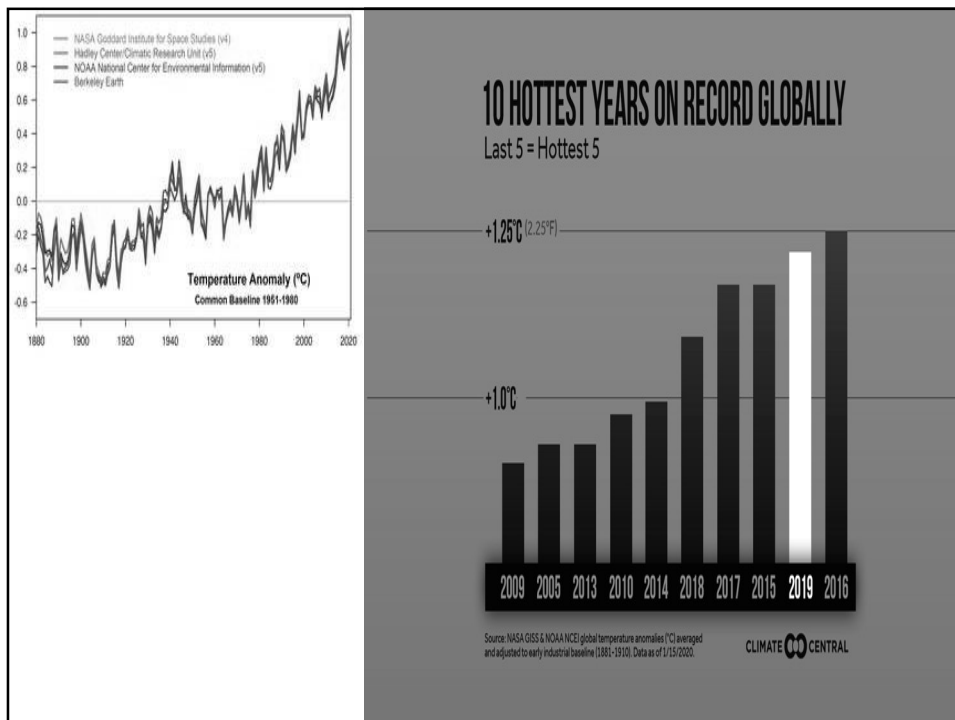
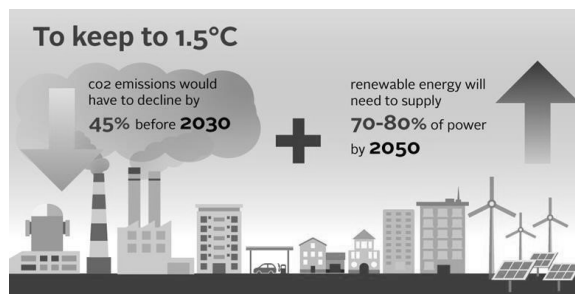


Impact on India

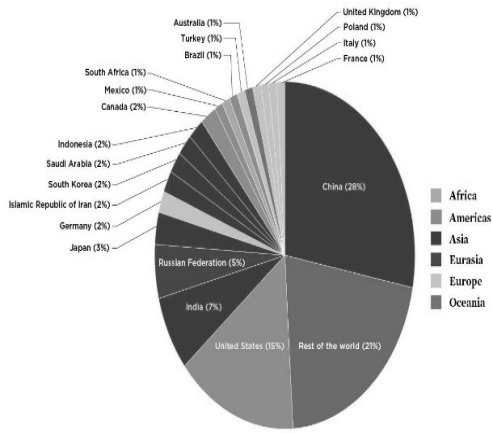
- With a 7,517 km coastline, India will face significant threats from rising seas - Indian Ocean is *warming faster than the global average*.
- Across 6 Indian port cities - Chennai, Kochi, Kolkata, Mumbai, Surat and Visakhapatnam - **28.6 million people** will be exposed to coastal flooding.
- The snowlines are retreating, and this can cause a *change in the water cycle, the precipitation patterns*, increased floods as well as an increased scarcity of water in the future in the states across the Himalayas.
- **Changes in monsoon precipitation** are also expected, with both annual and summer monsoon precipitation projected to increase.

IPCC calls for....

- ✓ Achieve **net zero emissions** (no additional greenhouse gases were emitted) by 2050.
- ✓ **Drastic cuts in GHG emissions** are needed this very decade (2021-2030).
- ✓ End to new coal plants and new fossil fuel exploration and development.
- ✓ Efforts of governments, investors and businesses towards a **low-carbon future**.



