

# Sustainable Engineering

## Module II

# Topics Discussed

- **Environmental Pollution:**
- Air Pollution and its effects
- Water pollution and its sources
- Zero waste concept and 3 R concepts in solid waste management
- Greenhouse effect, Global warming, Climate change, Ozone layer depletion,
- Carbon credits, carbon trading and carbon foot print
- Legal provisions for environmental protection.



## Air Pollution



# BHOPAL DISASTER

1984

It occurred on the night of 2-3 December 1984 at the Union Carbide India Limited (UCIL) pesticide plant in Bhopal, Madhya Pradesh. Over 500,000 people were exposed to methyl isocyanate (MIC) gas and other chemicals. The toxic substance made its way in and around the shanty towns located near the plant.

# Air pollution

- Air Pollution is defined *as presence of any solid , liquid or gaseous substance (including noise) present in the atmosphere in such concentrations that may or tend to be injurious to human beings or other living creatures or plants or property or enjoyment.*

*Air pollution* may be defined as the presence of substances, in such concentration of such characteristics and for such duration, that make the air *harmful* or *dangerous* to breathe for human or to cause damage to plants, animals and properties.

Alternatively, *Air Pollution* may be defined as any atmospheric condition in which *substances* are present at concentrations exceeding the safe levels, for such a duration so as to produce a *measurable effect* on men, animals, vegetation or materials. *Substances* mean any natural or anthropogenic i.e. man made physical matter or chemical compound capable of *air borne*. They may be present in air as solid particles, liquids or gases.

Air pollution is of public health concern and can occur as;

- |                                       |                         |
|---------------------------------------|-------------------------|
| (i) Indoor Air Pollution              | - Micro scale - Local   |
| (ii) Ambient or Outdoor Air Pollution | - Meso scale - Regional |
| (iii) Air Pollution at Global scales  | - Macro scale - Global  |

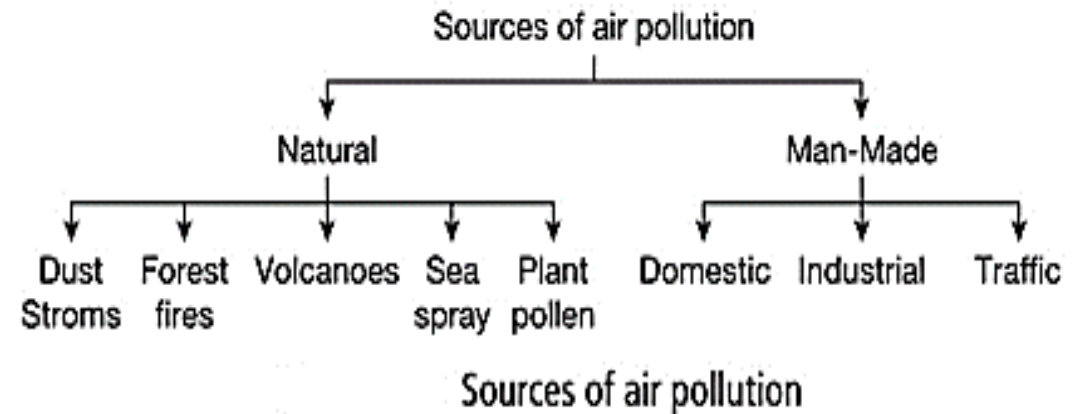
# Sources of Air pollution

## 1. Natural

- ✓ Volcanic eruptions
- ✓ Dust storms
- ✓ Forest fires

## Type-I Sources of Air Pollution

The sources of Air pollution are basically identified as *natural* and *man-made*



## 2. Anthropogenic/ Man made

### Stationary sources

- ✓ Point sources (Industries, power plants, fuels combustion)
- ✓ Area sources (Residential heating, coal, gas, oil, on site incineration, open burning etc.)

### Mobile sources

- ✓ Line sources (Highway vehicles, railroad locomotives, channel vessels etc.)

# TYPES OF AIR POLLUTANTS

- **Primary air pollutants**

Materials that when released pose health risks in their unmodified forms or those emitted directly from identifiable sources.

- **Secondary air pollutants**

Primary pollutants interact with one another, sunlight, or natural gases to produce new, harmful compounds.



**Origin:** Based on origin the air pollutants can be classified as;

- (i) **Primary pollutants:** Are those emitted directly to the atmosphere and found there in the form in which they were emitted.

e.g. Carbon compounds - CO, CO<sub>2</sub>, CH<sub>4</sub> and VOCs

Nitrogen compounds - NO, N<sub>2</sub>O and NH<sub>3</sub>

Sulfure compounds - H<sub>2</sub>S, SO<sub>2</sub>

Particulate Matter - PM<sub>10</sub>, PM<sub>2.5</sub>

- (ii) **Secondary pollutants:** Are those formed in the atmosphere from primary pollutants by chemical reaction in the presence of sunlight i.e., photochemical reaction or by hydrolysis or oxidation.

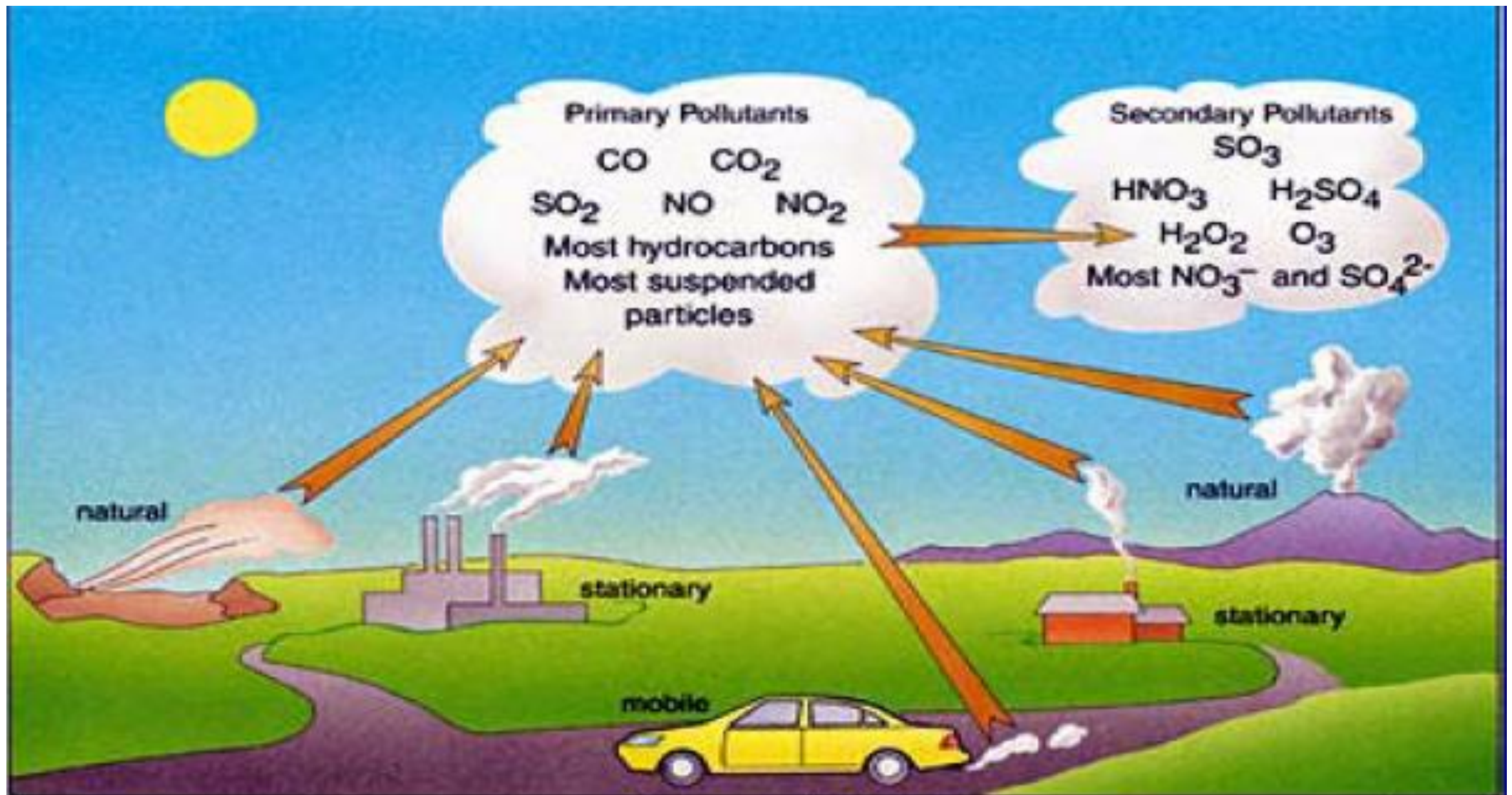
e.g. NO<sub>2</sub> and HNO<sub>3</sub> - from NO

Ozone (O<sub>3</sub>) - As a result of photochemical reactions of nitrogen oxides and VOCs

Acid droplets – Sulfuric acid from SO<sub>2</sub> and nitric acid from NO

Organic aerosols – From VOCs in gas to particle reactions

PAN – Peroxy Acetyl Nitrate



**Types and sources of air pollutants**

## Particulate Matter (PM)

---

*Particulate Matter (PM)* also known as particle pollution, is a complex of solid particles and aerosols (liquid droplets) suspended in the air. Particulates may carry any or all other pollutants (such as nitrates, sulfates, organic chemicals, metals and soil or dust particles) dissolved in or adsorbed to their surfaces.

