

Dr. Vishwanath Karad

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TECHNOLOGY, RESEARCH, SOCIAL INNOVATION & PARTNERSHIPS

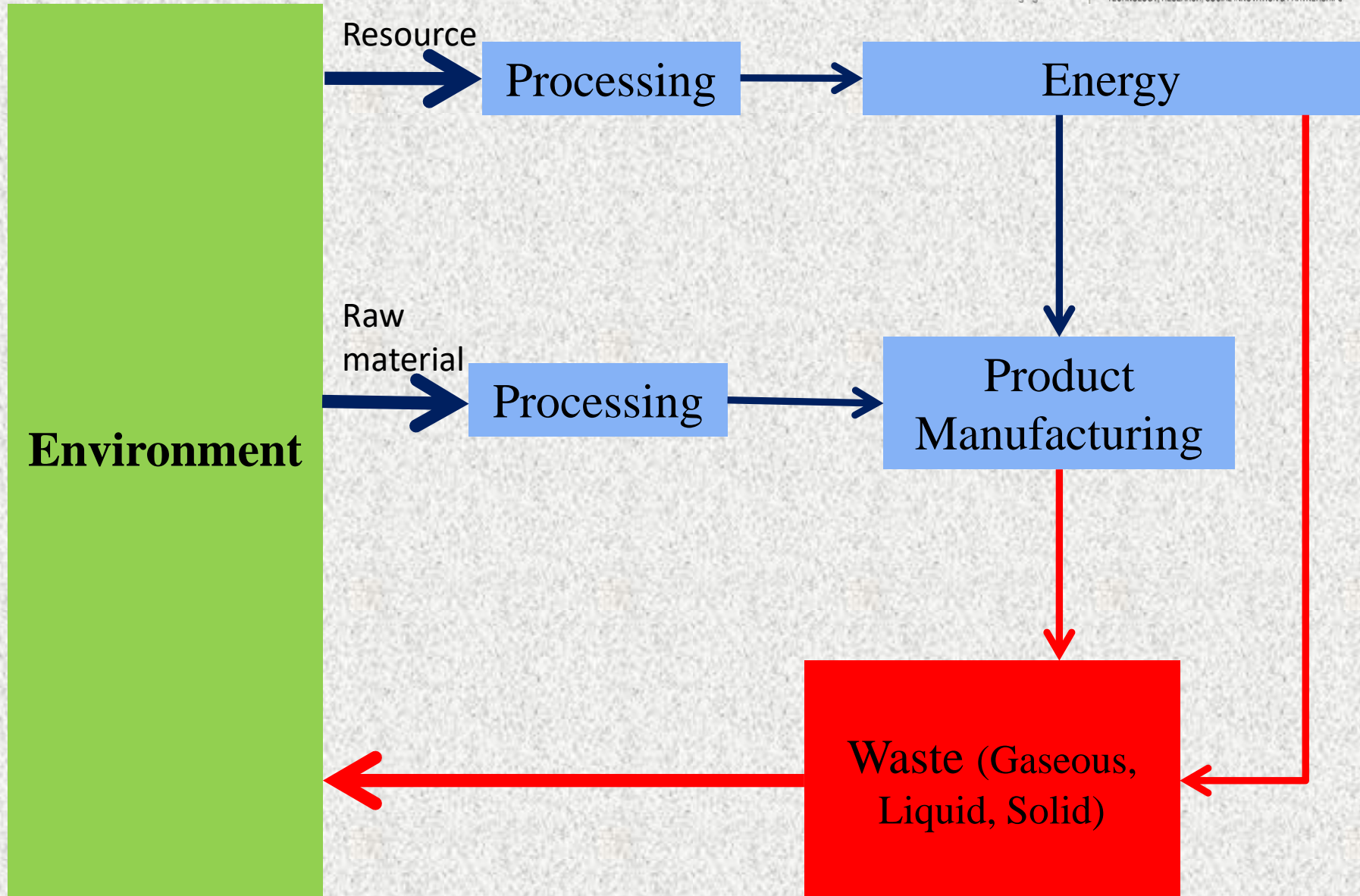
Sustainable Development and waste management

Sustainable development is a multidimensional concept which involves continuous decision making of interlinked issues such as **environment, social community and economy.**



