



- Pollution may be defined as the addition of undesirable material into the environment as a result of human activities. The agents which cause environmental pollution are called pollutants.

• Classification of Pollutants

According to the form in which they persist after release into the environment.

- **Primary pollutants:** These are persistent in the form in which they are added to the environment, e.g. **DDT, plastic, CO, CO₂, oxides of nitrogen and sulphur, etc.**
- **Secondary Pollutants:** These are formed by interaction among the primary pollutants. For example, **peroxyacetyl nitrate (PAN)** is formed by the interaction of **nitrogen oxides** and **hydrocarbons**.

According to their existence in nature

- ***Quantitative Pollutants:*** These occur in nature and become pollutant when their concentration reaches beyond a threshold level. E.g. carbon dioxide, nitrogen oxide.
- ***Qualitative Pollutants:*** These do not occur in nature and are human-made. E.g. fungicides, herbicides, DDT etc.

In terms of eco-system, the pollutants can be classified into two basic groups:

(a) Non-degradable Pollutants:

These are not broken down the natural processes like action of microbes. Most of these Mutants get accumulated in the environment and also get biologically magnified as these move along the food chains in an under composed state. These may also react with other compounds in the environment to produce toxins.

These can be further subdivided into two more classes:

(i) Waste:

e.g. glass, plastic, phenolic, aluminum cans etc.

(ii) Poisons:

e.g. radio-active substances, pesticides, smog gases, heavy metals like mercury, lead and their salts.

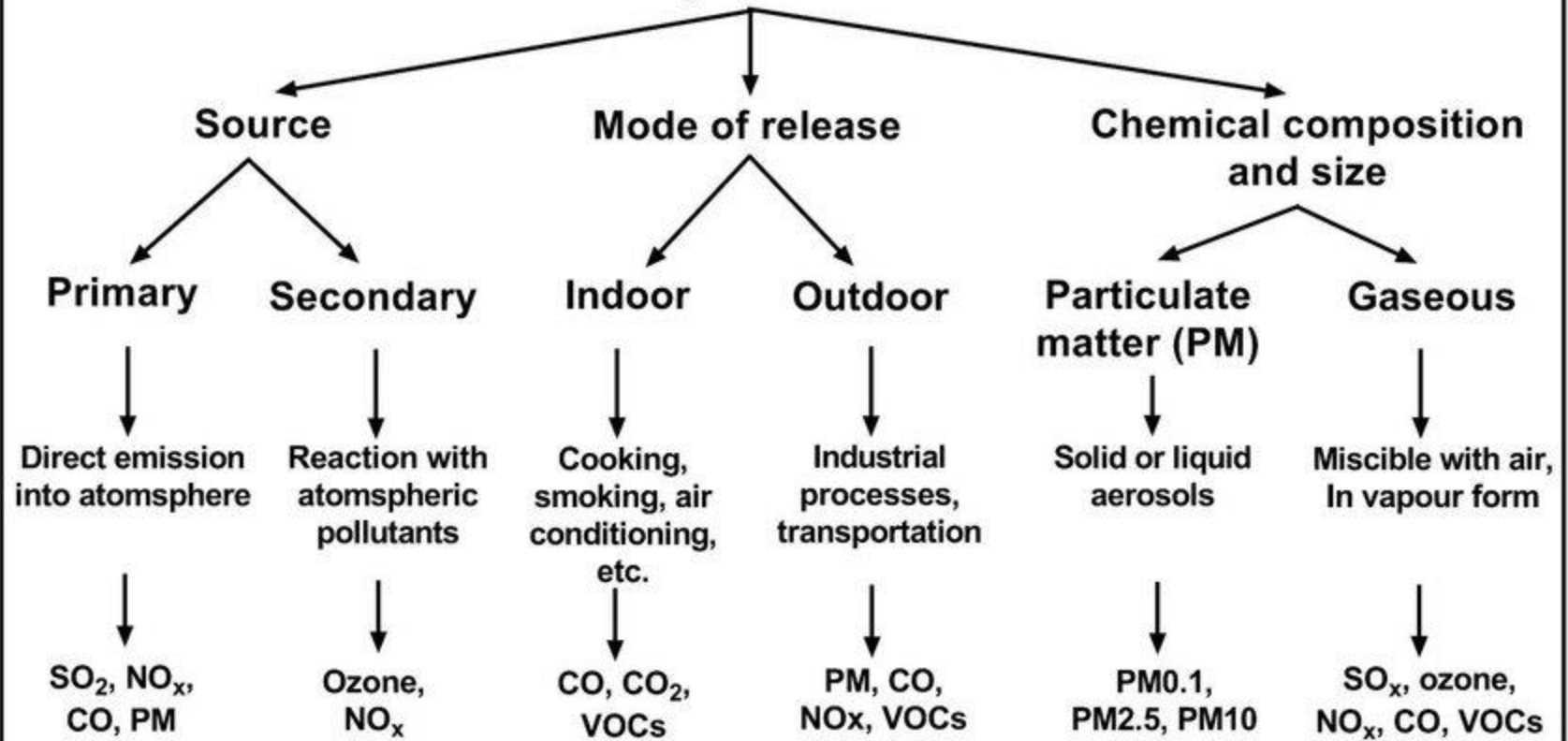
(b) Degradable pollutants or Bio-degradable Pollutants (Odum 1971):

These are natural organic substances which can be decomposed, removed or consumed and thus, reduced to acceptable levels either by natural processes like biological or microbial action or by some engineered systems, like sewage treatment plants.

Air pollution

- Air is said to be polluted when certain solid, liquid or gaseous substances (pollutants) present in the atmosphere directly or indirectly harm living organisms, property and environment.
- Air pollution is the world's single greatest environmental risk to health.
- Air pollution is said to cause roughly 7 million deaths annually.