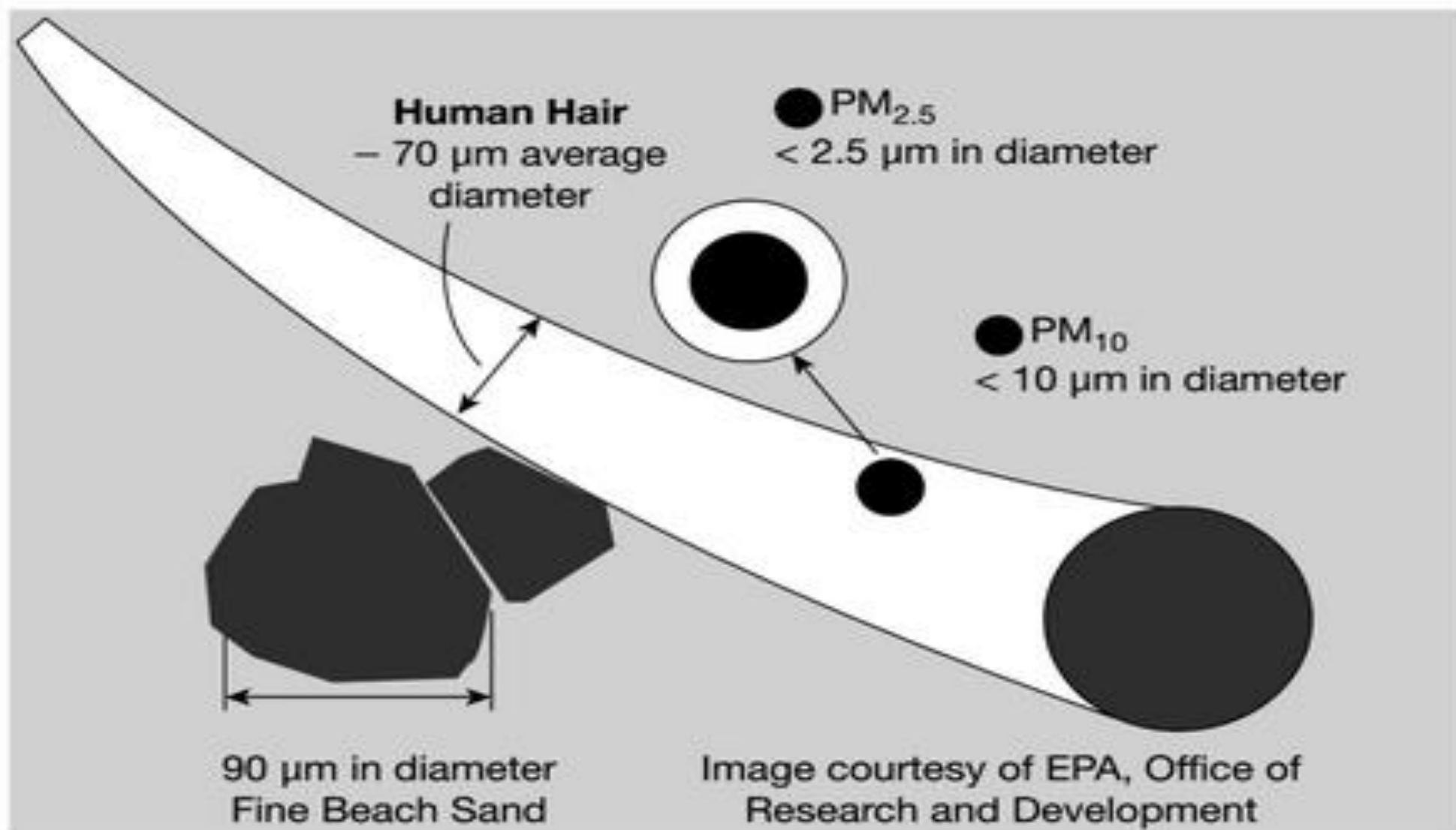
Based on the size, the particulates are

- (i) Inhalable coarse particles: Diameter  $2.5\text{ }\mu\text{m}$  to  $10\text{ }\mu\text{m}$ .
- (ii) Fine particles: Diameter  $\leq 2.5\text{ }\mu\text{m}$

# PARTICULATES

Particulates – small pieces of solid materials and liquid droplets.

- Examples: *ash from fires, asbestos from brakes and insulation, dust*
- Can accumulate in lungs and interfere with the ability of lungs to exchange gases.
- Some particulates are known carcinogens
- Those working industry conditions at highest risk (e.g. miners)



How small is 2.5 µm



## CRITERIA POLLUTANTS

Based on the studies carried out to investigate and describe the environmental effects of any air pollutant emitted by stationary or mobile sources, Environmental Protection Agency (EPA-USA) established the National Ambient Air Quality Standards (NAAQS) for six major air pollutants to protect human health and welfare. Because standards are developed based on *human health criteria* they are known as *criteria pollutants*. The criteria pollutants are:

- |  |  |
|--|--|
| (i) Particulate matter (PM)<br>(PM <sub>10</sub> * and PM <sub>2.5</sub> ) | (iv) Nitrogen dioxide (NO <sub>2</sub> ) |
| (ii) Carbon monoxide (CO)  | (v) Ground level Ozone (O <sub>3</sub> ) |
| (iii) Sulfur dioxide (SO <sub>2</sub> )                                    | (vi) Lead (Pb)                           |

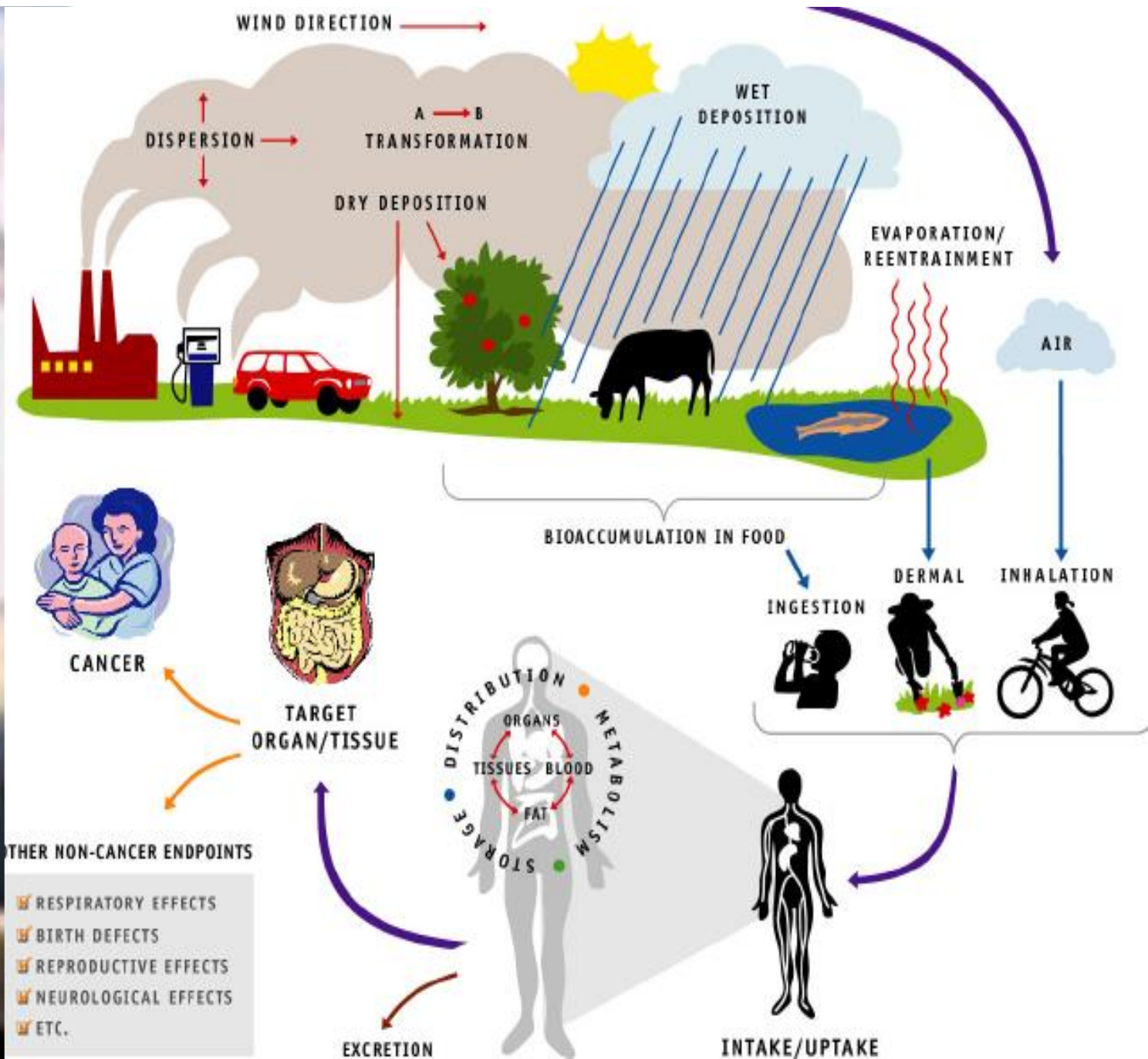
PM<sub>10</sub>\*: Particles with an aerodynamic diameter  $\leq 10 \mu\text{m}$ .

PM<sub>2.5</sub>\*: Particles with an aerodynamic diameter  $\leq 2.5 \mu\text{m}$ .

These *six criteria* pollutants are regulated to ensure that a region meets the National Air Quality Standards.

The set of limits, based on human health, is called *primary standards*.

Another set of limits, intended to prevent environmental and property damage, is called *secondary standards*.



# Effects of Air Pollution

- Can cause lung cancer, asthma, chronic bronchitis etc..
- Carbonmonoxide can combine with blood and reduce its oxygen carrying capacity.  
This impairs perception and thinking, slows reflexes and causes headache, drowsiness, dizziness and nausea.
- Many volatile organic compounds(eg: benzene and formaldehyde) can cause mutations, reproductive problem or cancer.
- Repeated inhalation of ozone, a component of photochemical smog causes coughing, chest pain, breathlessness, irritation of eyes etc...

- Leaves of crop plants are damaged when some gaseous pollutants enter the pores of the leaf.
- Chronic exposure to air pollution can break down waxy coating of leaves....
- At higher concentration of  $\text{SO}_2$ , most of the flower buds become stiff and hard. They eventually fall off from the plants as they are unable to flower.
- Air pollution break down exterior paint on cars and houses. They have discoloured irreplaceable monuments, historic buildings, marble structures....

# Pollution control mechanism

- Use electricity or solar energy
- Better quality fuels or better engines
- Replacement of old obsolete processes with new processes in industries.
- Installation of mechanical devices



# Control of particulate pollutants

The basic classes of particulate collection equipments:

1. Gravity settling chambers
2. Inertial Separators
3. Cyclone (centrifugal) separators
4. Wet collectors
5. Fabric filters
6. Electrostatic precipitators

# Water Pollution

# Introduction

- Water Pollution *is the presence of any foreign substance (organic , inorganic, radiological or biological) in water which tends to degrade the quality so as to constitute a hazard or impairs the usefulness of water*
- Leads to death of 14,000 people daily ([https://www.intechopen.com/books/water-pollution?goback=%252Egde\\_4374667\\_member\\_157178302](https://www.intechopen.com/books/water-pollution?goback=%252Egde_4374667_member_157178302))







# Signs of Pollution

- Offensive odours from rivers, streams, lakes and oceans
- Oily and greasy material floating on surface of water bodies
- Unchecked growth of aquatic weeds in water bodies
- Bad taste of drinking water
- Decrease in aquatic life in fresh water bodies etc



# Sources

## **Point sources**

- Point source water pollution refers to contaminants that enter a waterway from a single, identifiable source, such as a pipe or ditch.