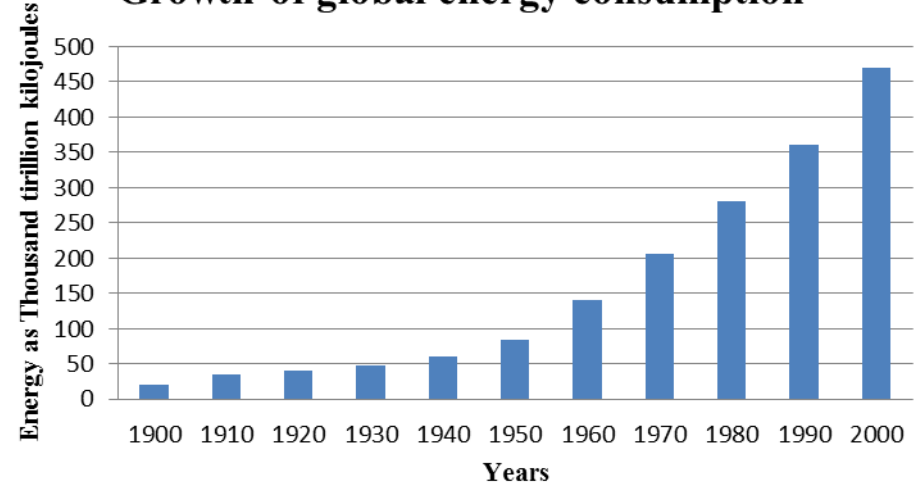
Functions of Environment

- Provides resources, raw materials for energy generation and product manufacturing
- Assimilates wastes generated from energy and product manufacturing operations

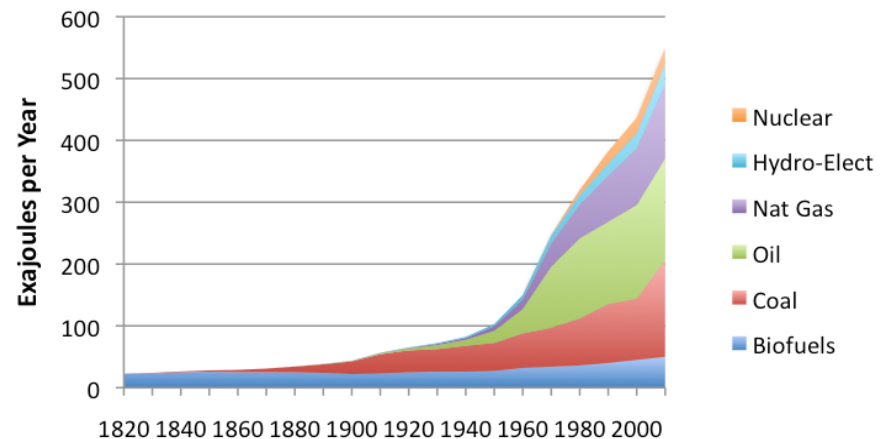


- There has been a rapid and steady rise in global energy consumption ever since the fossil fuels came into wide spread use.
- We have entered an ‘age’ of rapid consumption of fossil fuels, which represents the photosynthesis of millions of years ago.
- Per capita consumption of energy is not the same all over the world.
- Fossil fuels are difficult and costly to obtain and biomass constitutes the only source of energy