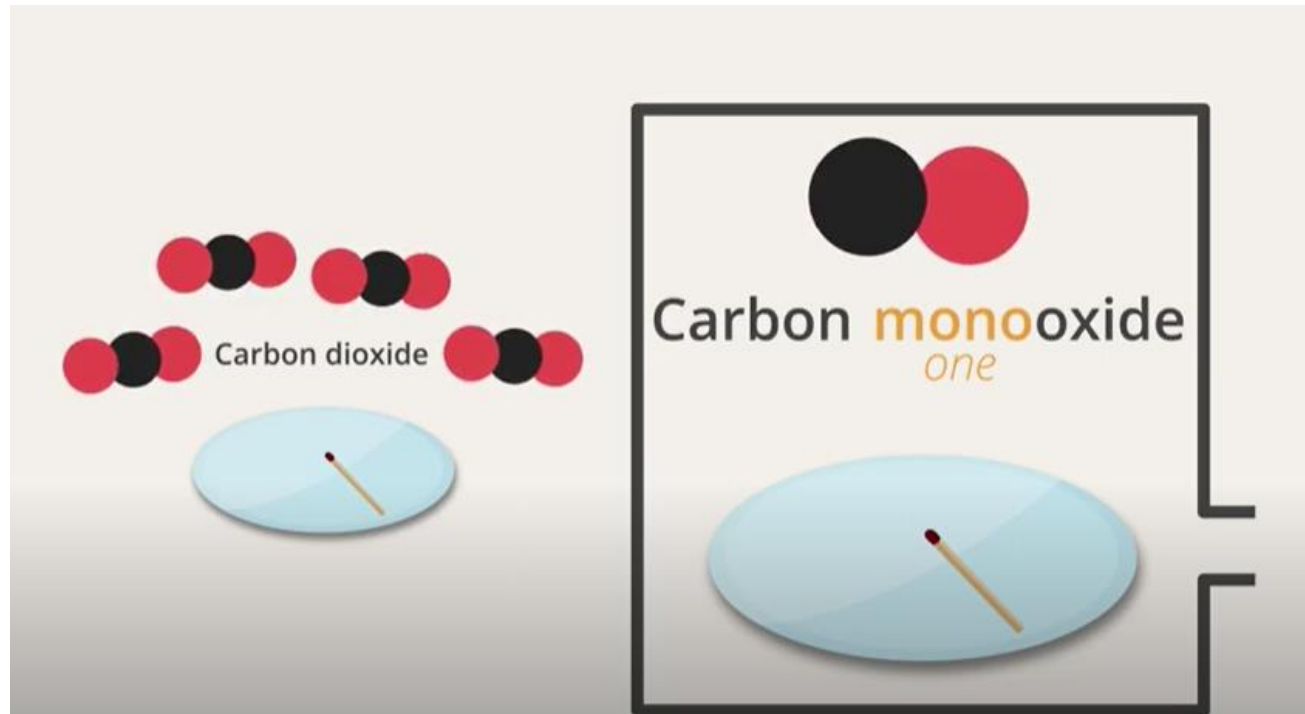
Air pollutants



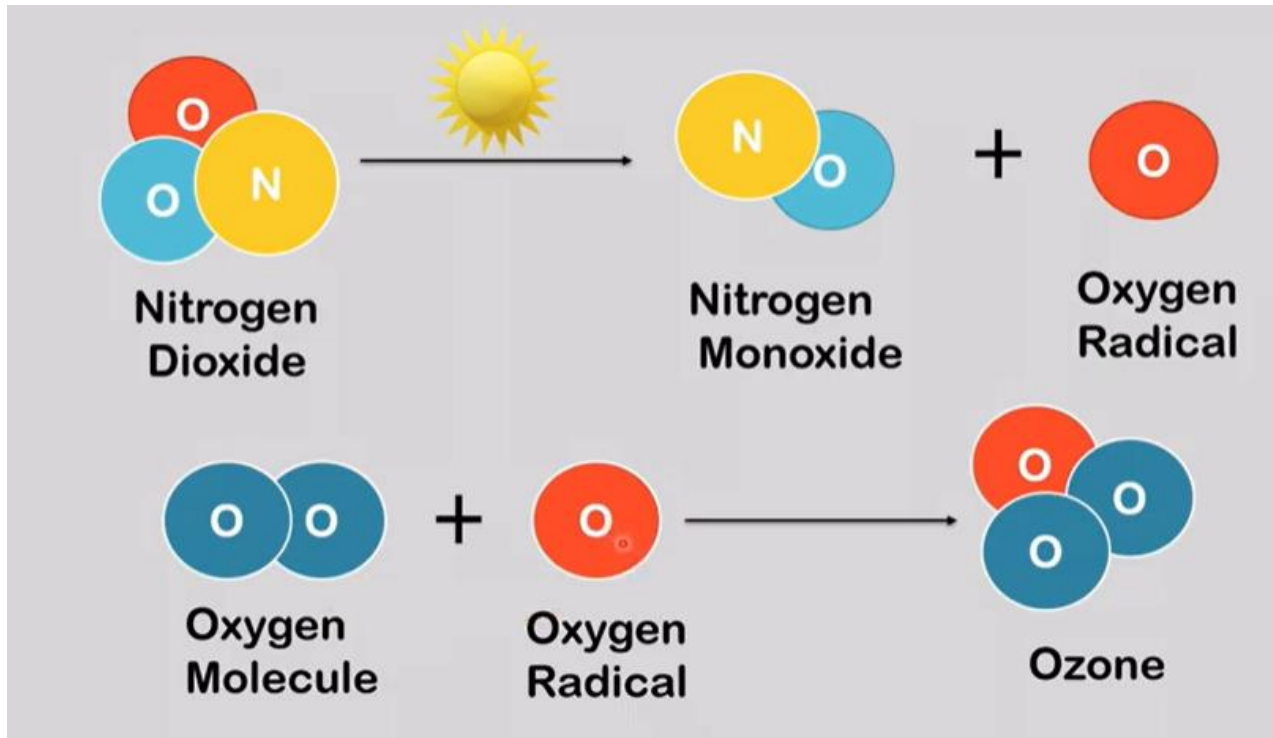
Major Gaseous Air Pollutants

- **Carbon monoxide (CO)**

- Carbon monoxide (CO) is a colourless, odourless, tasteless and highly toxic gas that is **slightly less dense than air**. It is **short-lived** (stay only a few months) in the atmosphere.
- Carbon monoxide is produced from the exhaust of **internal combustion engines** and **incomplete combustion** of various other fuels. **Iron smelting** also produces carbon monoxide as a by-product.
- It forms when there is not enough oxygen to produce carbon dioxide (CO₂).
- In the presence of oxygen, carbon monoxide burns with a **blue flame**, producing carbon dioxide.
- Other natural sources of CO include **volcanoes**, **forest fires**, and other forms of combustion.







The majority of tropospheric ozone formation occurs when [nitrogen oxides](#) (NO_x), [carbon monoxide](#) (CO) and [volatile organic compounds](#) (VOCs), react in the atmosphere in the presence of sunlight, specifically the UV spectrum. NO_x, CO, and VOCs are considered ozone precursors

**Unburnt
hydrocarbon**

- Volatile organic compounds (VOCs)
- Formaldehyde (HCHO)

+



Ozone

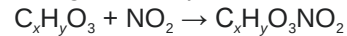
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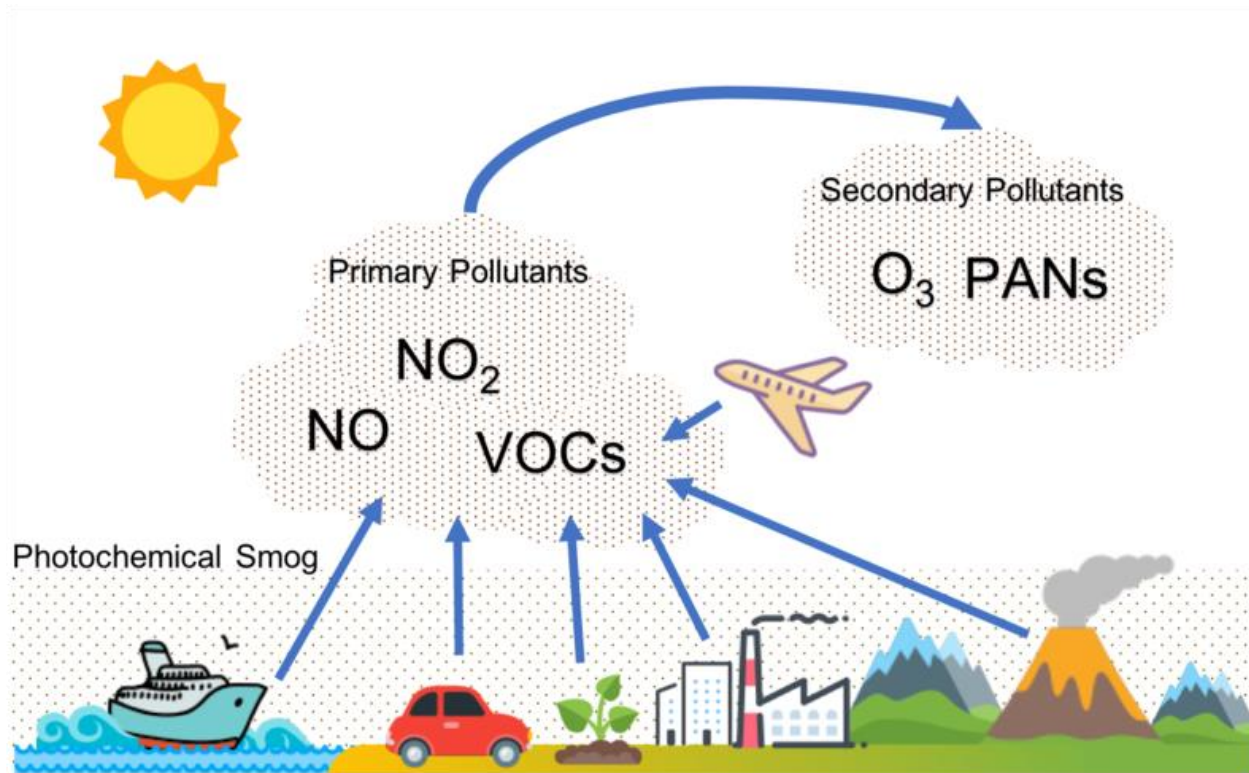