## **Nonpoint sources**

- Nonpoint source pollution refers to diffuse contamination that does not originate from a single discrete source. NPS pollution is often the cumulative effect of small amounts of contaminants gathered from a large area.



Point source



Non-Point source

# Major Sources

- Municipal waste
- Industrial waste
- Agricultural waste
- Erosion
- Accidental spillage of oil and other hazardous substance
- Acid mine drainage.....

## Various Pollutants

- The specific contaminants leading to pollution in water include a wide spectrum of chemicals, pathogens, and physical changes such as elevated temperature and discolouration

# Water Pollutants

It is possible to classify pollutants into eight categories in general

1.Sewage and other oxygen demanding wastes

2.Infectious Agents

3.Plant Nutrients

4.Organic Chemicals

5.Inorganic minerals and Chemical compounds

6. Sediments

7.Radio active substances

8.Heat



# Water Treatment

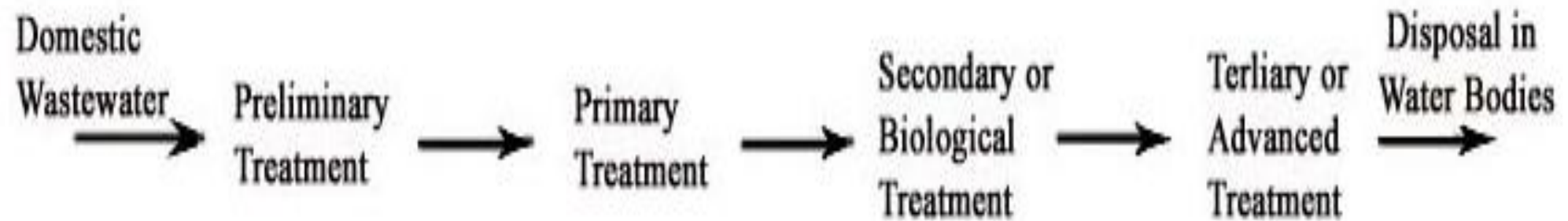
- The raw sewage must be treated before it is discharged into the river stream.
- The extent of treatment required to be given depends upon
  - the characteristics and quality of the sewage
  - the source of disposal, its quality and capacity to tolerate the impurities present in the sewage effluents without itself getting potentially polluted.

# Basic processes of water treatment

- The purpose of waste water treatment is to remove the contaminants from water so that the treated water meet the acceptable quality standards.
- The quality standards usually depend upon whether the water will be reused or discharged into a receiving stream.
- Available waste water treatment processes can be broadly classified as **physical**, **chemical** or **biological**.
- These processes which **consists of series of unit operations**, are applied in different **combinations and sequences** depending upon the prevailing situations of influent concentration, composition and condition and specification of the effluent.

# Treatment and control methods

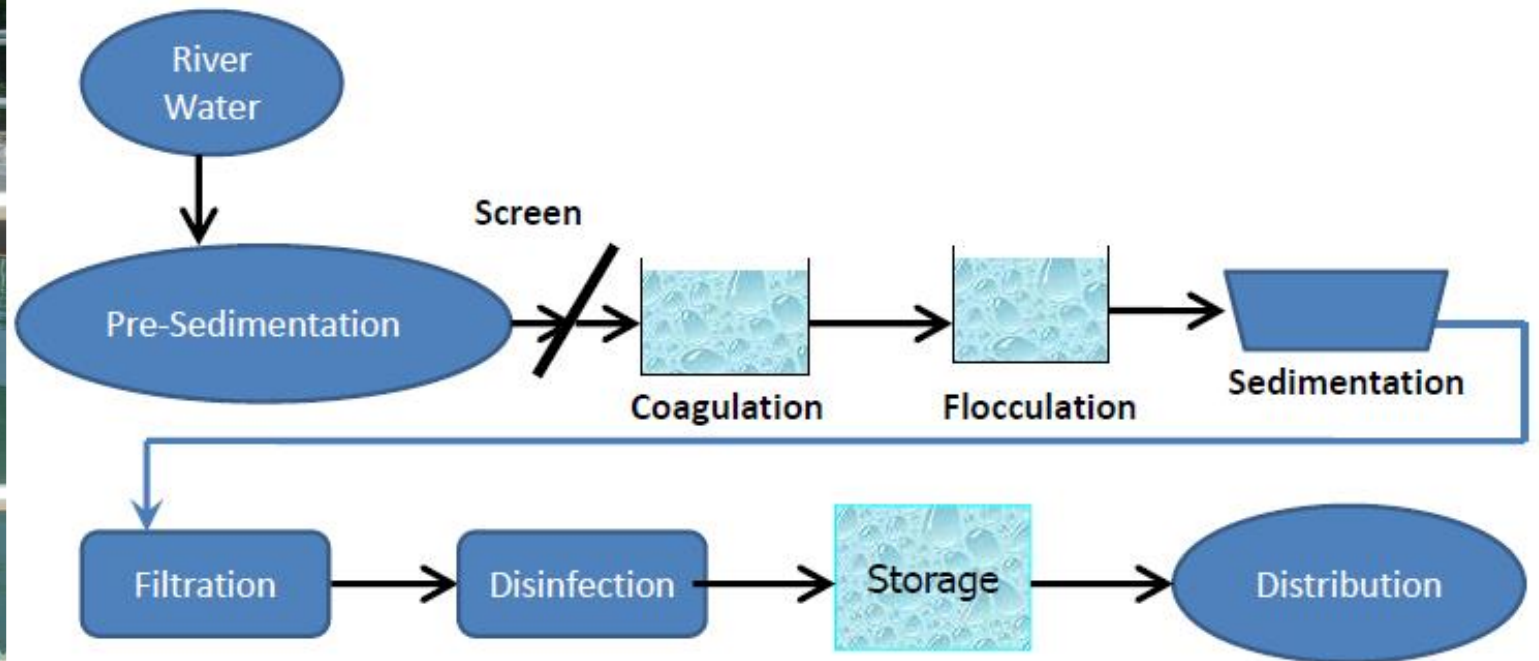
- **The layout of conventional wastewater treatment plant**



Siting and Hydraulics of Wastewater Treatment Plant



Circular sedimentation Tank



# Sustainable Wastewater Treatment

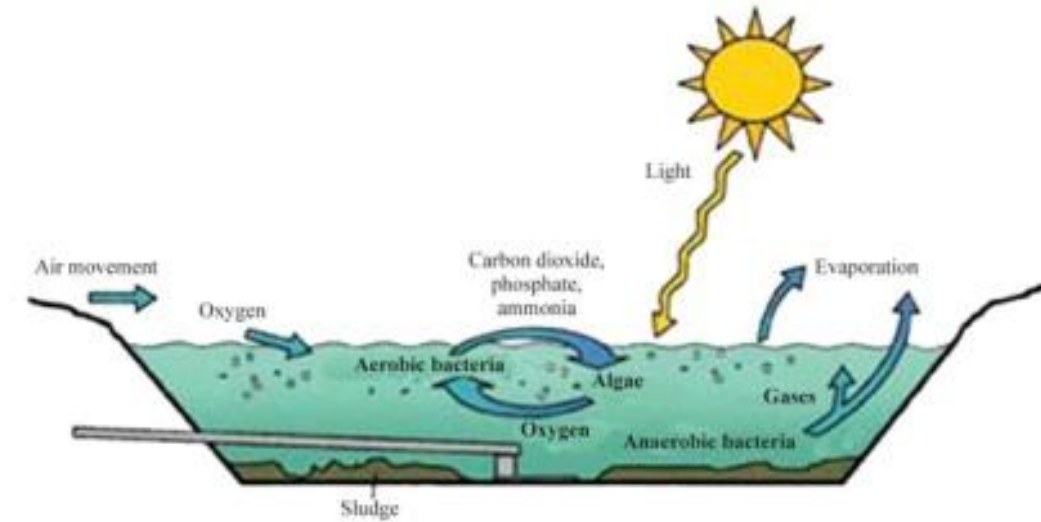
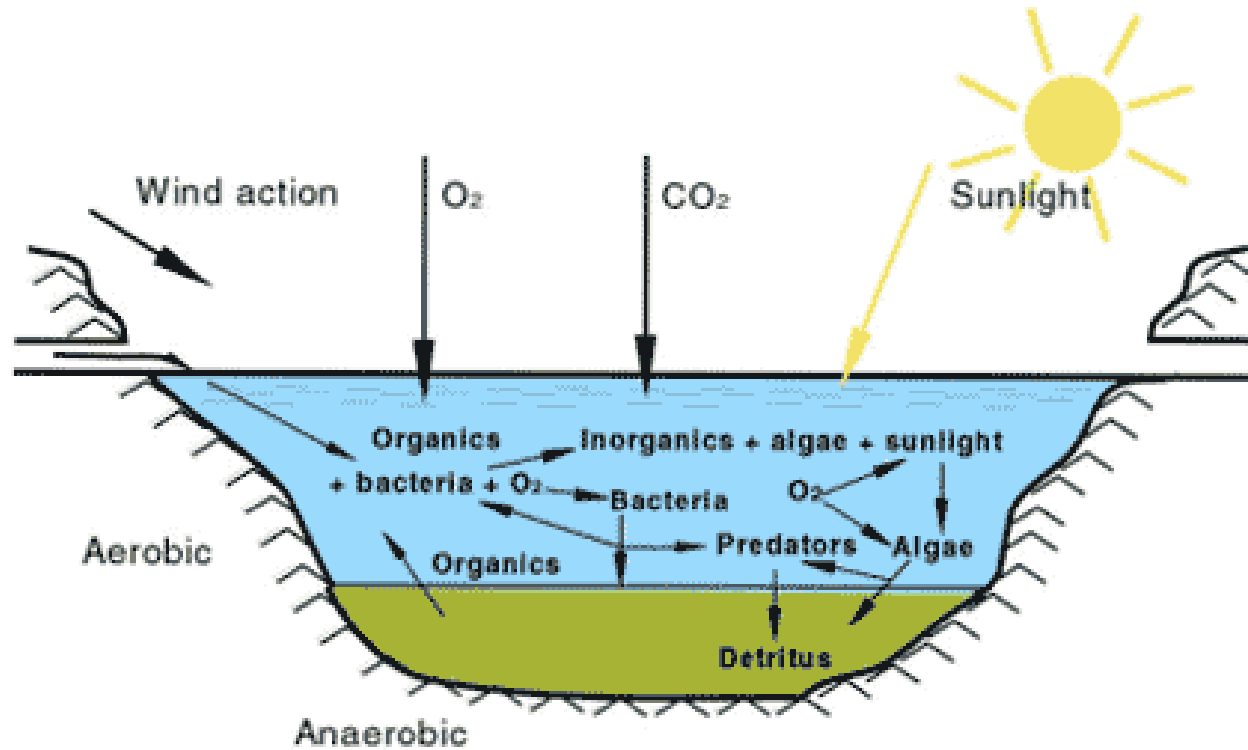
- Waste water is treated and the treated effluent is recycled and reused.
- Commonly followed wastewater treatment methods
  - Wastewater ponds
  - Constructed wetlands
  - USAB (Upflow Anaerobic Sludge Blanket)
  - SAT (Soil Aquifer Treatment)



- Wastewater Pond

is an open, flow through earthen basin of controlled shape specially designed and constructed to treat sewage and bio-degradable industrial waste by natural processes involving bacteria and algae.