Top emitters in 2020



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Data: Earth Systems Science Data 11, 1783-1838, 2019

Trends in carbon dioxide emissions by country and per capita

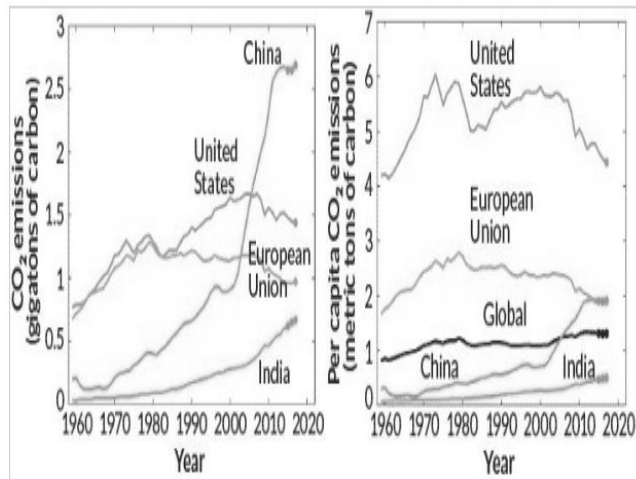
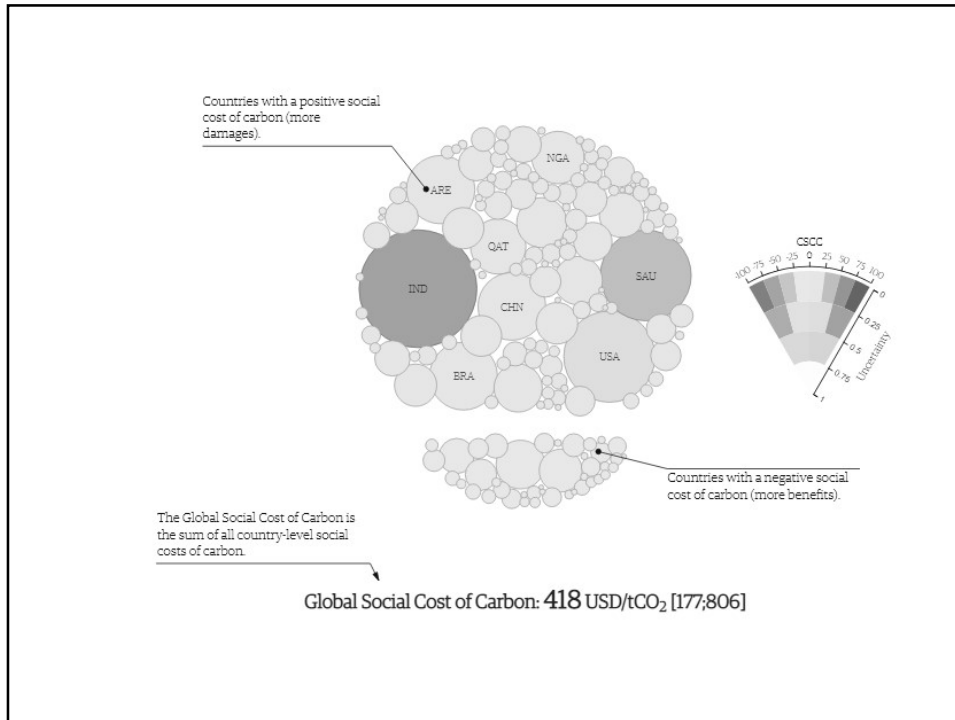


Image credit: Earth System Science Data

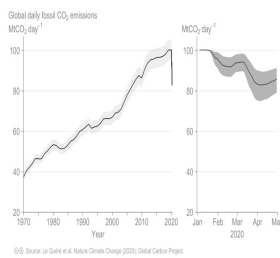
Social cost of carbon

- It is used to estimate in *dollars all economic damage that would result from emitting one ton of carbon dioxide* into the atmosphere.
- It indicates how much it is worth to us today to avoid the damage that is projected for the future.
- Helps - policy makers determine whether the costs and benefits of a proposed policy to curb climate change are justified.
- Higher SCC - means that the benefits of a particular climate policy to cut CO2 justify its cost
- Low SCC - makes a policy seemingly cost more than the benefits it ultimately delivers.

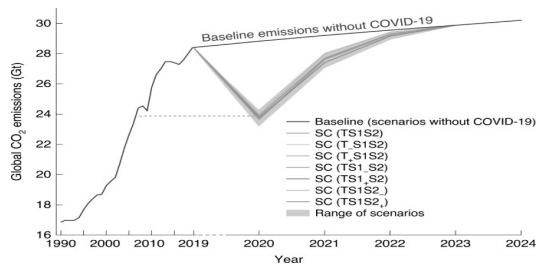
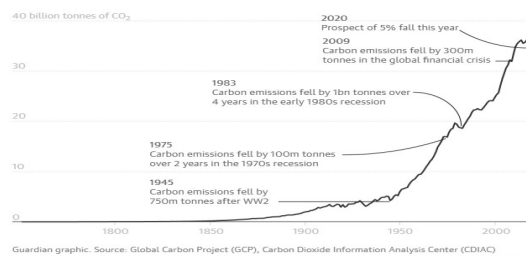
- Carbon dioxide emissions are costing the Indian economy up to **\$210 billion** every year.
- It is likely to suffer highest economic damage from climate change after the US.
- The country-level SCC for the India alone is estimated to be about \$86 per tonne of CO2.
- For US, the cost is about \$50 billion per tonne - means that the nearly *five billion metric tonnes of CO2 the US emits* each year is costing the US economy about **\$250 billion**.



COVID-19 effect of carbon emissions (as of April-May, 2020)



The coronavirus pandemic could result in a 5% fall in global carbon emissions



Some predictions....

- Global carbon emissions from the fossil fuel industry could fall by a **2.5 billion tonnes in 2020**
- It is a reduction in **5%** because of biggest drop in demand for fossil fuels

Reason

- **Coronavirus pandemic** - unprecedented restrictions on travel, work and industry, halt in flights etc.,
- It is expected to cut *billions of barrels of oil, trillions of cubic metres of gas and millions of tonnes of coal from the global energy system* in 2020 alone.