Nitrogen
Dioxide

PAN
(Peroxy Acetyl Nitrate)

The general equation is:





- **Health Effects**

- It is toxic to **haemoglobin animals (including humans)** when encountered in concentrations above about 35 ppm.
- **It combines with haemoglobin to produce carboxyhaemoglobin, which usurps the space in haemoglobin that normally carries oxygen.**

- **Carbon dioxide (CO₂)**

- Colourless and odourless gas. It is **heavier than air**.
- Natural sources include volcanoes, hot springs and geysers, and it is freed from carbonate rocks by dissolution in water and acids.
- Because carbon dioxide is **soluble in water**, it occurs naturally in groundwater, rivers and lakes, in ice caps and glaciers and also in seawater.

- **Effects on Health**

- CO₂ is an asphyxiant gas (asphyxia: a condition arising when the body is deprived of oxygen, causing unconsciousness or death.).
- Concentrations of 7% may cause suffocation, even in the presence of sufficient oxygen, manifesting as dizziness, headache, and unconsciousness.

- **Effects on Environment**

- Carbon dioxide is an important **greenhouse gas**.
- Burning of carbon-based fuels since the industrial revolution has led to **global warming**.
- It is also a major cause of **ocean acidification** because it dissolves in water to form **carbonic acid**.



- **Chlorofluorocarbons (CFCs)**

- Chlorofluorocarbons (CFCs) are used in **refrigerators, air conditioners and aerosol sprays**.

- **Ozone (O₃)**

- It occurs naturally in the stratosphere and absorbs harmful ultraviolet rays of the sun.
- However, at the ground level, it is a pollutant (**Greenhouse gas**) with highly toxic effects.
- Vehicles and industries are the major sources of ground-level ozone emissions.
- **Carbon monoxide, Nitrogen dioxide** play a major role in converting O₂ to O₃.
- Ozone makes our eyes itchy, and watery. It lowers our resistance to cold and pneumonia.

- **Nitrogen oxide (NO_x)**

- NO_x is a generic term for the various nitrogen oxides produced during combustion.
- They are produced mainly in **internal combustion engines** and **coal-burning power plants**.
- They are also produced naturally by **lightning**.

Oxygen and nitrogen do not react at ambient temperatures. But at high temperatures, they produce various oxides of nitrogen. Such temperatures arise inside an internal combustion engine or a power station boiler.

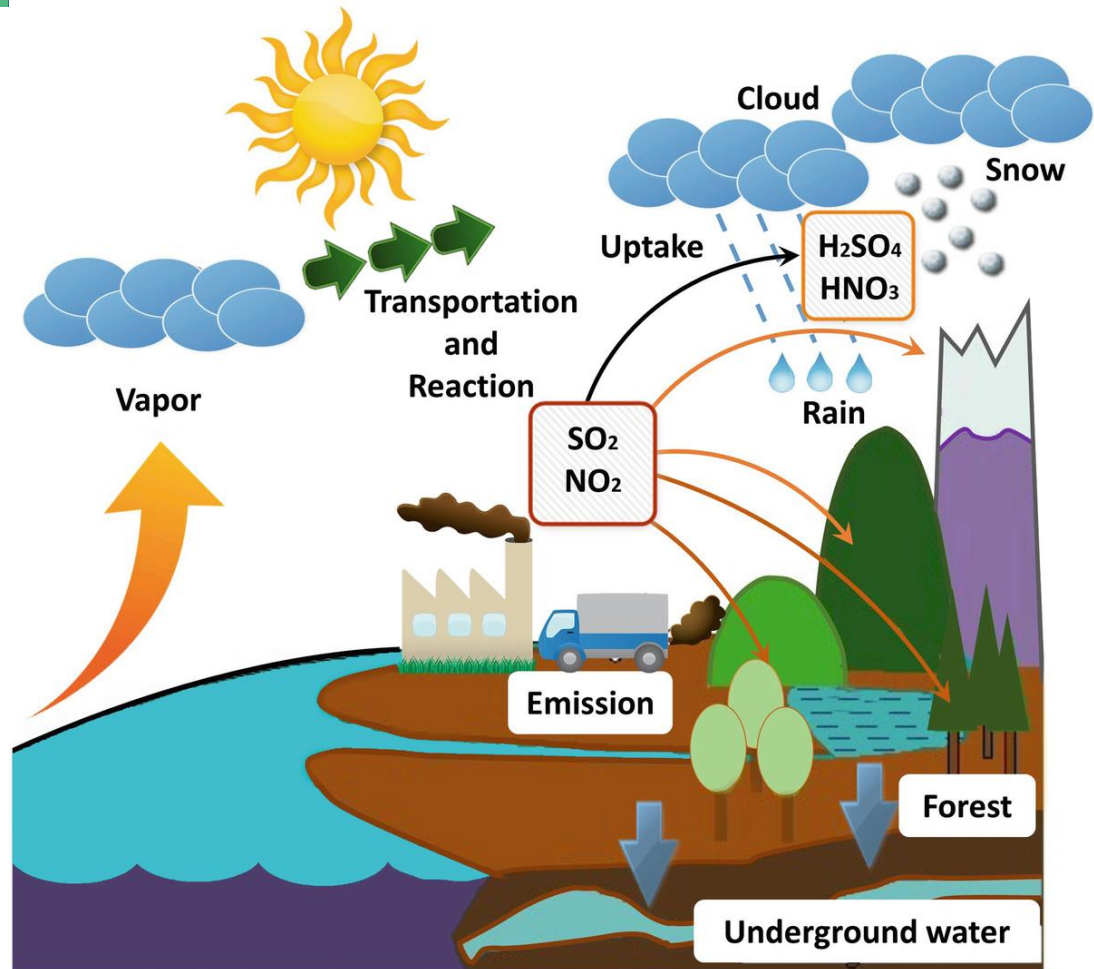
- **Agricultural fertilisation** and the **use of nitrogen-fixing plants** also contribute to atmospheric NO_x by promoting nitrogen fixation by microorganisms.
- **NO and NO₂ (contribute to global cooling)** should not be confused with **nitrous oxide (N₂O – GHG)**, which is a **greenhouse gas** ..