Growth of global energy consumption

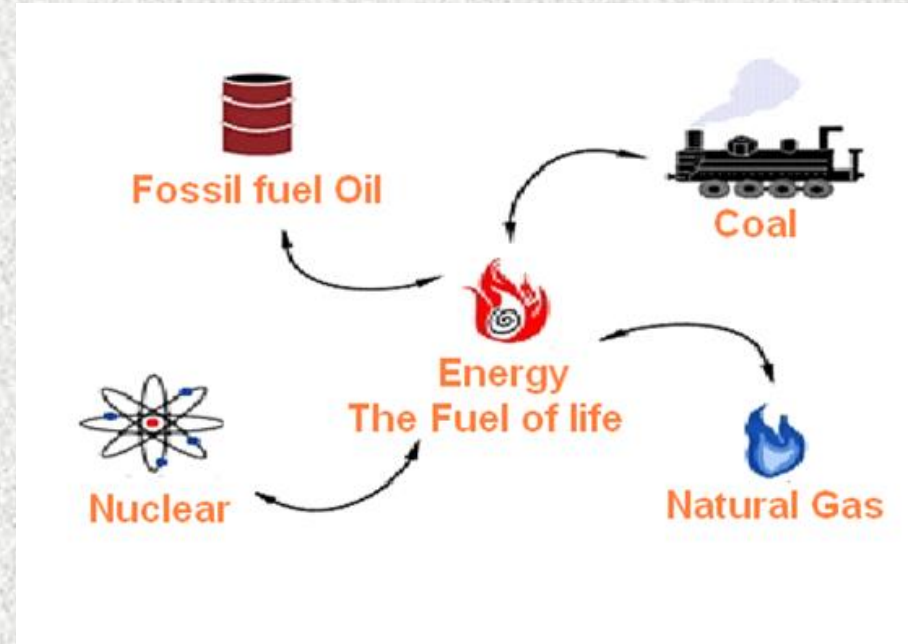


World Energy Consumption



Conventional Energy Source

- Those sources of energy which have been produced in nature over a very, very long time and cannot be quickly replaced when exhausted,
- These are exhaustible and depleting every day
- It is beyond the capacity of the global biosphere to absorb the emissions of a fossil fuel based energy system.
- Hands on experiment(glass of water, ink)
- It is necessary to conserve these sources

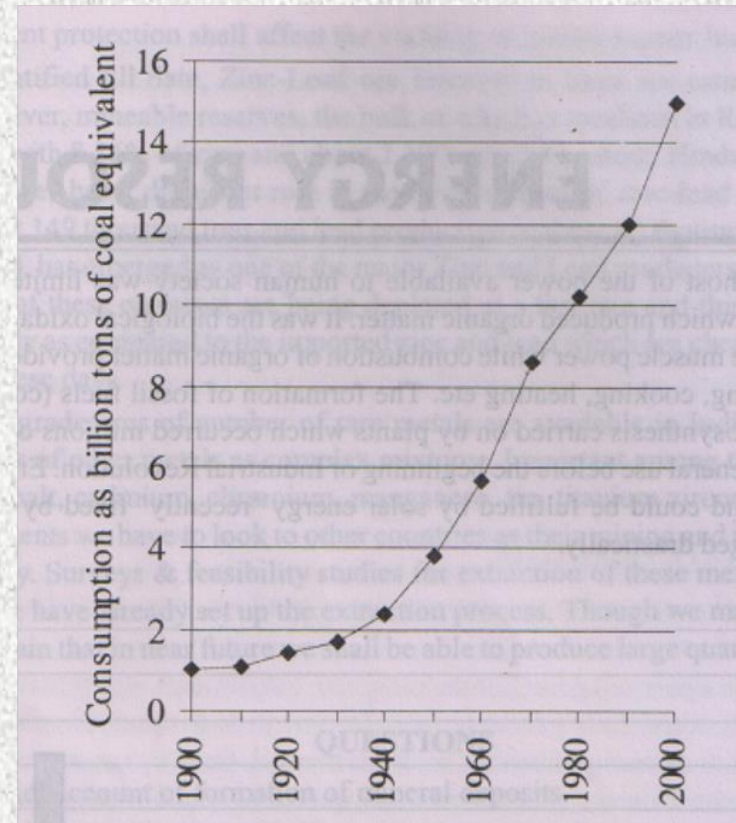


Need to Harnessing energies



- Energy consumption of a nation is usually considered as an index of its development.
- Developmental activities are directly or indirectly dependent upon energy.
- Wide disparities in per capita energy use between the developed and developing nations.