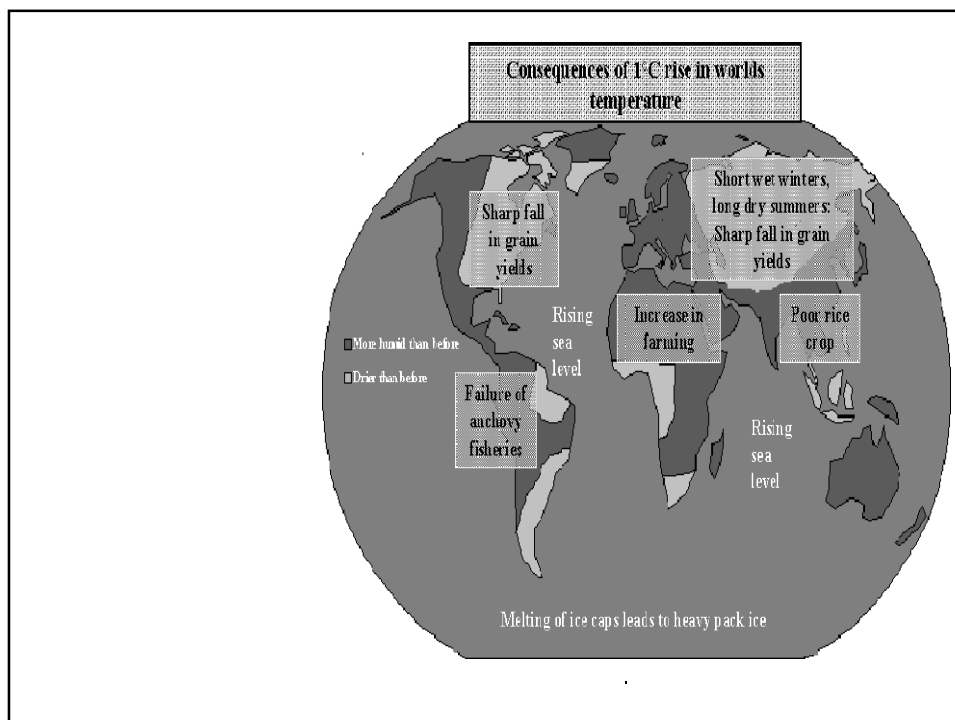
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Causes of Global warming

- Heavy *industrialization, power generation* and urbanization & *transportation based* on burning of fossil fuel.
- Urban *automobiles* and various industries which release CO₂, N₂O and other GHG's
- Burning of fossil fuels for *domestic* purposes.
- *Deforestation* leading to higher carbon dioxide concentrations
- *Cattle rearing and paddy rice farming*, land use and *wetland changes*, pipeline losses, and *landfill emissions* leading to higher methane concentrations.
- The *burning* of forests

Impacts of global warming

- Rising Seas
- Changes in rainfall patterns
- Increased likelihood of extreme events
- Melting of the ice caps
- Melting glaciers
- Widespread vanishing of animal populations
- Spread of disease
- Bleaching of Coral Reefs
- Loss of Plankton



CLIMATE CHANGE IMPACT ON INDIA

Indian Network for Climate Change Assessment (INCCA)- report

- Collective work of 45 scientists- on the impact of climate change in four regions of the country.
 1. *The Himalayan region*
 2. *The North-East*
 3. *The Western Ghats*
 4. *The coastal areas*

- Collective work of 45 scientists- on the impact of climate change in four regions of the country.