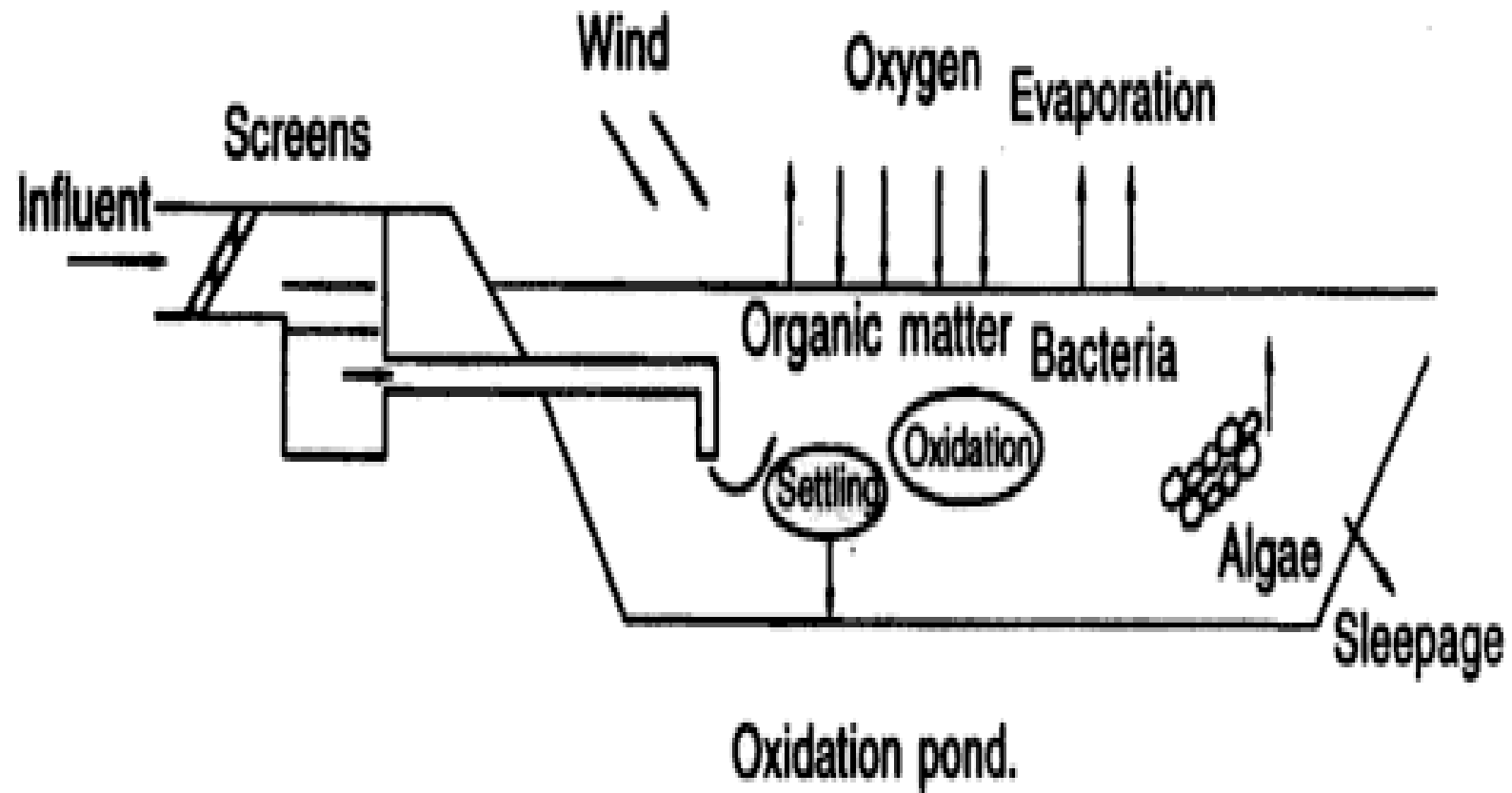
- Wastewater ponds



- The **waste stabilization pond** is a **biological treatment process** , where bacteria use organic matter in the wastewater as food.
- The three types of bacteria at work in most ponds are the **aerobic, anaerobic, and the facultative bacteria.**

## How oxygen is supplied in the ponds

- One way that oxygen is supplied to the wastewater is by **algae** .
- The algae produce the oxygen needed by the bacteria and the bacteria in turn produce carbon dioxide and other things that are needed by the algae.
- It is important to remember that the algae will thrive when there is sunlight present.





- Aerobic ponds are a maximum of two feet deep, so that the sunlight can reach throughout the entire depth of the pond, which will let the algae grow throughout.
- The oxygen they give off allows aerobic process microorganisms to live.
- Aerobic ponds are not used in colder climates because they will completely freeze in the winter.

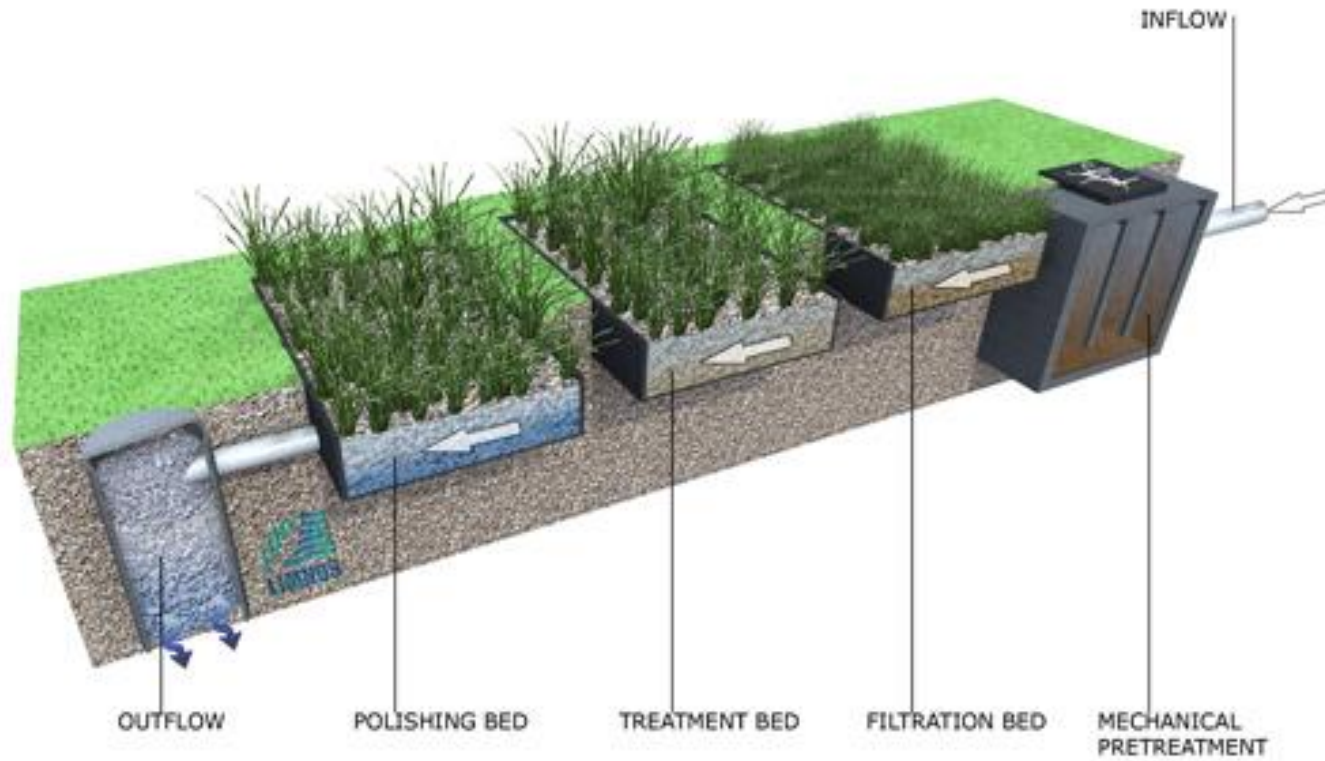
## Advantages

- It is a natural method of decomposition, so it is cheap
- Its operation and maintenance is simple
- It is highly efficient in removing BOD