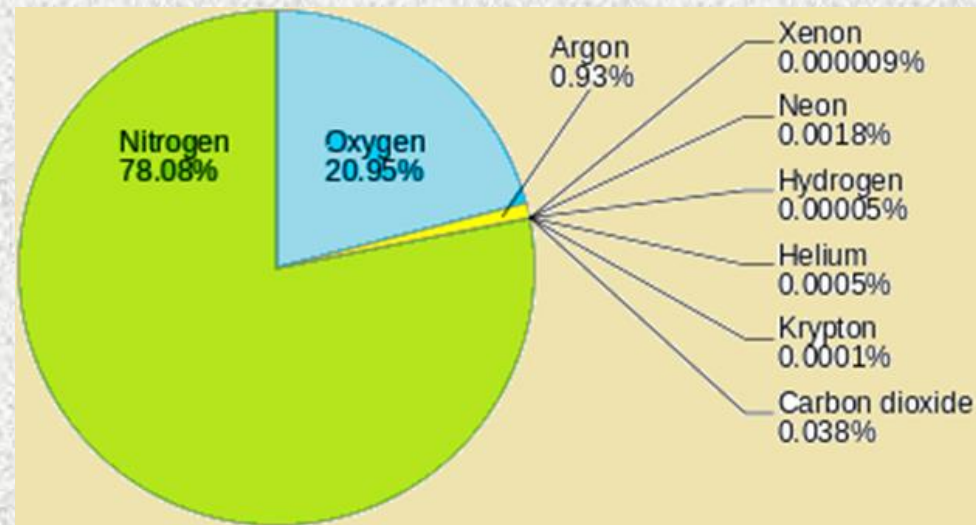
Global consumption of fossil fuels



Need to Harnessing energies

- It is beyond the capacity of the global biosphere to absorb the emissions of a fossil fuel based energy system.
- Concentration of CO₂ a green house gas is gradually increasing in the atmosphere and is likely to result in abrupt and catastrophic climatic disruptions by increasing the global temperature.
- A reduction can be achieved by limited use of fossil fuels.

CO₂ pollution



Challenges

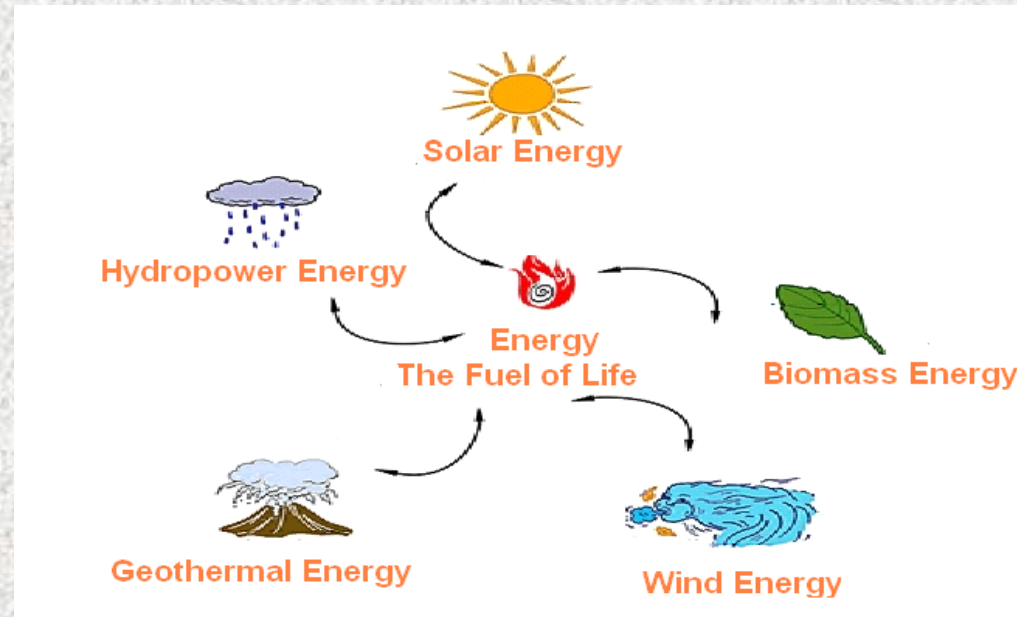
The challenge ahead is to meet the growing energy requirements by developing new technologies that use energy efficiently and harness the renewable energy resources economically to ensure equal access to it by future generations.

1. Growing energy demand
2. Reduced availability of fossil fuel
3. Limited capacity of global biosphere to cope with the overwhelming pollution due to fossil fuel consumption.`



Non – Conventional Energy Source

- In the decades ahead, fossil fuel based energy system will be replaced and ultimately a sustainable energy system based on renewable, clean and non-polluting energy resources will operate.