1. *The Himalayan region*

2. *The North-East*

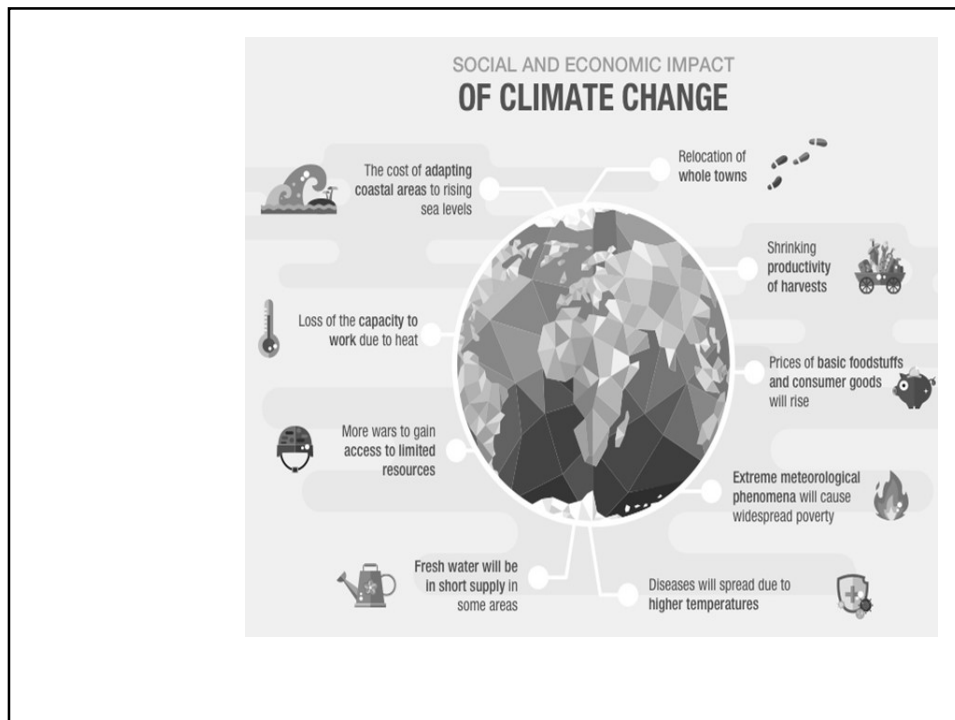
3. *The Western Ghats*

4. *The coastal areas*

- *Significant research gaps and Lack of extensive databases*
- *Impact of climate change by 2030 - four sectors*

Highlights

1. *Increase in annual temperatures - 1.7 to 2.2°*
2. Sea level and rainfall - **rise**,
3. Cyclones - more intense - less frequent.
4. Flooding - **30 %**
5. Droughts - **more severe**
6. *Mosquitoes + malaria – Himalayas+ North East*
7. **Irrigated rice – increase; maize, sorghum and apple – reduced**
8. *Thermal humidity - reduction in milk productivity*



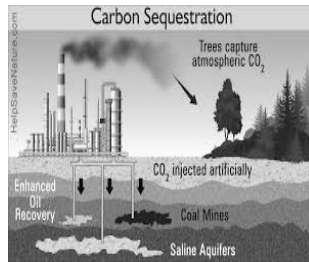
Deterioration of carbon sinks

- One third of the world's soil-bound carbon - *taiga and tundra*
- Melting of permafrost - **carbon dioxide and methane.**
- In **1970's** - tundra - carbon sink ; Today - carbon source

SOLUTIONS FOR CLIMATE CHANGE

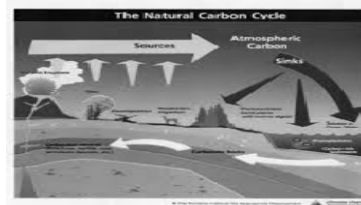
Clean coal technology

- Half of the world's electricity - coal.
- Remain - dominant energy source
- Clean coal technology – reduce environmental effects -
 - *Purify the coal before it burns.*
 - *Control the coal burn to minimize emissions*
 - *Electrostatic precipitators*
 - *Gasification*
 - *Wet scrubbers, or flue gas desulfurization systems*

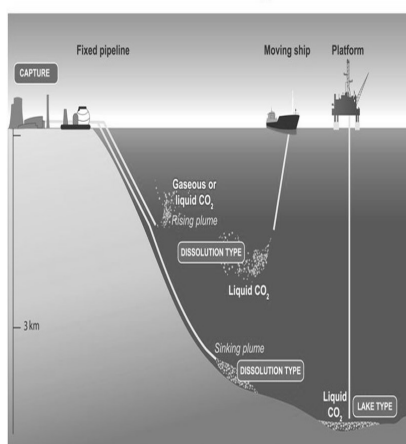


Carbon sequestration

- ‘Carbon capture and storage’
- Catches and **hide carbon dioxide (CO₂)**
- **Natural** – *Trees and Plants*
- **Artificial** - Containers - prevent or stall its re-entry into the atmosphere



Storage options – Oceanic and Geologic

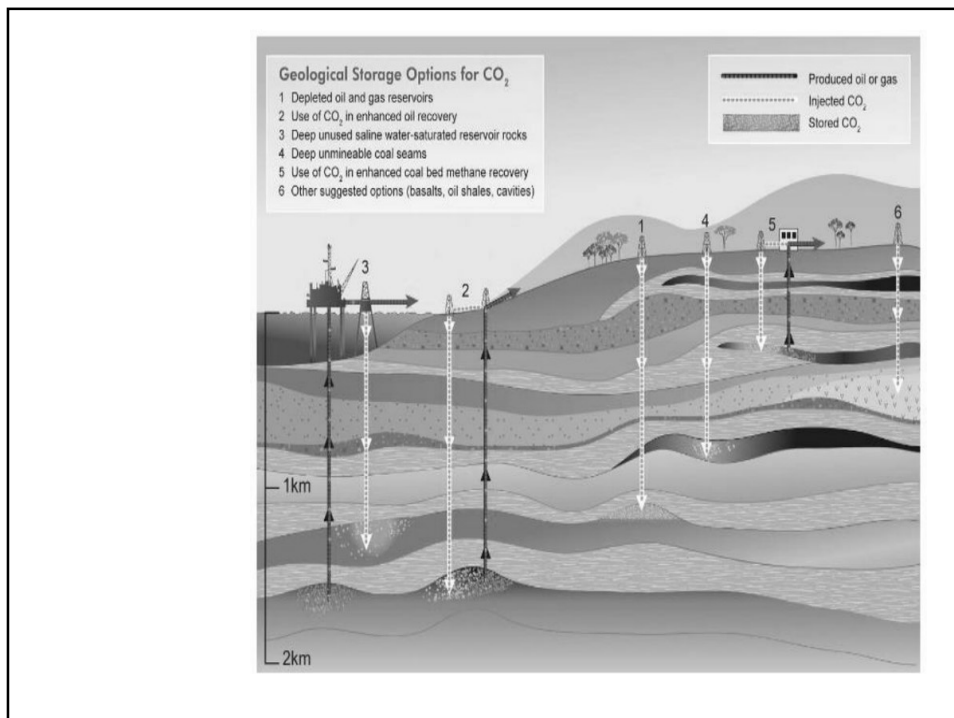
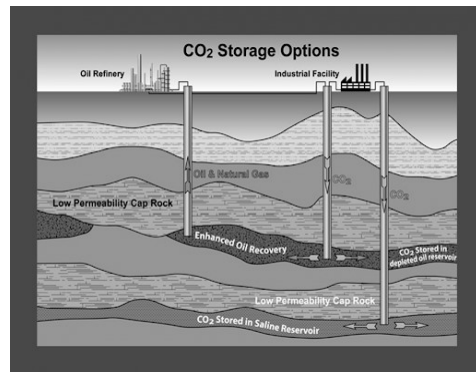