- **Effects on Health and Environment**

- NO_x gases react to form **smog** and **acid rain** as well as being central to the formation of **tropospheric ozone**
- When **NO_x** and **volatile organic compounds (VOCs)** react in the presence of sunlight, they form **photochemical smog**.

- **Sulphur dioxide (SO₂)**

- It is a toxic gas with a pungent, irritating smell. It contributes to **acid rain**.
- It is released naturally by **volcanic activity**. It is abundantly available in the atmosphere of **Venus**.
- Sulphur dioxide is primarily produced for sulfuric acid manufacture.
- Inhaling sulphur dioxide is associated with increased respiratory symptoms and premature death.
- It also weakens the functioning of certain nerves.
- It is also produced by
 - ✓ **burning coal in thermal power plants** and **diesel fuels**.
 - ✓ some industrial processes, such as the production of paper and smelting of metals.
 - ✓ reactions involving **Hydrogen Sulphide (H₂S)** and **oxygen**.
 - ✓ The **roasting of sulphide ores** such as **pyrite, sphalerite, and cinnabar (mercury sulphide)**.



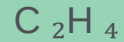
- **Volatile organic compounds (VOCs)**

- Volatile Organic Compounds (VOCs) are a large group of **carbon-based** chemicals that easily **evaporate** at room temperature.
- For example, **formaldehyde**, which evaporates from paint, has a boiling point of only -19°C .
- Formaldehyde causes irritation to the eyes and nose and allergies.
- The main indoor sources are **perfumes, hair sprays, furniture polish, glues, air fresheners, moth repellents, wood preservatives**, and other products.
- Health effects: irritation of the eye, nose and throat, headaches, nausea and loss of coordination.
- Long term health effects: suspected to damage the liver and other parts of the body.

- **Benzene**

- Benzene is a natural constituent of **crude oil** and is one of the elementary petrochemicals.
- it is an important component of **gasoline (petrol)**.
- Benzene increases the **risk of cancer** and other illnesses.
- Benzene is a notorious cause of **bone marrow failure**.

- **Ethylene**



- Ethylene is widely used in the chemical industry.
- Much of this production goes toward **polyethylene**.
- Ethylene is also an important **natural plant hormone**, used in agriculture to force the **ripening of fruits**.
- Ethylene is of low toxicity to humans and exposure to excess ethylene cause adverse health effects like headache, drowsiness, dizziness and unconsciousness.
- Ethylene is not but **ethylene oxide is a carcinogen (cancer-causing agent)**.

- **Biological pollutants**

- It includes pollen from plants, mite, and hair from pets, fungi, parasites, and some bacteria.
- Most of them are allergens and can cause asthma, hay fever, and other allergic diseases.

- **Asbestos**

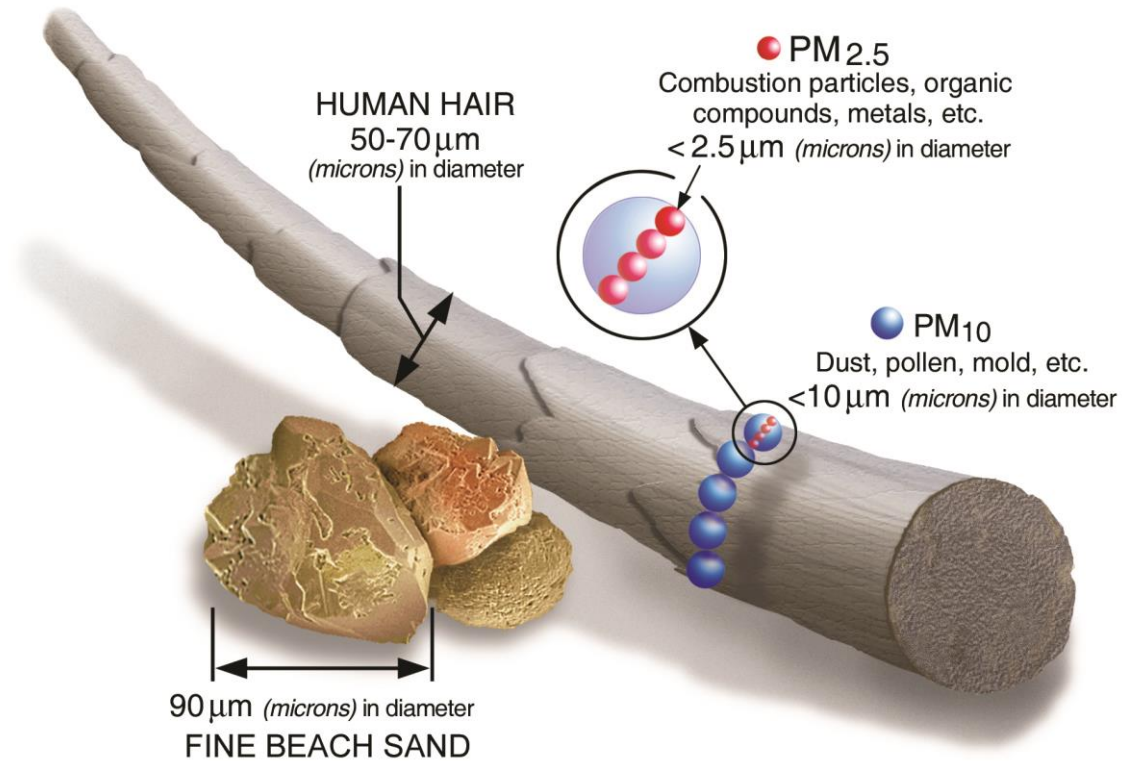
- Asbestos refers to a set of six naturally occurring silicate **fibrous minerals** — chrysotile, crocidolite, amosite, anthophyllite, tremolite, and actinolite.
- It is now known that prolonged inhalation of asbestos fibres can cause serious and fatal illnesses including **lung cancer**, **mesothelioma**, and **asbestosis** (a type of pneumoconiosis).

- **Radon**

- It is a gas that is emitted naturally by the **soil**.
- Due to modern houses having poor ventilation, it is confined inside the house and causes lung cancers.

- **Particulate pollutants**

- Particulate pollutants are matter suspended in air such as dust and soot.
- Major source of SPM (suspended particulate matter) are industries, vehicles, power plants, construction activities, oil refinery, railway yard, market place, industries, etc.
- Their size ranges from **0.001 to 500 micrometres** (μm) in diameter.
- ✓ Particles less than 10 μm float and move freely with the air current. Particles which are more than 10 μm in diameter settle down.
- ✓ Particles less than 0.02 μm form **persistent aerosols**.
- According to the Central Pollution Control Board (CPCB), particulate size **2.5 μm or less in diameter (PM 2.5)** are responsible for causing the **greatest harm to human health**.
- These fine particulates can be inhaled deep into the lungs and can cause breathing and respiratory symptoms, irritation, inflammations and **pneumoconiosis** (disease of the lungs caused due to inhalation of dust. It is characterised by inflammation, coughing, and fibrosis – excess deposition of fibrous tissue).



- **Fly ash**

- Fly ash is ejected mostly by **thermal power plants** as by-products of coal burning operations.
- Fly ash pollutes air and water and may cause **heavy metal pollution** in water bodies.
- Fly ash affects crops and vegetation as a result of its direct deposition on leaf surfaces.

- **Composition**

- Fly ash particles are **oxide rich and consist of silica, alumina, oxides of iron, calcium, and magnesium and toxic heavy metals like lead, arsenic, cobalt, and copper.**
- Major oxides are present are **aluminium silicate** (in large amounts), **silicon dioxide** (SiO_2) and **calcium oxide** (CaO).