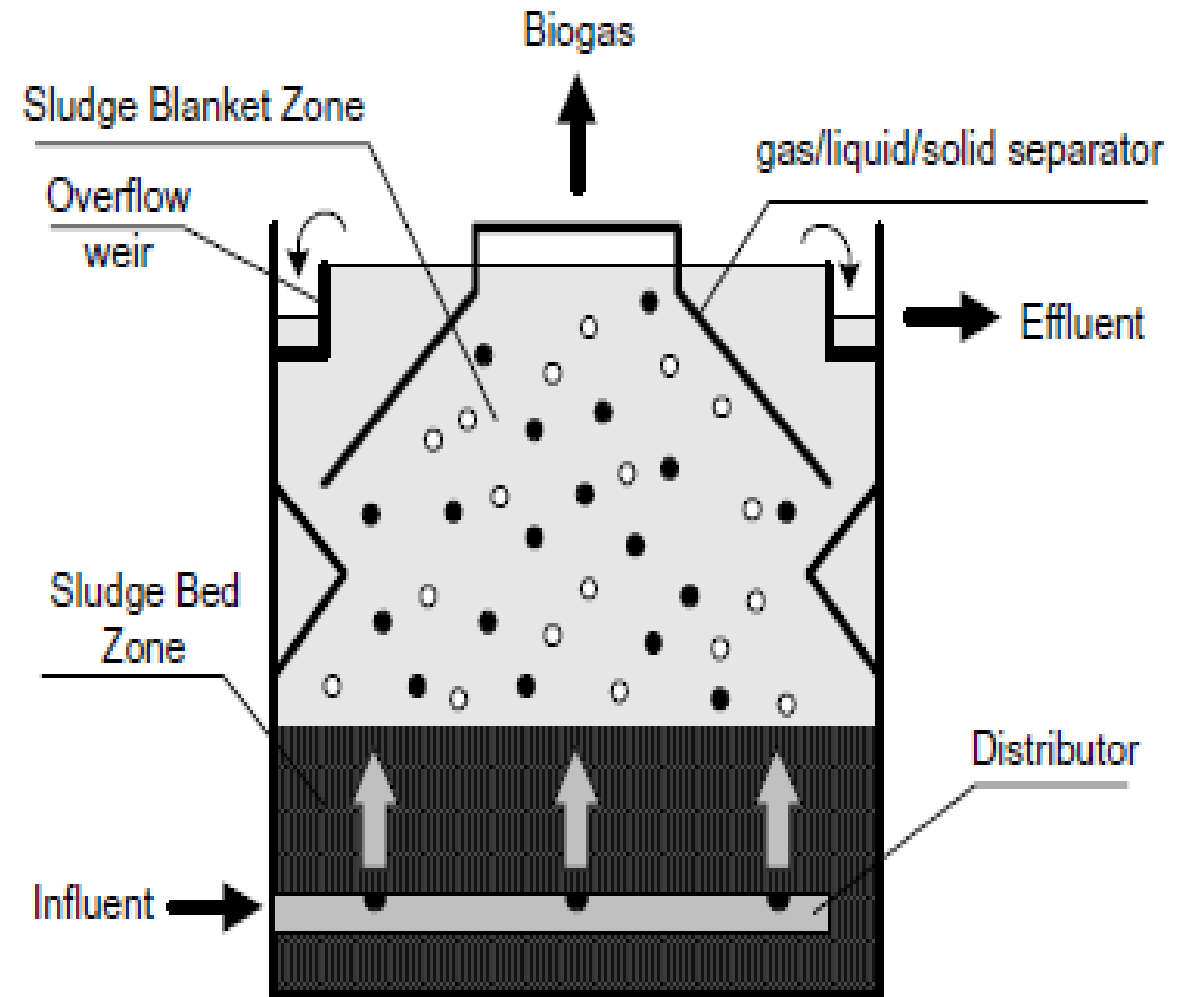
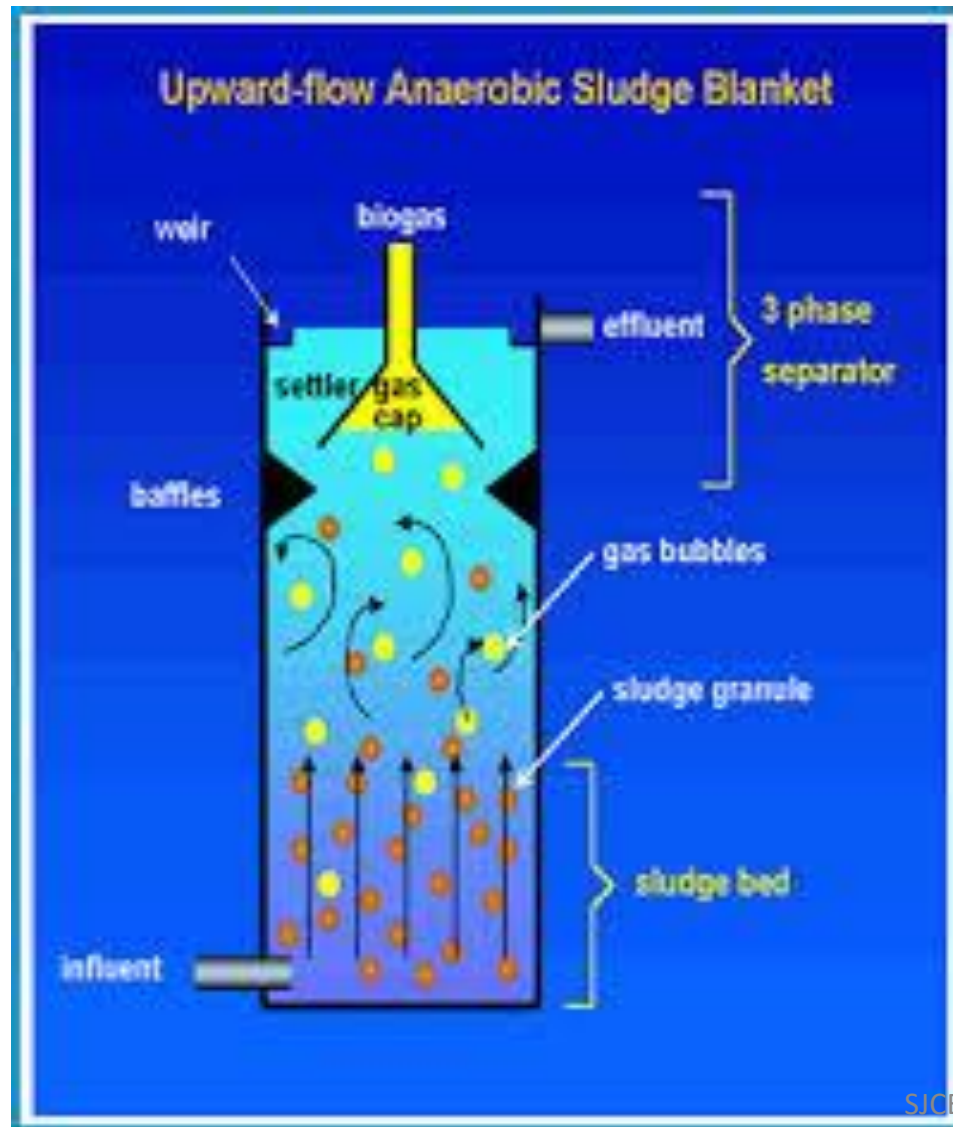
## Disadvantages

- Large area required for treatment
- It creates bad smell and mosquito nuisance
- In rainy or cloudy condition sewage may become septic and this may cause insanitary condition.

- Constructed wetlands

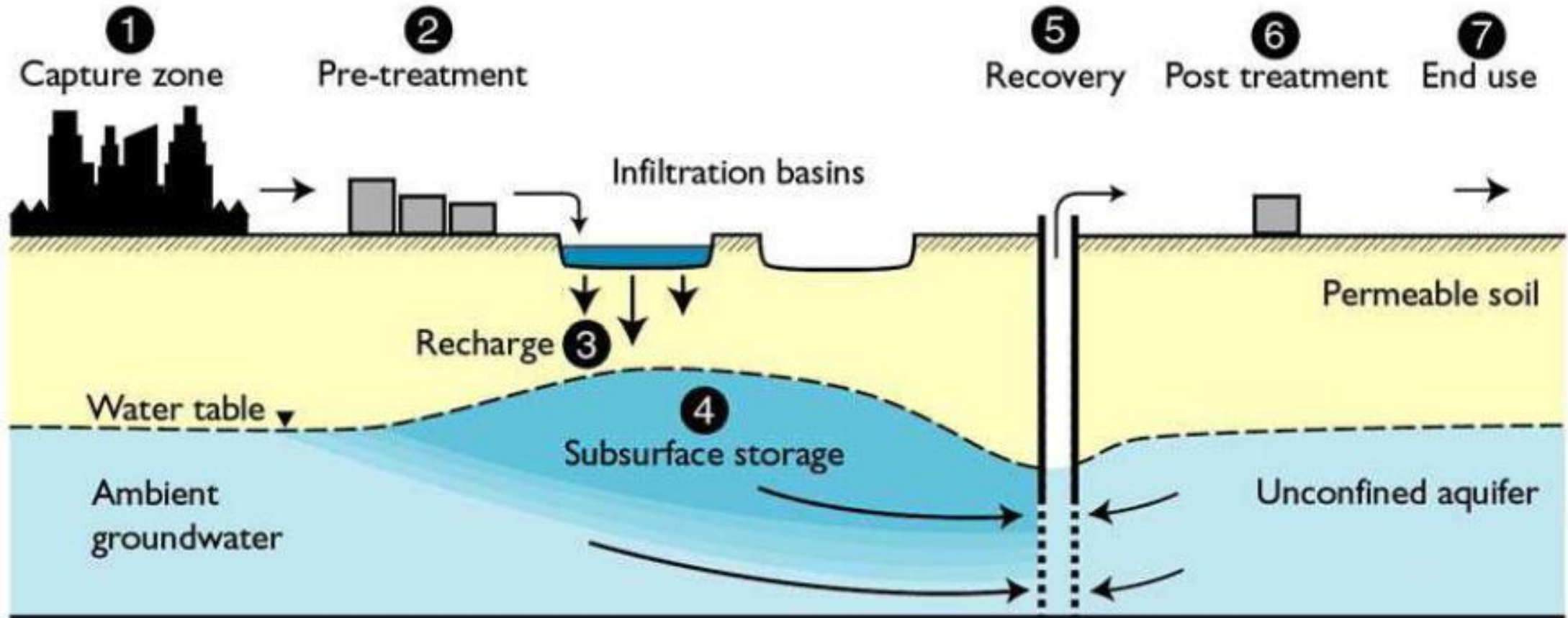


# UASB





# Soil Aquifer Treatment





# Solid Waste Management



# Solid Waste - Introduction

- Solid waste is the unwanted or useless solid materials generated from residential, industrial and commercial activities in a given area.
- Solid wastes of the society, includes *garbage, ashes, dust, rubbish* etc.