Oceanic

- injecting liquid CO₂ into water - **500 to 3,000 meters deep** - dissolves under pressure – **blue carbon**
- Decrease pH and potentially harm marine habitats – **Ocean acidification.**

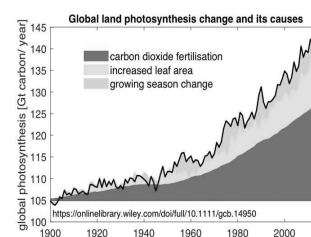
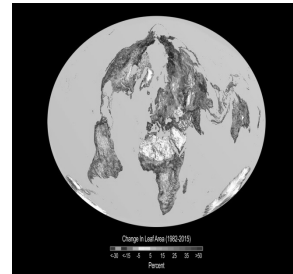
Geologic

- *Depleted oil fields*
- *Depleted gas fields*
- *Deep saline aquifers*
- *Unminable, abandoned and uneconomical Coal seams*
- *Subterranean deep saline formations*
- *Saline water-filled basalt volcanic*
- *Low permeable cap rock etc.,*



Carbon Dioxide Fertilization

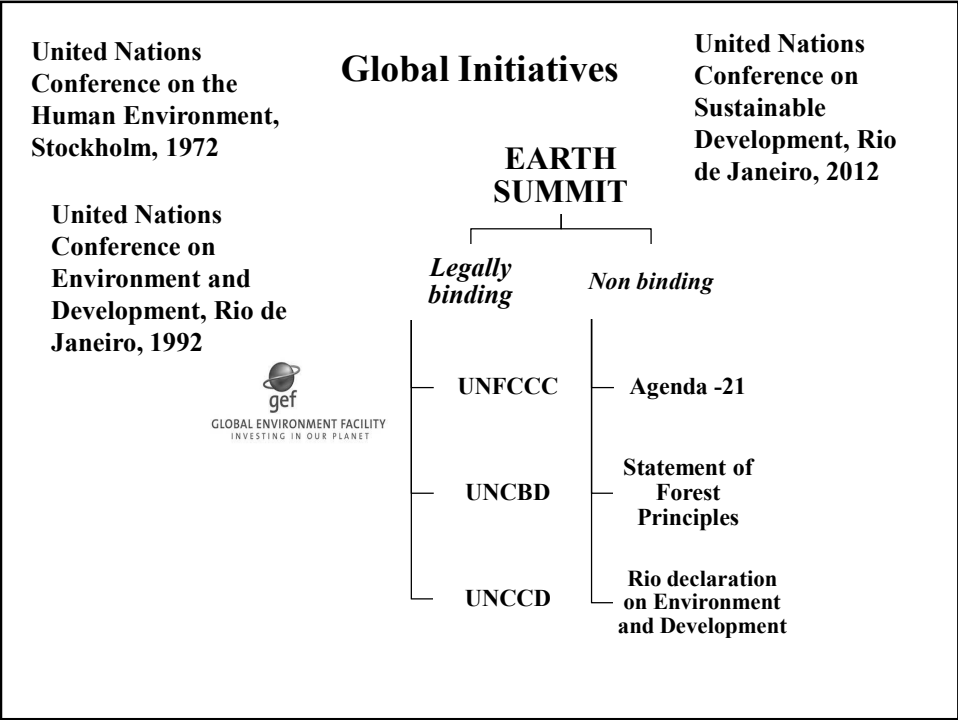
- Rising CO₂- greening (leaves) of earth's vegetated lands – **CO₂ fertilization**
- Increased photosynthesis- increased plant growth.
- CO₂ fertilization contribution - **70 %**
- Nitrogen - **9 %**
- Land cover changes, climate change, precipitation and sunlight changes –*rest*
- *Diminishes over time*