- **Uses**

- Cement can be replaced by fly ash up to 35%, thus reducing the cost of construction, making roads, etc.
- Fly ash bricks are light in weight and offer high strength and durability.
- Fly ash is a better fill material for road embankments and in concrete roads.
- Fly ash can be used in the reclamation of wastelands.
- Abandoned mines can be filled up with fly ash.
- Fly ash can increase crop yield when added to the soil. But if it gets deposited on the leaf, it will reduce photosynthesis.
- It also enhances the water holding capacity of the land.

- **Lead**

- It is present in **petrol, diesel, lead batteries, paints, hair dye** products, etc.
- It can cause nervous system damage and digestive problems and, in some cases, cause cancer.
- Lead affects children in particular.
- **Tetraethyl lead (TEL)** is used as an **anti-knock agent in petrol** for a smooth and easy running of vehicles.
- The lead particles coming out from the exhaust pipes of vehicles is mixed with air.
- It produces injurious effects on kidney and liver and interferes with the development of red blood cells.
- Lead mixed with water and food can create cumulative poisoning.
- It has long term effects on children as it lowers intelligence.

- **Prevention and Control of Air Pollution**

- **Control of Industrial Pollution**

- Industrial pollution can be greatly reduced by:
 - ✓ use of cleaner fuels such as liquefied natural gas (LNG) in power plants, fertiliser plants etc. which is cheaper in addition to being environmentally friendly.

- ✓ installing devices which reduce the release of pollutants.
- Devices like filters, **electrostatic precipitators**

- **Filters**

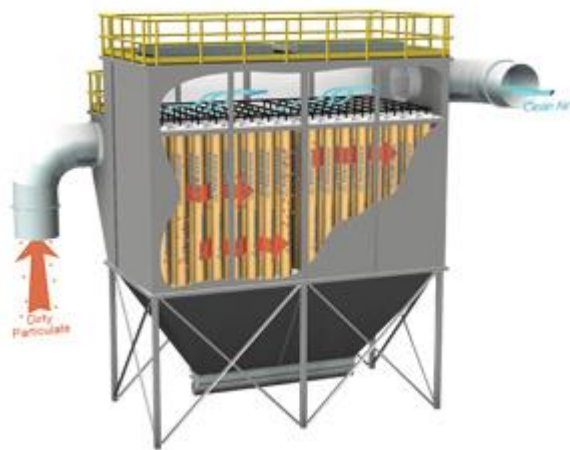
- Filters remove particulate matter from the gas stream.
- Baghouse filtration system is the most common one and is made of cotton or synthetic fibres (for low temperatures) or glass cloth fabrics (for higher temperature up to 290⁰ C).

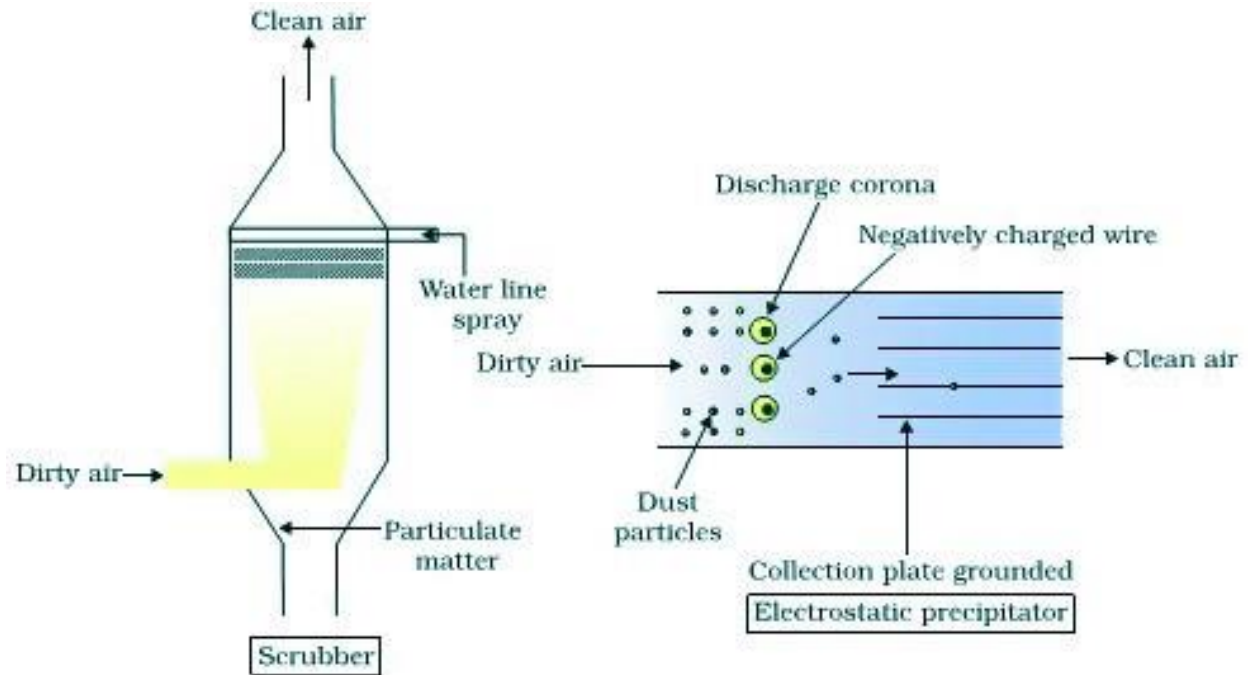
- **Electrostatic precipitators (ESP)**

- Electrostatic precipitation can remove over 99 per cent particulate matter present in the exhaust.
- The **emanating dust is charged with ions**, and the **ionised particulate matter is collected on an oppositely charged surface**.