## Characteristics

- The composition and quantity of solid wastes produced varies from place to place and also from season to season.
- For an Indian city quantity of solid waste produced varies from about 0.5 to 0.8 kg per capita per day.
- The organic wastes are about 55 % and inorganic wastes are 45%.

# Classification based on their source

- Municipal Waste (Household waste)
- Industrial Wastes
- Hazardous Wastes
- Biomedical waste or Hospital waste

## Municipal Wastes

Generated from households or domestic sector.

- Garbage
- Rubbish
- Ashes and Residues
- Demolition and construction wastes
- Waste from streets.

## Industrial Waste

- Waste generated from industrial sector.
- metal
- Chemical
- Paper
- Pesticide
- Dye
- Refining etc



## Biomedical waste

- Is generated during the diagnosis, treatment, or immunization of human beings or animals.
- It may be in form of disposable syringes, bandages, body fluids etc..
- These wastes are highly infectious and can be a serious threat to human health.

## Hazardous wastes

- Harmful Chemicals
- Heavy Metal
- Old batteries
- Shoe polish
- Old medicines
- Paint tins...

# Impacts of Solid Wastes

- Land
- Water
- Air
- Health

- **Impact on Land**

- Common land pollutants are fertilizers, dead animals, demolished buildings, metals, radioactive elements, insecticides, plastic, leather etc...
- Deteriorate soil quality and decrease in vegetation leading to erosion
- Breeding ground for rats, flies, birds and other disease causing organism
- Land value near dumps is low
- Attract birds and affect aircraft landing
- Toxic chemicals like DDT, biphenyls enter food chain through plants and vegetables and cause biomagnification

- **Impact on water environment**
- Rainwater runoff from solid waste open dumps contaminates nearby surface water sources.
- Leachate, liquid discharge from dumps and landfills can alter aquatic habitats and harm plants and animals
- The high oxygen content in wastes can deplete dissolved oxygen in water bodies, denying oxygen to aquatic life

- Impact on Air
- Lead to release of bad odour
- Generation of green house gases from solid waste landfill adds up the problem of climate change.
- High risk too rag pickers and workers working with waste

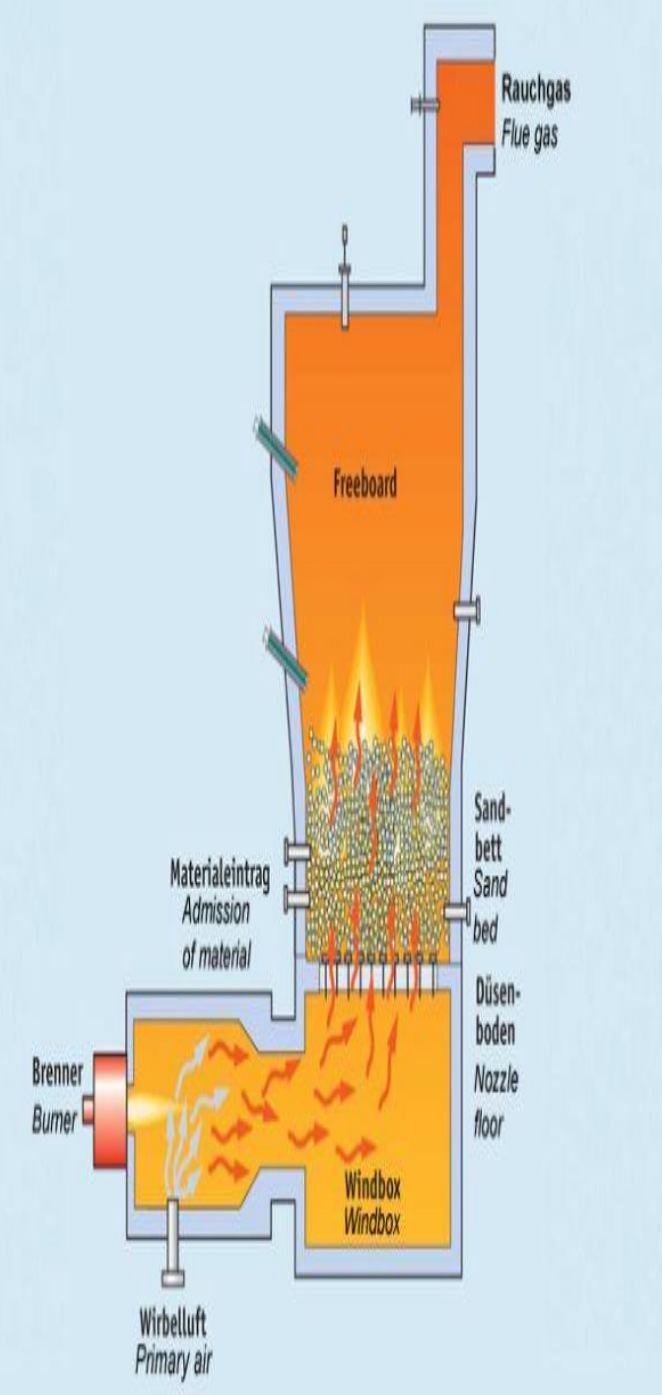
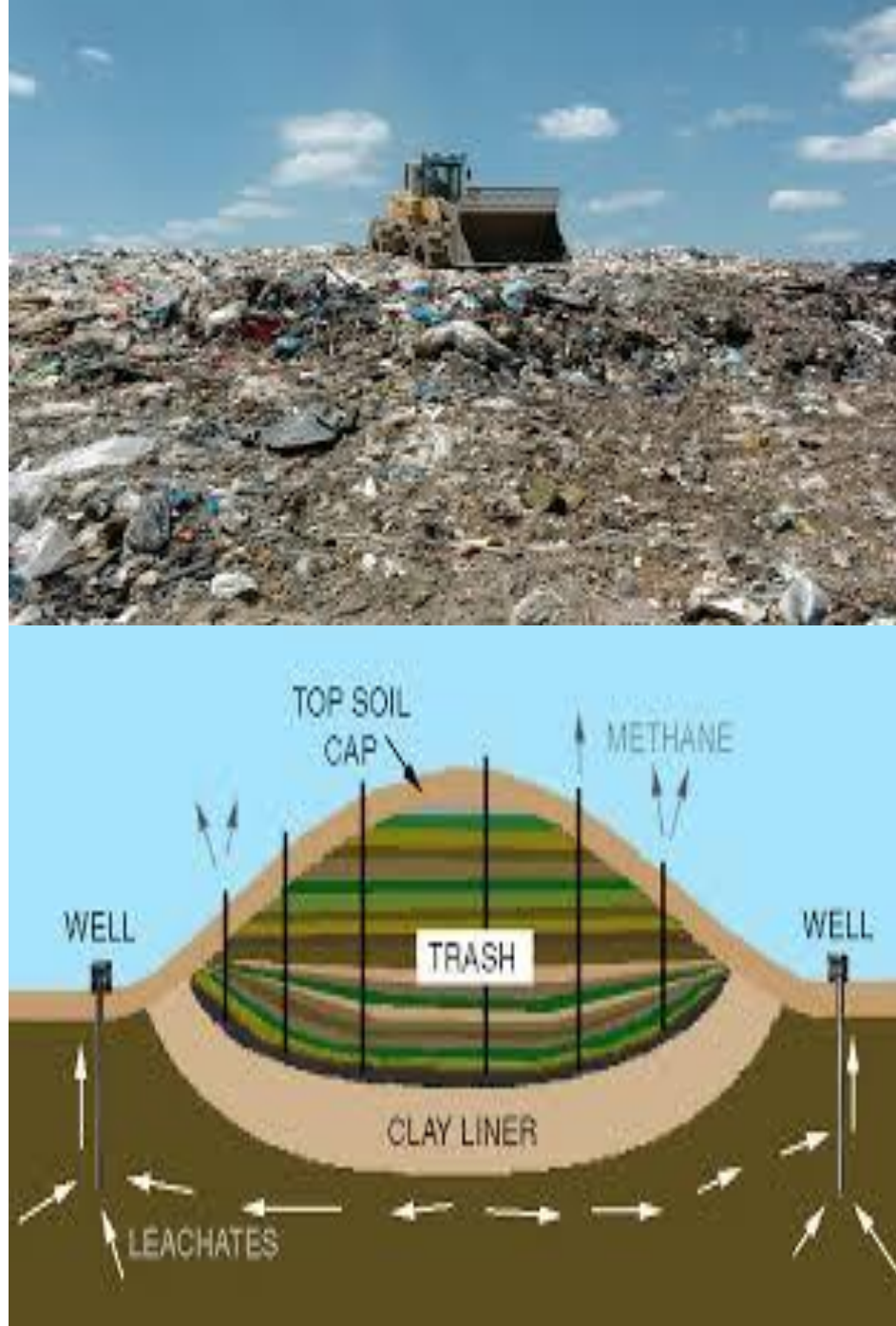


- **Impact on Health**

- Prolonged exposure of air pollution causes bronchitis, pneumonia, and other respiratory diseases.
- Heavy metals may get deposited on humans leading to poisoning and affecting health.
- Anaerobic decomposition of solid waste releases bad odour which leads to unhygienic conditions and thereby rise in health problems

# Disposal

- Composting
- Sanitary Landfill
- Incineration
- Dumping into sea
- Pulverization
- Pyrolysis



# Zero waste concept

- The concept of “zero waste” include *one hundred percent reuse and recycling rate coupled with recovery of all materials from waste materials.*
- ***Zero waste seeks to***
  - i. Maximise recycling
  - ii. Minimise waste
  - iii. Reduce consumption
  - iv. Ensure products are reused, repaired or recycled to nature

## ***Zero Waste:***

- *The conservation of all resources by means of responsible production, consumption, reuse and recovery of all products, packaging, and materials, without burning them, and without discharges to land, water or air that threaten the environment or human health.* (The definition adopted by the *Zero Waste International Alliance (ZWIA)*).
- Zero Waste refers to waste prevention as opposed to end-of-pipe waste management.
- It is a whole systems approach that aims for a massive change in the way materials flow through society, resulting in no waste.

[https://en.wikipedia.org/wiki/Zero\\_waste](https://en.wikipedia.org/wiki/Zero_waste)

## Why implement waste minimization strategies?

- Amount of waste produced is extremely large
- More difficult to locate solid waste disposal sites
- Cost of disposal is increasing exponentially
- Finding new source of energy nowadays is becoming increasingly difficult
- Interest has grown in reuse and recycling.