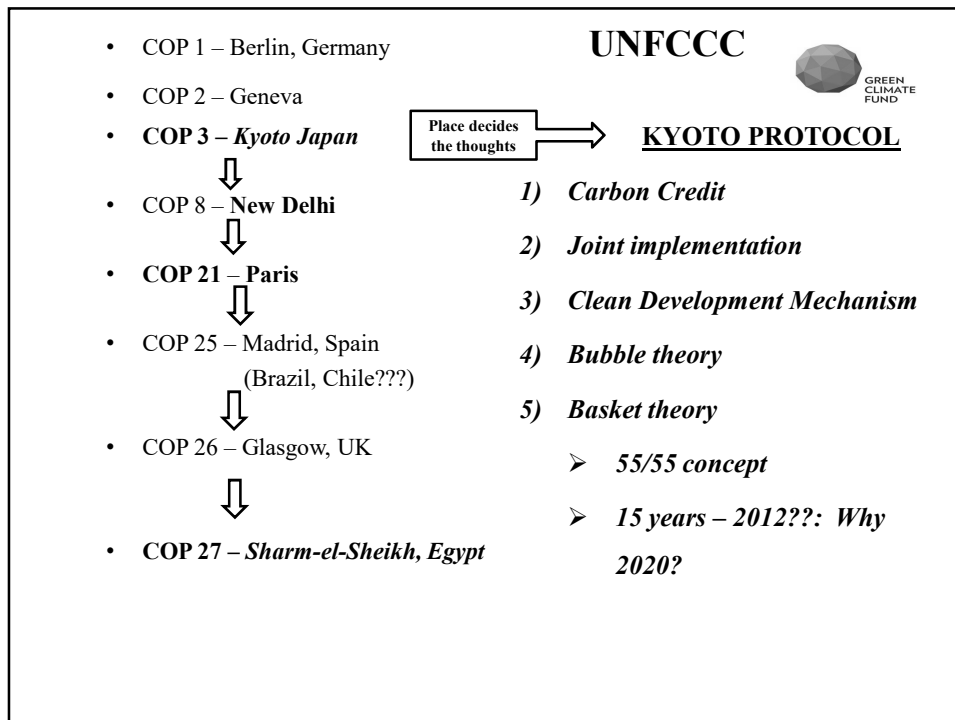


SBCI Initiative

- By **United Nations Environment Program**
- *UN + public and private stakeholders (building sector)*
- **Aim** - promoting *sustainable building practices* globally
- **Proposal** - a **Common Carbon Metric** - support **greenhouse gas (GHG) emissions reductions** - *accurate measurement of energy efficiency improvements* in building operations.

- **Goal** - To provide *globally applicable common metrics* - energy use in and GHG emissions
- *International, regional, national, and local policy development and industry initiatives.*
- Gathering consistent data + reporting the **climate performance** of existing buildings

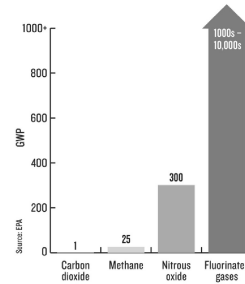




Kyoto Protocol

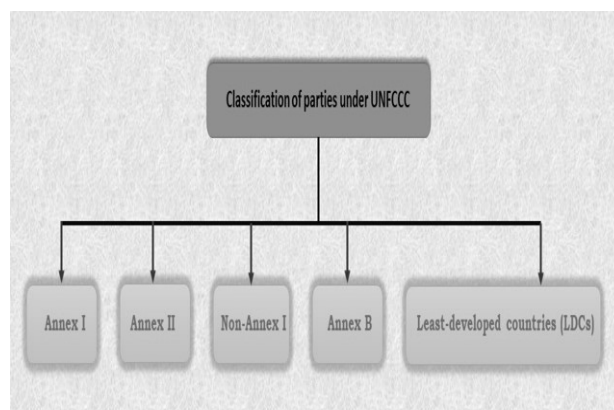
- On 16th February 2005 the Kyoto Protocol finally became an *international law*.
- At the treaty's implementation the agreement had been ratified by **141 countries**, including India, representing **61.6%** of emissions.
- The Kyoto Protocol operates on the principle of "*common but differentiated responsibility*".
- Commitment periods
 - **2008 – 2012**
 - **2013 – 2020**

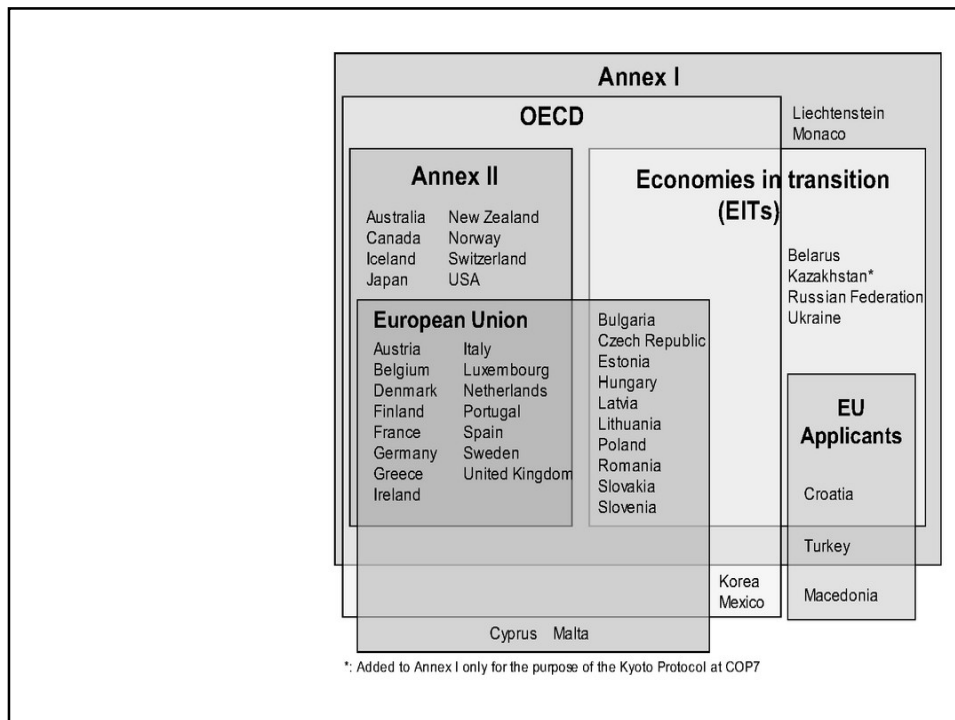
- Only the **industrialized nations** who have signed up to the treaty are **legally bound** to reduce worldwide emissions of six greenhouse gases (collectively) by an average of **5.2%** below their 1990 levels by the period 2008-2012 and **18%** by 2013-2020
- Targeted GHG's :
 1. *Carbon dioxide (CO₂)*
 2. *Methane (CH₄)*
 3. *Nitrous Oxide (N₂O)*
 4. *Hydrofluorocarbons (HFCs)*
 5. *Perfluorocarbons (PFCs)*
 6. *Sulphur hexafluoride (SF₆)*