Comparison



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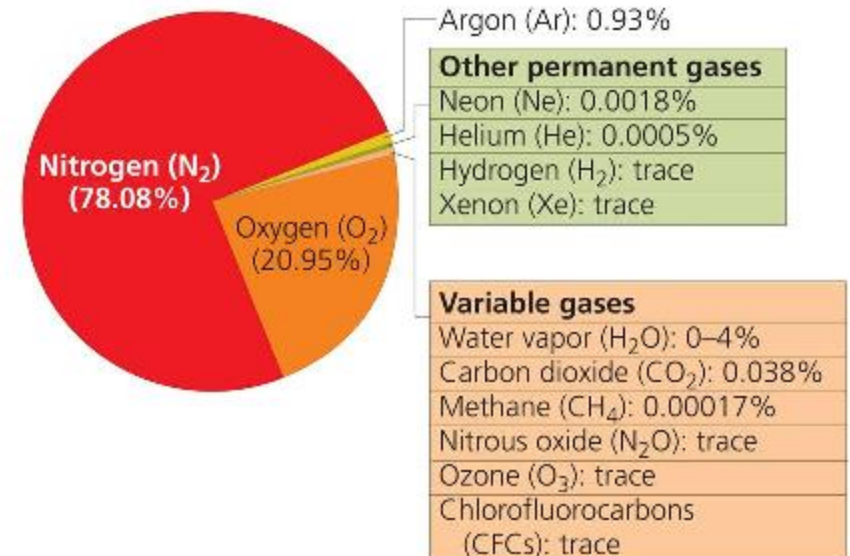
Conventional Energy Source	Non-Conventional Energy Source
These are Non renewable	These are renewable
It will be exhausted one day	These are continuously available
Necessary to conserve	No need to conserve
Causes more pollution	Pollution free
	High capital cost
High output in terms of power and efficiency	Low output in terms of power and efficiency
Ease of conversion from one form to another	Storage and conversion from one form to another is difficult
Ease in carrying from one place to another	Conveyance from one place to another is difficult
Can be used as input source for large scale energy production	Cannot be explored under unfavorable atmospheric conditions

Environmental pollution- Sustainable development



- For normal and healthy living a conducive environment is required by all living beings, including humans, livestock, plants, micro-organisms and the wildlife.
- The favourable unpolluted environment has a specific composition. When this composition gets changed by addition of harmful substances, the environment is called polluted environment.
- Environmental pollution can be defined as any undesirable change in the physical, chemical or biological characteristics of any component of the environment (air, water, soil) which can cause harmful effects on various forms of life or property.

The atmosphere's composition



SUSTAINABLE DEVELOPMENT

Development that meets the need of present generation without comprising the need of future generation.

Objective Of Sustainable Development

- To improve quality of human life
- To promote equity and fairness
- Sustaining the natural resources
- Protecting ecosystems
- To fulfill international obligations
- Long term planning and implementation

Important measures for SUSTAINABLE DEVELOPMENT

Population control

Pollution control

Reduced land use consumption

Production efficient technology

Integrated land use planning

Biosphere conservation

Water resource management

Use of renewable energy resources



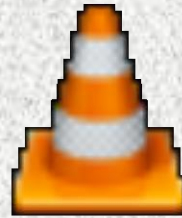
Engineers role in achieving SUSTAINABLE DEVELOPMENT



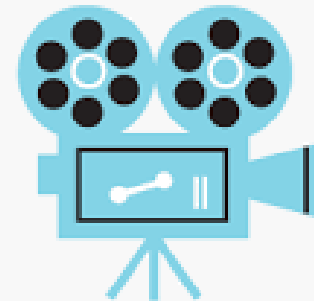
- As in many other professions, there are different kinds of engineers, including civil, environmental, mechanical, electrical, chemical, industrial, agricultural, mining, petroleum and computer engineers.
- Engineers are involved with two kinds of projects:
 1. They design and build projects that meet basic human needs (potable water, food, housing, sanitation, energy, transportation, communication, resource development and industrial processing).
 2. They solve environmental problems (create waste treatment facilities, recycle resources, clean up and restore polluted sites and protect or restore natural ecosystems).

Contribution of Engineer in sustainable development

- Extracting and developing natural resources
- Processing and modifying resources
- Designing and building transportation infrastructure
- Meeting the needs of consumers
- Recovering and reusing resources
- Producing and distributing energy
- Managing waste



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ENVIRONMENTAL IMPACT ASSESSMENT



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- It is the process of examining the impacts of a development on the environment
- But it is also used to mean the document that is the result of the examination



- Help the decision making process by providing information about the consequences of development
- Promote sustainable development by identifying environmentally sound practice & mitigation measures for developments

Which Developments???