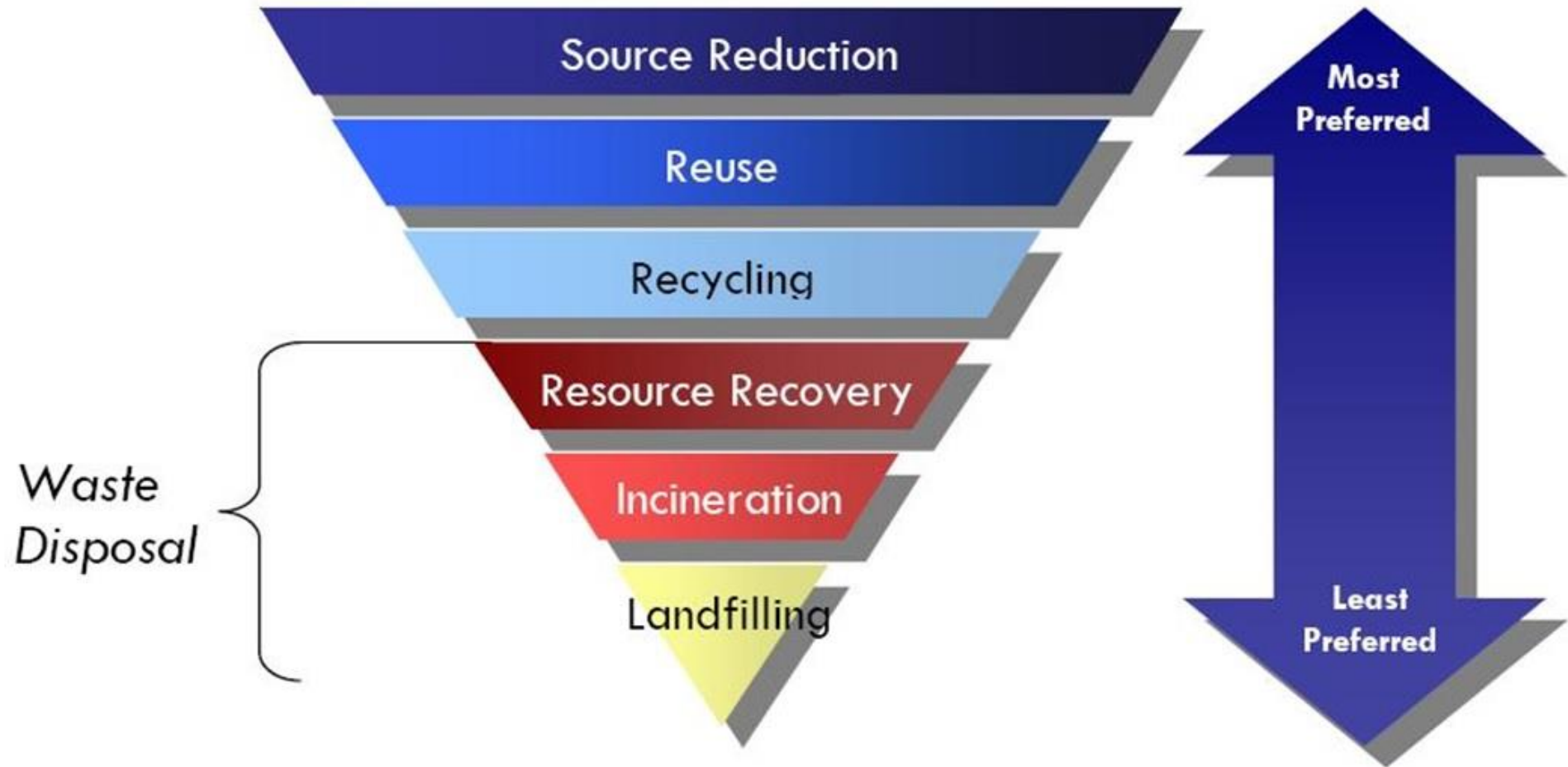
# Waste Minimization Strategies - The “Three R’s”

- Reduce
- Reuse
- Recycle

[https://en.wikipedia.org/wiki/Waste\\_hierarchy](https://en.wikipedia.org/wiki/Waste_hierarchy)



## *The Solid Waste Management Hierarchy*



# Reduce

- Reducing can help in minimization of wastes.
- **Do not use what you do not need**

eg: Carry your own shopping bag when you go to the market and put all your purchases directly into it.

# Reuse

- ❖ Use something over and over again until it cannot be used any more
- ❖ To extend the life of a single product although products purpose may change
- ❖ In reuse product does not return to the manufacturer
- ❖ Remains with in the public

eg: retreading of tires

reuse of cloth bags

Bagasse a waste product of sugar industry, is used in pulp and paper industry

# Importance of Reuse

1. keeps goods and materials out of the waste stream
2. preserves the “embodied energy” that was originally used to manufacture an item.
3. creates less air and water pollution than making a new item or recycling
4. results in less hazardous wastes
5. saves money in purchases and disposal costs

# Reusable Materials

- Plastics
- Paper
- Aluminium cans
- Glass
- Tires
- Construction and demolition waste
- Electronics
- Flyash
- wood

# PAPER-REUSE

- Use the other side of printed sheets when documents are not in the final stages
- Cut scraps of paper and use them as notes
- Avoid paper products as much as possible: use cloth towels instead of paper towel, use a ceramic mug instead of paper cup.
- Reuse file folders.
- Donate old books, trade and consumer magazines to local library.



## Glass - Reuse

- Cullet can be used in place of natural aggregate
- Another civil engineering application-glassphalt –produced by replacing a percentage of natural aggregate in asphalt with crushed glass



# Recycle

- ❖ breaking down of the used item into raw materials which are used to make new items
- ❖ Requires the participation of public to perform separation step
- ❖ **Recycling** means that the paper, glass, aluminum, steel, or plastic that you separate for recycling is re-processed, cleaned and purified and then comes back in its original form as new paper, glass, aluminum, steel or plastic.



- Two types

- Upcycle:

Converting low value material into high value products ( more desirable)

Downcycle:

Converting valuable products into low-value raw materials(less desirable)

# Importance

- Overall environment friendly, low cost waste management strategy.
- Saves resources, energy, money
- Reduce new landfills and incinerators
- Reduce pollution from extracting resources.
- A better economic choice than the use of virgin materials.
- Creates job opportunities

# Global Environmental Issues

- Resource Degradation
- Climate Change
- Ozone Layer Depletion
- Global Warming

# Climate Change

## Major Indicators of climate change

1. Increase in CO<sub>2</sub> concentration
2. Melting of Polar ice cap
3. Increase in sea level
4. Increase in land temperature

<https://climate.nasa.gov/images-of-change?id=741#741-highs-and-lows-of-chinas-poyang-lake>



## The deadly state of our planet (Examples of climate change in 2020)

- Hurricanes battering communities in the southern United States. It has been a record year - there have been 20 named storms so far, surpassing the typical seasonal average of 11.
- In Antarctica, we have learned that ocean warming is threatening the Pine Island and Thwaites glaciers, which already account for 5 percent of the global sea level rise. Ice about twice the size of Manhattan has broken free from the Arctic's largest-remaining ice shelf in northeast Greenland. The integrity of Earth's glaciers is crucial to the stability of the climate system. **And projections show sea levels could rise more than a metre in just 80 years as polar ice melts, which would drown coastlines around the world.**
- Record-breaking fires are raging in California and Oregon, and surging again in the Brazilian Amazon.
- The World Wildlife Fund's 2020 Living Planet report estimated that species of mammals, birds, reptiles, amphibians and fish plummeted by an average of 68 percent between 1970 and 2016.

## CLIMATE CHANGE

# Section of world's largest remaining ice shelf breaks apart

A large chunk of ice - about 110 square km in size - broke off of 79N, or Nioghalvfjerdsfjorden, an ice shelf in northeast Greenland. The region has warmed about 3C since 1980.



PHOTO SOURCE: COPERNICUS DATA/ESA/SENTINEL-2B/PROMICEGL | AUGUST 5, 2020

# Ozone Layer Depletion

- Ozone ( $O_3$ ) is an important natural component of the stratosphere.
- When high energy ultraviolet (UV) radiation splits normal oxygen molecule ( $O_2$ ) into atomic oxygen ( $O$ ). These combine with diatomic oxygen molecule ( $O_2$ ) to form triatomic ozone ( $O_3$ ).

Further reading url:

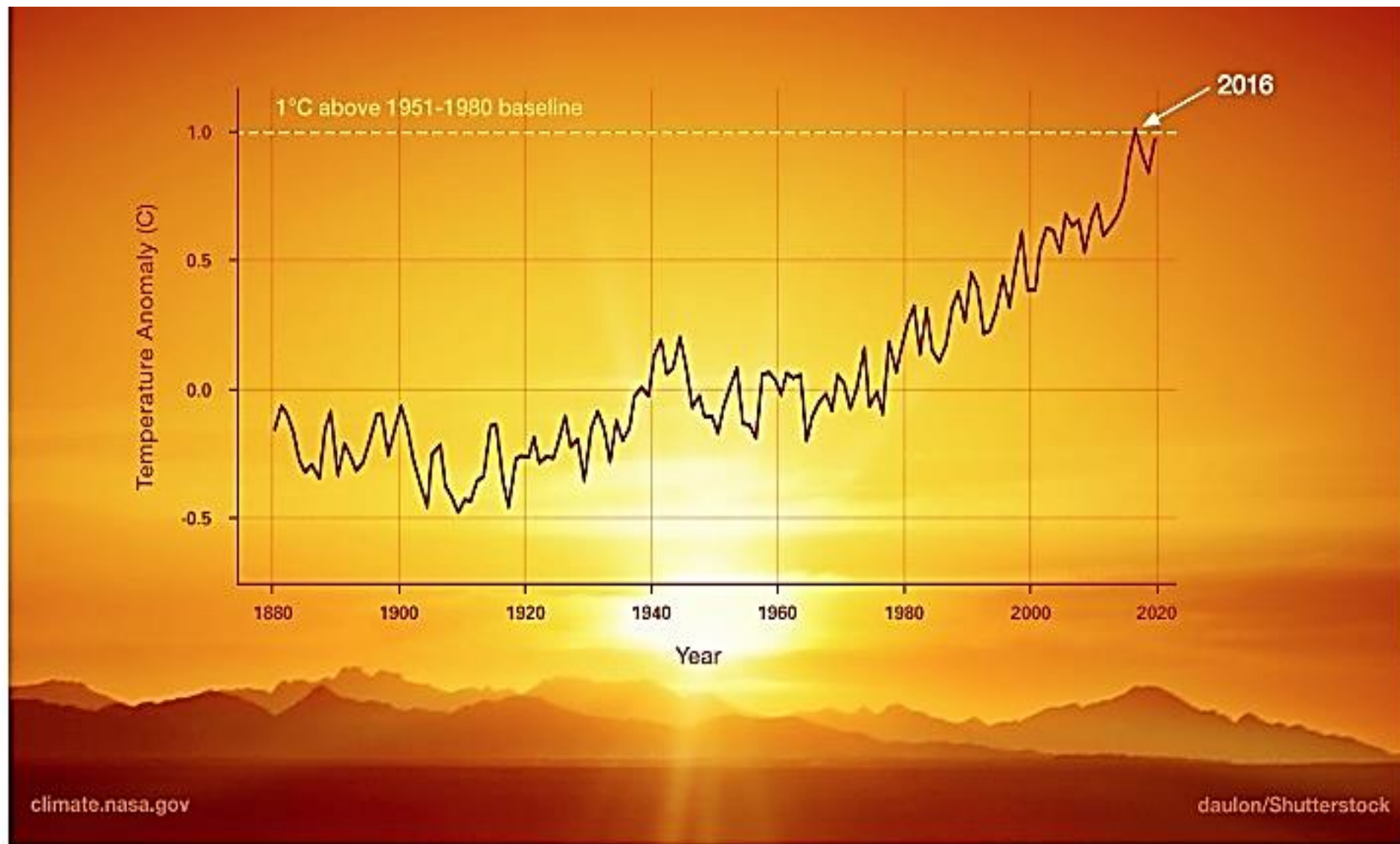
<https://www.britannica.com/science/ozone-depletion>