The global warming potential (GWP) of human-generated greenhouse gases is a measure of how much heat each gas traps in the atmosphere, relative to carbon dioxide.

Parties to Kyoto - Classification





Annex B

- Annex I Parties with first or second-round Kyoto greenhouse gas emissions targets.
- **Compulsory binding targets** to reduce GHG emissions.

Non-Annex I

- Parties to the UNFCCC not listed in Annex I of the Convention (mostly low-income developing countries).
- **No binding targets** to reduce GHG emissions.

LDCs

- Least-developed countries
- **No binding targets** to reduce GHG emissions.

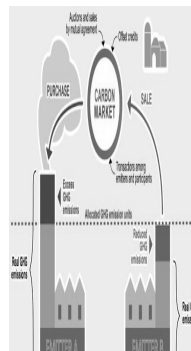
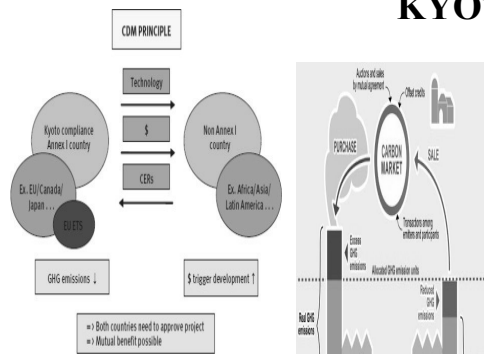
Annex I

- *Developed countries*
- They are 41 industrialized countries which have obligations to reduce their greenhouse gas emissions under the Kyoto Protocol.
- Their combined emissions, averaged out during the 2008-2012 period, should be 5.2% below 1990 levels.

Annex II

- *Developed countries*
- This is a **subset** of Annex I countries.
- Required to provide *financial and technical support* to the EITs and developing countries to assist them in reducing their greenhouse gas emissions.

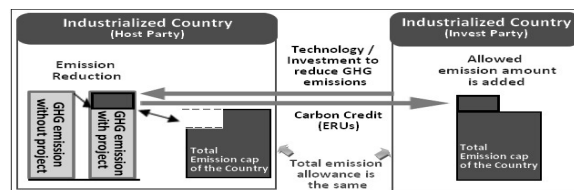
KYOTO - Mechanisms



1. *International emission trading*
2. *Joint Implementation (JI)*
3. *Clean Development Mechanism (CDM)*

Other concepts

1. *Bubble theory*
2. *Basket theory*



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Important COP's and their outcomes

COP 13 (2007) – Bali

- Adopted the Bali Road Map
- Reaching an agreed outcome and adopting a decision
- Review of the financial mechanism, going beyond the existing *Global Environmental Facility*

COP-15 (2009) –Copenhagen

- *Copenhagen Accord*
- Limiting the maximum global average temperature increase to no more than 2 degrees Celsius above pre-industrial levels
- Developed countries promised to provide *US\$30 billion* for the period 2010-2012.
- Mobilize long-term finance of *US\$100 billion* a year by 2020 from a variety of sources

COP-16 (2011) – Cancun

- Commit to a maximum temperature rise of **2 degrees Celsius** above pre-industrial levels
- Consider lowering the maximum to **1.5 degrees** in the near future
- agreed to establish a **Green Climate Fund** to provide financing to projects, programmes, policies and other activities in developing countries

The Green Climate Fund (GCF)



- It is an international financial institution connected to the UNFCCC
- Proposed by Parties to the UNFCCC during the 2009 Conference of Parties (COP) in Copenhagen, Denmark
- Its design was agreed to during the 2011 COP in Durban, South Africa.
- Mechanism - redistribute money from the developed to the developing world.
- Intended to raise Climate Finance of **\$100 billion** by 2020

Aims

- Assist developing countries in their efforts to combat climate change through the provision of grants and other concessional financing for mitigation and adaptation of projects, programs, policies, and activities.
- The GCF is capitalized by contributions from donor countries and other sources, potentially including innovative mechanisms and the private sector.
- The GCF currently complements many of the existing multilateral climate change funds (e.g., the Global Environment Facility, the Climate Investment Funds, and the Adaptation Fund);