- Major new road networks
- Airport & port developments
- Building dams & reservoirs
- Quarrying
- Large scale housing projects
- Nuclear power plants
- Thermal power plants



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Objectives of EIA



- To analyze ill-effects of any upcoming projects on environment
- To suggest remedial measures to overcome the adverse impact thus reducing pollution
- To obtain environmental clearance from concerned authorities like CPCB,SPCB,MOEF
- To select suitable site for project taking in to consideration impact vs. cost-benefit analysis

Points considered for EIA



- Status of existing environmental condition
(Physical and social)
- Study of project activities
- Suggestions to minimize adverse effects
- Pollution control
- Identifying damages
(Short term-long term, Reversible-irreversible, Direct-indirect, Local scale- global scale and quantifying damages)

Matters covered under EIA



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- Description of the proposed activities;
- Description of the base environmental and climatic conditions
- Analysis of the
land use and land use change,
waste generation
water consumption
power consumption
Social and health impacts
- An assessment of air pollution and noise generation.
- A risk assessment report and disaster management plan to mitigate adverse environmental impacts of proposed activity;
- An indication of the likely area to be affected by the proposed activity or its alternatives;
- A detailed environmental feasibility report of all the information provided.

Solid Waste Management



What is a solid waste?

- Solid waste is that material which arises from various human activities and which is discarded as useless or unwanted.
- The waste in solid and semi-solid forms are called **Solid Waste**.



Open dumping at Urali Phursungi



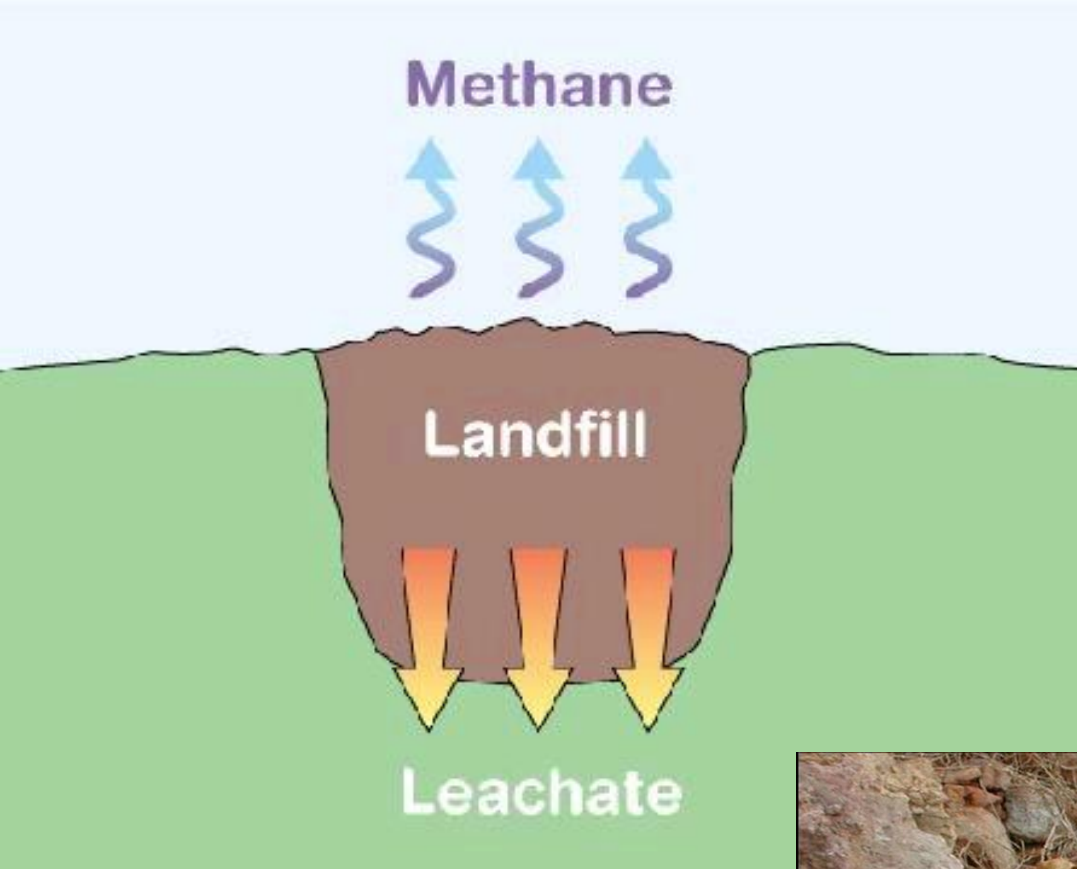
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Leachate is the liquid that drains or 'leaches' from a landfill.