[https://en.wikipedia.org/wiki/Ozone\\_depletion](https://en.wikipedia.org/wiki/Ozone_depletion)

# Global Warming

- Global warming is the long-term heating of Earth's climate system observed since the pre-industrial period (between 1850 and 1900) due to human activities, primarily fossil fuel burning, which increases heat-trapping **greenhouse** gas levels in Earth's atmosphere.
- Since the pre-industrial period, human activities are estimated to have increased Earth's global average temperature by about 1 degree Celsius (1.8 degrees Fahrenheit), a number that is currently increasing by 0.2 degrees Celsius (0.36 degrees Fahrenheit) per decade.
- Most of the current warming trend is extremely likely (greater than 95 percent probability) the result of human activity since the 1950s and is proceeding at an unprecedented rate over decades to millennia.





This graph illustrates the change in global surface temperature relative to 1951-1980 average temperatures (Source: NASA's Goddard Institute for Space Studies). \*

Credit: NASA/JPL-Caltech

# Carbon Credit

- Kyoto Protocol – proposed 3 mechanism
  - a) Emission Trading
  - b) Clean Development Mechanism (CDM)
  - c) Joint Implementation

The **emission reductions** generated by these flexible mechanisms are collectively referred to as ‘**carbon credits**’

A **carbon credit** is a tradable permit or certificate that provides the holder of the **credit** the right to emit one ton of **carbon** dioxide or an equivalent of another greenhouse gas.



# Basics of Carbon Credit

- Greenhouse gases contribute to climate change.
- Carbon credits and carbon markets are a component of national and international attempts to mitigate the growth in concentrations of greenhouse gases (GHGs).
- Carbon credit or Carbon offset is a financial unit of measurement that represents the removal of one tonne of carbondioxide equivalent (tCO<sub>2</sub>e) from the atmosphere
- One ton of CO<sub>2</sub> equivalent = one carbon credit.

- The goal is to *allow market mechanisms to drive industrial and commercial processes in the direction of low emissions or less carbon intensive approaches than those used when there is no cost to emitting carbon dioxide and other GHGs into the atmosphere.*

# Carbon Trading

Carbon trading is the process of buying and selling permits and credits to emit carbon dioxide.

**Carbon emissions trading** is a form of emissions trading that specifically targets carbon dioxide (calculated in tonnes of carbon dioxide equivalent or tCO<sub>2</sub>) and it currently constitutes the bulk of emissions trading.

Under Carbon trading, a country or a polluter having more emissions of carbon is able to purchase the right to emit more and the country or entity having fewer emissions sells the right to emit carbon to other countries or entities. The countries or polluting entities emitting more carbon thereby satisfy their carbon emission requirements.

# Carbon Footprint

A **carbon footprint** is the total greenhouse gas (GHG) emissions caused by an individual, event, organization, service, or product, expressed as carbon dioxide equivalent

The global average annual carbon footprint per person in the late 2010s was 0.7 tonnes CO<sub>2</sub>eq food, 1.1 tonnes from the home, 0.8 tonnes transport and 0.8 tonnes other.

(<https://www.bbc.com/news/science-environment-52719662>)

[https://en.wikipedia.org/wiki/Carbon\\_footprint](https://en.wikipedia.org/wiki/Carbon_footprint)



- Carbon footprint is calculated as carbondioxide equivalent using the relevant 100 year global warming potential
- **Carbon footprint = Primary footprint + Secondary footprint**
- Primary footprint is a measure of our direct emission of CO<sub>2</sub> from the direct burning of fossil fuels including domestic energy consumption and transportation.
- Secondary Footprint measure indirect CO<sub>2</sub> emissions from whole lifecycle of products we use

# Factors affecting Carbon Footprint

1.Population

2.Energy efficiency

3.Energy structure – carbon emission depend on source of energy. Natural gas emit low GHG while coal emits high GHG.

4.Type of economic development



## Ways to reduce Carbon Footprint?

- Reduce, Reuse and Recycle
- Use less air conditioning and heating at homes.
- Planting trees

A single tree will absorb one ton of CO<sub>2</sub> over its lifetime

- Use of renewable fuels brings down carbon footprint considerably.

# Top options for reducing your carbon footprint

Average reduction per person per year in tonnes of CO<sub>2</sub> equivalent



Live car-free  
**2.04**



Refurbishment  
/renovation  
**0.895**



Battery electric car  
**1.95**



Vegan diet  
**0.8**



One less long-haul  
flight per year  
**1.68**



Heat pump  
**0.795**



Renewable energy  
**1.6**



Improved cooking  
equipment  
**0.65**



Public transport  
**0.98**



Renewable-based  
heating  
**0.64**

Source: Centre for Research into Energy Demand Solutions



SJCET/CE/JJS/ModuleII

# Legal provisions for environmental protection

- The environment laws in India looks at key practical issues including emissions to air and water, environmental impact assessments, waste, contaminated land, and environmental issues in transactions.

## Legal provisions for environmental protection

- The main environmental laws, including under which various key environmental permits (or consents) are being issued in India, include the:
- **Water (Prevention and Control of Pollution) Act 1974 (Water Act)**, which also initially identified the powers, functions and hierarchy of the environmental agencies, the CPCB and the SPCBs.
- **Air (Prevention and Control of Pollution) Act 1981 (Air Act)**.
- **Environment (Protection) Act 1986 (EP Act)**. This umbrella law enables the central government to take *measures it deems necessary to protect and improve the environment, and to prevent, control and abate environmental pollution*.

A wide range of rules and notifications have been adopted under it (EP Act), such as the:

- E-Waste (Management) Rules 2016, as amended in 2018 (E-Waste Rules);
- Bio-Medical Waste Management Rules 2016;
- Plastic Waste Management Rules 2016;
- Solid Waste Management Rules, 2016;
- Construction and Demolition Waste Management Rules 2016;
- Hazardous and Other Waste (Management and Transboundary Movement) Rules 2016, as amended in 2019 (HW Rules);
- Manufacture, Storage and Import of Hazardous Chemicals Rules 1989 (MSIHC Rules);
- Coastal Regulation Zone Notification 2019; and
- Environment Impact Assessment Notification 2006.

- Wild Life (Protection) Act 1972.
- Forest (Conservation) Act 1980.
- Public Liability Insurance Act 1991.
- Biological Diversity Act 2002.
- National Green Tribunal Act 2010.

## Regulatory authorities

- The key regulatory authorities are the:
  - ✓ Ministry of Environment, Forests and Climate Change (MoEFCC).
  - ✓ CPCB.
  - ✓ SPCBs.
  - ✓ District Level Authorities (that is, municipal corporations).



- There has been an upward trend in terms of regulatory enforcement, which can be explained by various factors.
- ✓ Various states have started to insist *on the installation of continuous online emissions/effluent monitoring systems*, which gives the State Pollution Control Boards (SPCBs) the necessary and objective information to monitor the compliance of companies in their jurisdiction.
- ✓ The state high courts, the Central Supreme Court, and the various benches throughout India of the National Green Tribunal (NGT) closely monitor the implementation and enforcement of environmental laws.

# References

- Erach Barucha, *Textbook for Environmental Studies for Undergraduate Courses*.
- <https://www.aljazeera.com/tag/climate-change/>
- <https://en.azvision.az/news/130864/-record-breaking-wildfires-and-melting-ice-the-deadly-state-of-our-planet-.html>
- <https://www.sustainablesanantonio.com/practices-technology/reduce-reuse-recycle/>

## Case Study - 1

- Air pollution in Asia has worsened since 2000 and is responsible for deaths of thousands of people in Beijing, Jakarta, Seoul and Manila. The pollution is a result of the use of fossil fuels by the industry and transport sectors. The problem got aggravated in Asia due to the use of poor quality fuel, inefficient method of energy production, use of vehicles in poor condition and traffic congestion. This was revealed during a research conducted by World Bank and Stockholm Development Institute. The research states that air pollution in the continent has surpassed the combined emissions in Europe and North America. The deaths caused by fine particulate matter far exceed those caused by sulphur dioxide, nitrogen oxide, ozone and lead. The health cost in major Asian cities now exceed for 15-18 percent of urban income expenditure, claims World Bank officials.

# Questions

- a. There is a sudden decision to remove all vehicles from the road that fails to meet specified norms of emission level within a specified time period. As part of citizen forum you are requested to give views on the enforced regulation. State your views on this.
- b. A massive campaign on environmental degradation is to be initiated. Bring out a slogan and the key message that need to be addressed.
- c. Suppose you are a Carbon Credit Auditor appointed to assess the greenhouse gas emission reduction strategies. Identify a component of assessment and brief the methodology that could be adopted in connection with this.