COP-17 (2011) –Durban

- Decision by Parties to adopt a universal legal agreement on climate change *no later than 2015*.
- Securing *second phase of Kyoto Protocol*

COP-18 (2012) –Doha

- Agreed to extend the life of the Kyoto Protocol (2013-2020)
- *Canada, Japan, Russia, Belarus, Ukraine, New Zealand and the United States* – exit
- *China, India and Brazil* - not subject to any emissions reductions

COP-19 (2013) – Warsaw

- **Intended Nationally Determined Contributions** was coined
- **Warsaw Mechanism** – proposed - provide expertise and aid to developing nations - to cope with loss and damage from natural extremities - heatwaves, rise in sea level, droughts and floods

COP-20 (2014) –Lima

- Urged parties to take national pledges by finalizing their **INDC** by *November 2015*

COP-21 (2015) –Paris

- A deal to attempt to *limit the rise in global temperatures to less than 2⁰C* was agreed
The outcome document - *Paris Agreement on Climate Change*.
- First time -all countries commit to cut carbon emissions
- Partly legally binding and partly voluntary
- Agreement -open for ratification by each member nation from April 2016 onwards – implemented -*2020 onwards*

- Peak greenhouse gas emissions as soon as possible and achieve a balance between sources and sinks of greenhouse gases in the second half of this century (*zero net anthropogenic greenhouse gas emissions*)
- Pursue efforts to *limit the temperature increase to 1.5 °C*.
- Developed countries reaffirmed the commitment to mobilize *\$100 billion a year* in climate finance by 2020 and agreed to continue mobilizing finance in future
- To review progress every five years
- *Loss and Damage principle* – associated with the adverse effects of climate change
- *Climate Neutral Now initiative*

Momentum for Change :*Climate Neutral Now initiative*

- Launched by UNFCCC secretariat in 2015
- Aims at encouraging and supporting all levels of society to take climate action to achieve a *climate neutral world by mid-century* (as per Paris Agreement)
- It has three step process, which requires individuals, companies and governments to:
 1. *Measure their climate footprint*
 2. *Reduce their emissions as much as possible*
 3. *Offset what they cannot reduce with UN certified emission reductions*

COP-23 (2017) –Bonn

- Presided by **Fiji**
- Road map for *Talanoa dialogue*
- It is an *inclusive, participatory and transparent* dialogue to resolve differences without putting blame on anyone
- Three questions
 - Where we are?*
 - Where do we want to go?*
 - How do we get there?*

India and Climate change

- India - already taken a number of actions on voluntary basis with own resources in pursuance of a sustainable development strategy.
- India has adopted the *National Action Plan on Climate Change (NAPCC)* in 2008 which has both mitigation and adaptation measures.
- The *Eight National Missions* which form the core of the NAPCC represent multi- prolonged, long-term, and integrated strategies for achieving key goals in the context of climate change.

Eight National Missions

1. *National Solar Mission*
2. *National Mission for Enhanced Energy Efficiency*
3. *National Mission on Sustainable Habitat*
4. *National Water Mission*
5. *National Mission for Sustaining the Himalayan Eco-system*
6. *National Mission for a Green India*
7. *National Mission for Sustainable Agriculture*
8. *National Mission on Strategic Knowledge for Climate Change*

- India has announced a domestic goal of reducing the emission intensity of its GDP by **20-25 per cent** of the 2005 level by **2020**.
- All the states have also been asked to **prepare state-level action plans**. These plans are envisioned as extensions of the NAPCC at various levels of governance, aligned with the eight National Missions.
- India on *1st October, 2015* submitted its '**climate action plan**' to United Nations Framework Convention of the Climate Change (UNFCCC) at Bonn in Germany.
- The 'Climate Action Plan' of individual country is called the **Intended Nationally Determined Contribution (INDC)** in the realm of climate change negotiation

India –limitations to control global warming

- ✓ India's dependency on coal
- ✓ Huge spending on poverty alleviation and rural programs programs
- ✓ Lack of alternate technologies
- ✓ Lack of funds
- ✓ Poverty and health issues
- ✓ FDI from other countries
- ✓ India is highly prone to climate related catastrophes like floods, droughts, heat waves and cyclones Indian political and economic conditions

Global Environment Facility (GEF)

- Initially established -as a pilot program with the **World Bank** in 1991
- Mainly to
 - Assist in the protection of the global environment
 - To promote environmental sustainability development.
- GEF was restructured and become a permanent and separate institution in *1992 during the Rio Earth Summit*
- Objective - *to help tackle our planet's most pressing environmental problems – through strategic investments*

- GEF is *a unique partnership of 18 agencies* — including United Nations agencies, multilateral development banks, national entities and international NGOs
- It works with **183 countries** to address the *world's most challenging environmental issues*.
- It is a **Financial Mechanism** for **five major** international environmental conventions
 1. *The Minamata Convention on Mercury*
 2. *The Stockholm Convention on Persistent Organic Pollutants (POPs)*
The United Nations Convention on Biological Diversity (UNCBD)
 3. *The United Nations Convention to Combat Desertification (UNCCD)*
 4. *The United Nations Framework Convention on Climate Change (UNFCCC).*