- **Working**

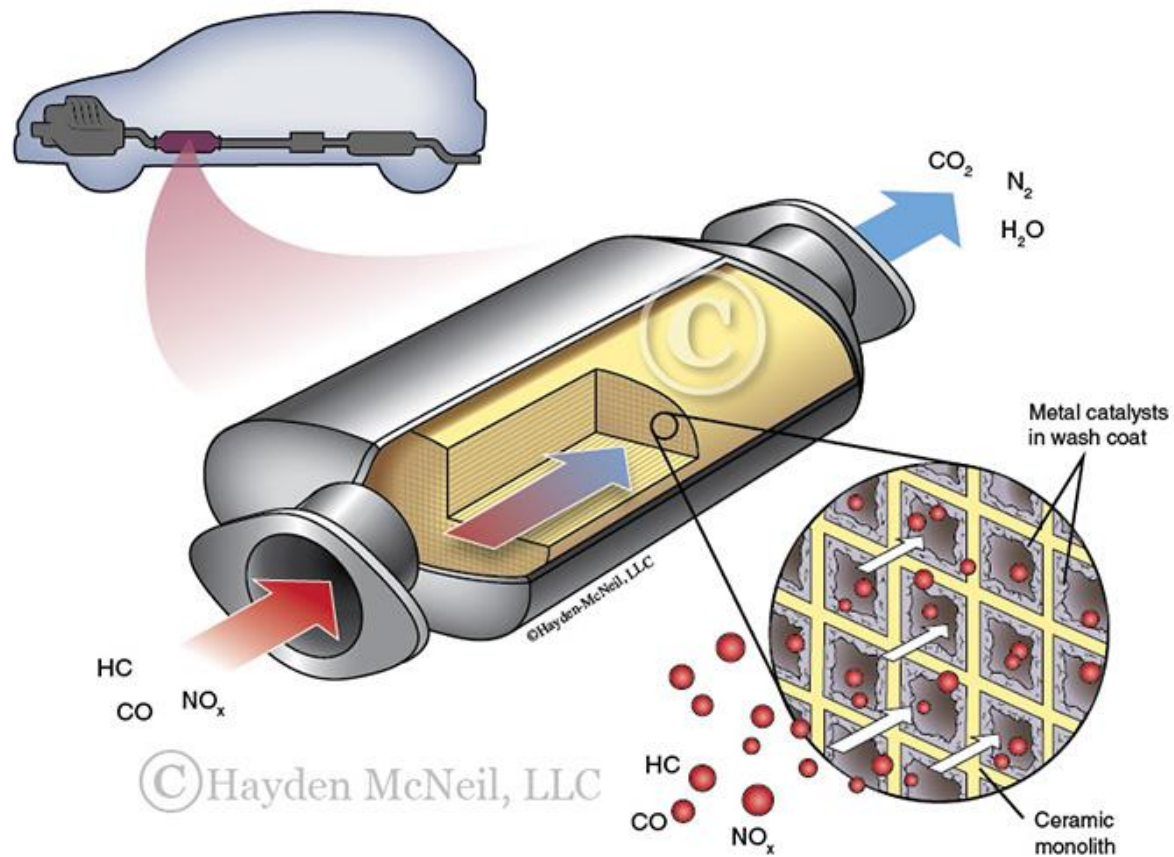
- An electrostatic precipitator has electrode wires that are maintained at several thousand volts, which produce a **corona** that releases **electrons**.
- These electrons attach to dust particles giving them a net negative charge. The collecting plates are grounded (relatively positive charge) and attract the charged dust particles.
- ESPs are used in boilers, furnaces, and many other units of **thermal power plants, cement factories, steel plants**, etc





- **Catalytic converter**

- Catalytic converters, having expensive metals namely **platinum-palladium** and **rhodium** as the catalysts, are fitted into automobiles for reducing the emission of poisonous gases.
- As the exhaust passes through the catalytic converter, unburnt hydrocarbons are converted into **carbon dioxide and water**, and **carbon monoxide and nitric oxide are changed to carbon dioxide and nitrogen gas**, respectively.
- Motor vehicles equipped with catalytic converter should use **unleaded petrol** because the lead in the petrol inactivates the catalyst.



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Apart from the use of the above mentioned devices, other control measures are:

- increasing the height of chimneys.
- closing industries which pollute the environment.
- shifting of polluting industries away from cities and heavily populated areas.

development and maintenance of a green belt of adequate width

- **Steps Taken to Control Vehicular Pollution**

- Earlier lead in the form of **tetraethyl lead** was added in the petrol to **raise octane level** for the **smooth running** of engines. Addition of lead in petrol has been banned to prevent the emission of lead particles.
- Usage of alternative fuels like **CNG in public transport vehicles is made mandatory** in cities like Delhi. All the buses of Delhi were converted to run on CNG by the end of 2002.

- Simultaneously parallel steps taken in Delhi for reducing vehicular pollution include phasing out of old vehicles, **use of unleaded petrol, use of low-sulphur petrol and diesel**, use of catalytic converters in vehicles, application of stringent pollution-level norms for vehicles, etc.

- **BS VI from 2020**

- From April **2017**, BS IV norms are applicable nationwide.
- October 2018: Supreme Court ordered a **ban on the sale of Bharat Stage IV vehicles from April 1, 2020**.
- The central government had announced the **April 1, 2020 deadline for adopting Bharat Stage VI** emission norms by manufactures.

- **Bharat Stage (BS) norms**

- The BS norms are instituted by the government to regulate the emission of air pollutants from motor vehicles.
- The norms were introduced in 2000.
- The norms limit the release of air pollutants such as **nitrogen oxides, carbon monoxide, hydrocarbons, particulate matter (PM) and sulphur oxides** from vehicles using **internal combustion engines**.
- The norms are meant to be adopted by using appropriate fuel and technology.
- As the stage goes up, the control of emissions become stricter.
- BS IV and BS VI norms are based on similar norms in Europe called Euro 4 and Euro 6.

- **Differences between BS IV and BS VI**

- The **extent of sulphur** is the major difference between Bharat Stage IV and Bharat Stage VI norms.
- **BS-IV fuels contain 50 parts per million (ppm) sulphur**; the **BS-VI grade fuel only has 10 ppm sulphur**.
- BS VI can bring
- ✓ **PM in diesel cars down by 80 per cent.**
- ✓ **nitrogen oxides from diesel cars by 70 per cent and in petrol cars by 25 per cent.**
- BS VI also makes **onboard diagnostics (OBD) mandatory** for all vehicles.
- **RDE (Real Driving Emission)** will be introduced for the first time that will measure the emission in real-world conditions and not just under test conditions.

- **Impact**

- Compliance requires a higher investment in technology to make new vehicles.
- Upgrading vehicles in stock is an additional burden for the manufacturers.
- BS VI-compliant vehicles will be expensive.
- BS VI-compliant fuel too will be more expensive.

- **Effects of Air Pollution: Acid Rain – Acidification**

- Acid rain refers to any precipitation (rain, fog, mist, snow) that is more acidic than normal (**pH of less than 5.6**. pH below 7 is acidic).
- Acid rain is caused by atmospheric pollution from acidic gases such as **sulphur dioxide** and **oxides of nitrogen** emitted from the burning of fossil fuels.
- It is also recognized that acidic smog, fog, mist, move out of the atmosphere and settle on dust particles which in turn accumulate on vegetation as acid depositions.
- When rain falls, the acid from these depositions leak and form acid dews.

- **Types of Acid Deposition**

- "Acid rain" is a broad term referring to a mixture of wet and dry deposition (a form of deposition material) from the atmosphere.

- **Wet Deposition**

- If the acid chemicals in the air are blown into areas where the weather is wet, the acids can 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**

- In areas where the weather is dry, the acid chemicals may become incorporated into dust or smoke and fall to the ground through dry deposition, **sticking to the ground, buildings, vegetation, cars**, etc.

- **Effects on humans**

- Bad smells, reduced visibility; irritation of the skin, eyes and the respiratory tract.
- Some direct effects include chronic bronchitis, pulmonary emphysema and cancer.

- **Effects on soil**

- The exchange between hydrogen ions and the nutrient cations like potassium and magnesium in the soil cause **leaching of the nutrients**, making the soil infertile.

- **Effects on aquatic life**

- Eggs or sperms of fish, frogs and other aquatic organisms are sensitive to pH changes.
- Acidic lake waters may kill microbes and turn them unproductive.

- **Effect on terrestrial life**

- Acidic medium promotes **leaching** of heavy metals like **aluminium, lead** and **mercury**. Such metals when percolate into ground water affect soil micro flora/fauna.
- Other indirect effects of acid rain on wildlife are loss or alteration of food and habitat resources.

- **Effects on microorganisms**

- pH determines the proliferation of any microbial species.
- **The optimum pH of most bacteria and protozoa is near neutrality.**
- **Most fungi prefer an acidic environment.**
- **Most blue-green bacteria prefer an alkaline environment.**
- **So, microbial species in the soil and water shift from bacteria-bound to fungi-bound.**
- **This causes a delay in the decomposition of soil organic material.**

- **Effect on buildings, monuments and materials**

- Many old, historical, ancient buildings and works of art/textile etc. are adversely affected by acid rain.
- Limestone and marble are destroyed by acid rain. Smoke and soot cover such objects..
- Many buildings/monuments such as Taj Mahal in Agra have suffered from acid rain (Marble Cancer).

- .

- **Acid Rain Areas**

- They are concentrated in the industrialised belt of the northern hemisphere.
- Scandinavia, Canada, the Northeast United States and North-western Europe.

- **In India**

- In India, the first report of acid rain came from Bombay in 1974.
- Instances of acid rain are being reported from metropolitan cities.
- Lowering of soil pH is reported from north-eastern India, coastal Karnataka and Kerala, parts of Orissa, West Bengal and Bihar.

- **Acid Rain Control**

- Use of low sulphur fuel or natural gas or washed coal (chemical washing of pulverised coal) in thermal plants can reduce incidences of acid rain.
- Buffering: the practice of adding a neutralising agent to the acidified water to increase the pH. Usually, lime in the form of **calcium oxide and calcium carbonate** is used

- **National Ambient Air Quality Standards (NAAQS)**

Ambient air quality refers to the condition or quality of air surrounding us in the outdoors. National Ambient Air Quality Standards are the standards for ambient air quality set by the Central Pollution Control Board (CPCB) that is applicable nationwide. The CPCB has been conferred this power by the Air (Prevention and Control of Pollution) Act, 1981.

The NAAQS have been revisited and revised in November 2009 for 12 pollutants, which include

- **sulphur dioxide (SO₂),**
- **nitrogen dioxide (NO₂),**
- **particulate matter having micron (PM₁₀),**
- **particulate matter having a size less than 2.5 microns (PM_{2.5}),**
- **ozone,**
- **lead,**
- **carbon monoxide (CO),**
- **arsenic,**
- **nickel,**
- **benzene,**
- **ammonia, and**
- **benzopyrene.**

- **National Air Quality Index (AQI)**

- Launched by the Environment Ministry in April 2015.
- Initiative under '**Swachh Bharat**'.

- **AQI**

- It helps the common man to judge the air quality within his vicinity.
- Index constituted as a part of the Government's mission to improve the culture of cleanliness.

- **Old vs new**

- While the earlier measuring index was limited to three indicators, the current measurement index had been made quite comprehensive by the addition of more parameters.

- **Previously who measured Air pollution**

- Central Pollution Control Board along with State Pollution Control Boards have been operating the **National Air Monitoring Program (NAMP)**.

- **Why is AQI necessary?**

- Quality of data from some cities remains weak, and the standards set for pollutants fall short of World Health Organization recommendations.
- The pollution related analysis using a vast number of complex parameters was complicated for the common man to understand.

- **Categories of air pollution under AQI**

- There are six AQI categories, namely Good, Satisfactory, Moderately polluted, Poor, Very Poor, and Severe.

- **Pollutants considered**

- The AQI will consider eight pollutants (**PM10, PM2.5, NO₂, SO₂, CO, O₃, NH₃, and Pb**).

CENTRAL POLLUTION CONTROL BOARD'S

AIR QUALITY STANDARDS

AIR QUALITY INDEX (AQI)	CATEGORY
0-50	Good
51-100	Satisfactory
101-200	Moderate
201-300	Poor
301-400	Very Poor
401-500	Severe

AQI Category	AQI	Concentration range*							
		PM ₁₀	PM _{2.5}	NO ₂	O ₃	CO	SO ₂	NH ₃	Pb
Good	0 - 50	0 - 50	0 - 30	0 - 40	0 - 50	0 - 1.0	0 - 40	0 - 200	0 - 0.5
Satisfactory	51 - 100	51 - 100	31 - 60	41 - 80	51 - 100	1.1 - 2.0	41 - 80	201 - 400	0.5 - 1.0
Moderately polluted	101 - 200	101 - 250	61 - 90	81 - 180	101 - 168	2.1 - 10	81 - 380	401 - 800	1.1 - 2.0
Poor	201 - 300	251 - 350	91 - 120	181 - 280	169 - 208	10 - 17	381 - 800	801 - 1200	2.1 - 3.0
Very poor	301 - 400	351 - 430	121 - 250	281 - 400	209 - 748*	17 - 34	801 - 1600	1200 - 1800	3.1 - 3.5
Severe	401 - 500	430 - +	250+	400+	748+*	34+	1600+	1800+	3.5+

* CO in mg/m³ and other pollutants in µg/m³; 2h-hourly average values for PM₁₀, PM_{2.5}, NO₂, SO₂, NH₃, and Pb, and 8-hourly values for CO and O₃.

The Air (Prevention and Control of Pollution) Act, 1981

- Aims for the prevention, control and abatement of air pollution.
- Establishes Boards at the Central and State levels.
- For better monitoring of air pollution, ambient air quality standards were established.

- The Air Act prohibits the use of polluting fuels and substances and regulates the use of appliances that give rise to air pollution.
- It empowers the State Government, after consultation with the SPCBs, to declare any area or areas within the State as air pollution control area or areas.
- Establishing or operating any industrial plant in the pollution control area requires consent from SPCBs.

National Clean Air Programme

- It was launched by the **Ministry of Environment and Forests** recently.
- It was launched by the MoEFCC in **January 2019**.
- It **provides a framework for the Centre and the states to combat air pollution**.
- NCAP has a **goal to meet the prescribed annual average ambient air quality standards at all locations in the country in a stipulated time frame**.
- It has been launched **to cut down particulate matter by 20-30% in at least 102 cities by 2024**.

Need for NCAP

- **Cities** occupy just **3% of the land**, but contribute to **82% of GDP**.
- They are also responsible for **78% of Carbon dioxide** emissions.
- Though cities are engines of growth and equity, they have to be sustainable.
- NCAP has been launched as an **inclusive program to reduce pollution and make cities sustainable**.

Features of NCAP

- The **national level target of 20%–30% reduction of PM_{2.5} and PM₁₀ concentration by 2024** is proposed under the NCAP taking 2017 as the base year for the comparison of concentration.
- NCAP is a **mid-term, five-year action plan with 2019 as the first year.**

- There are **102 non-attainment cities** identified for implementing mitigation actions under NCAP.
- For each of these cities, a **city specific action plan** is being made.
- Cities have already prepared action plans in consultation with Central Pollution Control Board.
- **Smart Cities program will be used to launch NCAP** in the 43 smart cities falling in the list of the 102 non-attainment cities.
- NCAP will be **evolved based on the evolving scientific and technical information.**

- In addition, the following would be constituted for effective implementation of NCAP
 - **Sectoral working groups**
 - **National level Project Monitoring Unit**
 - **Project Implementation Unit**
 - **State level project monitoring unit**
 - **City level review committee under the Municipal Commissioner**
 - **DM level Committee in the Districts**

- **Other features of NCAP include,**
 - **increasing number of monitoring stations in the country including rural monitoring stations,**
 - **technology support,**
 - **emphasis on awareness and capacity building initiatives,**
 - **setting up of certification agencies for monitoring equipment,**
 - **source apportionment studies,**
 - **emphasis on enforcement,**
 - **specific sectoral interventions etc.**

State of Global Air 2020: HEI

State of Global Air 2020 (SoGA 2020) has been released by the **Health Effects Institute (HEI)**.

- It highlights that **air pollution is the largest risk factor for death** among all health risks and it is the **first-ever comprehensive analysis of air pollution's global impact on newborns**.
- HEI is an **independent, nonprofit research institute** funded jointly by the USA's Environmental Protection Agency and others.

Key Points

- **India, Bangladesh, Pakistan and Nepal** are among the top ten countries with the **highest PM_{2.5} (particulate matter) exposures in 2019** and all of these countries experienced increases in outdoor PM_{2.5} levels between 2010 and 2019.
- **India is also among the top ten countries with highest ozone (O₃) exposure in 2019.** Also, **among the 20 most populous countries,** India recorded the highest increase (17%) in O₃ concentrations in the past ten years.
- **Long-term exposure to outdoor and household (indoor) air pollution** contributed to over 1.67 million annual deaths from stroke, heart attack, **diabetes**, lung cancer, chronic lung diseases, and **neonatal diseases**, in **India in 2019.**

Central Pollution Control Board

- Statutory organisation under the Ministry of Environment, Forest and Climate Change (MoEFCC).
- It was established in 1974 under the Water (Prevention and Control of Pollution) Act, 1974.
- Also derives its powers from the Air (Prevention and Control of Pollution) Act, 1981.
- Apex organisation in the country to control pollution.

Functions of CPCB:

- Coordinates the activities of the State Pollution Control Boards
- Conducts environmental assessments and research.
- Maintains national standards under a variety of environmental laws, in consultation with zonal offices, tribal, and local governments.
- Monitors water and air quality, and maintains monitoring data under National Air Quality Monitoring Programme (NAMP)
- Advises the central government to prevent and control water and air pollution.

The Environment Protection Act (EPA), 1986

- EPA is an umbrella legislation that includes the Water Act, 1974 and the Air Act.
- Under the Environment Act, the Central Government can:
 1. Set standards for emissions and discharges of pollution in the atmosphere by any person carrying on an industry or activity;
 2. Regulate the location of industries;
 3. Look after management of hazardous wastes,
 4. Empower any person to enter, inspect, take samples and test.

- From time to time, the Central Government issues notifications under the Environment Act for the protection of ecologically-sensitive areas or issues guidelines for matters under the Environment Act.
- The Act prescribes stringent penalties to the defaulters for violation of the provisions of the Act.
- The jurisdiction of Civil Court is barred under the Act.
- Every State has to set up Green Bench Courts to attend to Public Interest Litigation (PIL) cases concerning environmental hazards.

Environmental Pollution (Prevention and Control) Authority (EPCA)

- EPCA was constituted with the objective of ***‘protecting and improving’ the quality of the environment and ‘controlling environmental pollution’ in the National Capital Region***. The EPCA also assists the apex court in various environment-related matters in the region.
- EPCA is ***Supreme Court mandated body*** tasked with taking various measures to tackle air pollution in the National Capital Region. It was notified in 1998 by Environment Ministry under Environment Protection Act, 1986.

Functions:

- To protect and improve quality of environment and prevent and control environmental pollution in National Capital Region.
- To enforce Graded Response Action Plan (GRAP) in NCR as per the pollution levels.

Environmental Pollution (Prevention and Control) Authority (EPCA) will implement an emergency action plan in Delhi to tackle rising air pollution.

- The emergency plan is called the Graded Response Action Plan (GRAP).

Category	Ambient Particulate Matter (PM) Concentration	Measures
Moderate to Poor	•PM 2.5 between 61-120 $\mu\text{g}/\text{m}^3$ •PM10 between 101-350 $\mu\text{g}/\text{m}^3$	•Enforce pollution control in thermal power plants •Mechanized sweeping on roads •Ban on firecrackers •Stop garbage burning
Very Poor	•PM2.5 between 121-250$\mu\text{g}/\text{m}^3$ •PM10 between 351-430 $\mu\text{g}/\text{m}^3$	•Stop use of diesel generator sets •Increase bus and metro services and increasing frequency of metro service •Stop use of coal/firewood in hotels and open eateries
Severe	•PM2.5 more than 250$\mu\text{g}/\text{m}^3$ •PM10 more than 430$\mu\text{g}/\text{m}^3$	•Increase frequency of mechanized sweeping of road and sprinkling of water on roads •Close brick kilns, Hot Mix plants, Stone Crushers •Shut down Badarpur power plant •Introduce concessional rates to encourage off-peak travel in public transport.
Severe+ or Emergency	•PM2.5 of or more than 300$\mu\text{g}/\text{m}^3$ •PM10 of or 500$\mu\text{g}/\text{m}^3$ (persist for 48 hours or more)	•Stop entry of diesel trucks into Delhi (except essential commodities) •Stop construction activities •Introduce odd and even scheme •Shutting of schools

Pradhan Mantri Ujjwala Yojana (PMUY)

- PMUY was launched in 2016 and is implemented by the Ministry of Petroleum and Natural Gas through its Oil Marketing Companies.
- Through PMUY, initially, 5 crores below poverty line (BPL) households were targeted for providing deposit free LPG connections to BPL households by 31st March, 2019. This target has been achieved.

SAFAR

- The System of Air Quality and Weather Forecasting And Research (SAFAR) is a national initiative introduced by the **Ministry of Earth Sciences (MoES)** to measure the air quality of a metropolitan city, by measuring the **overall pollution level** and the **location-specific air quality** of the city.
- The system is **indigenously** developed by the **Indian Institute of Tropical Meteorology (IITM)**, Pune and is operationalized by the **India Meteorological Department (IMD)**.
 - It has a giant true color LED display that gives out **real-time air quality index** on a 24x7 basis with **color-coding** (along with **72 hours advance forecast**).

The ultimate objective of the project is to **increase awareness** among the general public regarding the air quality in their city so that appropriate **mitigation measures and systematic action** can be taken up.

- SAFAR is an integral part of India's first **Air Quality Early Warning System** operational in Delhi.

It monitors all **weather parameters** like temperature, rainfall, humidity, wind speed, and wind direction, UV radiation, and solar radiation.

- Pollutants monitored:** PM2.5, PM10, Ozone, Carbon Monoxide (CO), Nitrogen Oxides (NOx), Sulfur Dioxide (SO2), Benzene, Toluene, Xylene, and Mercury.

SAMEER App is one of the air pollution mitigation measures which provides **hourly updates** on the **National Air Quality Index (AQI)**.

- The app is developed by the **Central Pollution Control Bureau (CPCB)** which provides information on air quality for more than 100 cities across the country.
- The app represents the listed cities in a **colour-coded format based on their AQI levels**.
- The app can also be used to **file or track complaints** related to garbage dumping, road dust, vehicular emissions or other pollution issues in a particular area

WAYU (Wind Augmentation PurifYing Unit)

•The air purifying devices include WAYU (Wind Augmentation PurifYing Unit) and High-Efficiency Particulate Arrestance (HEPA) filters.

WAYU (Wind Augmentation PurifYing Unit)

- It is developed to **address air pollution at traffic intersections and dense traffic zones.**
- It has been indigenously developed by the **Council of Scientific and Industrial Research - National Environmental Engineering Research Institute (CSIR-NEERI).**
- The device has the capacity to purify the air in an area of the **500-meter square.** It is **energy efficient** and has a **low maintenance cost.**
- The device works on two principles :
 - **Wind generation for dilution of air pollutants:** It comprises a fan that sucks in air and removes dust and particulate matter.
 - **Active Pollutant removal:** The carbon monoxide and hydrocarbons are oxidized into less harmful carbon dioxide using activated carbon coated with titanium dioxide.