Impacts of solid waste on health



- Produce foul smell and breed various types of insects.
- Spoils the aesthetics of the site.
- Industrial solid waste affects productivity of land.
- Toxic substance may percolate to pollute surface as well as ground water.
- Resulted in high algal population in rivers and sea.
- Degrades water and soil quality
- Hazardous waste is injurious to human health as well as workers who handle and transfer the waste.

Classification of solid waste

Types Of Solid Waste	
Garbage	Fruit, vegetable and animal residues
Rubbish 1. Combustible- 2. Non combustible-	Paper, plastic, wood, lather, rubber Glass, metal, construction waste etc.
Ashes and Residues-	Material remaining from burning of wood and coal
Agricultural waste	residues from the growing and processing of raw agricultural products
Hazardous waste-	Chemical, biological, explosives.

Sources and Types of Solid Wastes

➤ Sources of solid wastes in a community are:

- Residential
- Commercial
- Institutional
- Construction and Demolition
- Municipal
- Industrial
- Agricultural



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Sources and Types of Solid Wastes

Source	Typical facilities, activities, locations where wastes are generated	Types of solid wastes
Residential	Single and multifamily dwellings	Food wastes, paper, cardboard, plastics, textiles, leather, yard wastes, wood, glass, metals, ashes, special wastes (e.g., bulky items, consumer electronics, white goods, batteries, oil, tires), and household hazardous wastes
Industrial	Light and heavy manufacturing, fabrication, construction sites, power and chemical plants	Industrial process waste, scrap materials, etc. Non - industrial waste including food wastes, construction and demolition wastes, rubbish, ashes , hazardous wastes, ashes, special wastes

Source	Typical facilities, activities, locations where wastes are generated	Types of solid wastes
Commercial	Stores, hotels, restaurants, markets, office buildings, etc.	Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes
Institutional	Schools, hospitals, prisons, government centers	Same as commercial
Construction and Demolition	New construction sites, road repair, renovation sites, demolition of buildings, broken pavement	Wood, steel, concrete, dirt, etc.

Source	Typical facilities, activities, locations where wastes are generated	Types of solid wastes
Municipal Services (excluding treatment facilities)	Street cleaning, landscaping, parks, beaches, other recreational areas, water and wastewater treatment plants	Street sweepings; landscape and tree trimmings; general wastes from parks, beaches, and other recreational areas; sludge
Agricultural	Field and row crops, orchards, vineyards, dairies, feedlots, farms, etc.	Spoiled food wastes, agricultural wastes, rubbish, hazardous waste.

Factors affecting the collection of dry refuse

1. Location of dustbins
2. Collection frequency
3. Population density
4. No. of workers used per dumper
5. Time of collection
6. Collection routes
7. Cost of collection.



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Collection methods of Solid waste

A. House to house collection

1. Curb system
2. Alley system
3. Set-out system
4. Set-out-set back system
5. Backyard system

B. Storage bin system

A. House to house collection



Curb system:-

- It is the responsibility of house owner for placing refuse container at the curb.
- Workmen from refuse vehicles collect and empty the containers in the vehicles.

Alley system:-

- The container is placed at the alley line from where they are picked up by workmen from refused vehicles who deposit back the empty container.

Set-out service:-

- The worker with refused vehicles collect the containers from individual houses and empty the container in refuse vehicles .The empty containers are then collected by the owners.

Set-out-set back system:-

- In this system set out man go to individual, collect the containers & empty them in refuse vehicles.
- Another group of person return them to house owners yard.

Backyard service:-

- The workers with them carry a bin or wheel barrow etc. to the yard, empty the refuse container in the bin or wheel barrow.
- The wheel barrow or bin is then taken to refuse vehicle where it is emptied.

B. Storage bin system:-

- In this, waste is collected at specific points or in the bin provided by municipal authorities.
- Bins made up of steel or iron placed at suitable location.
- The house owner or street sweeper stores the waste in these bins.
- These wastes are then collected by vehicle and are taken to disposal site.

These Sorting Facilities are Well Organized and Materials are Separated for Further Processing



Separation of Recyclable and Placing Separately



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Recyclables Collected from Scavengers are Deposited in One Place

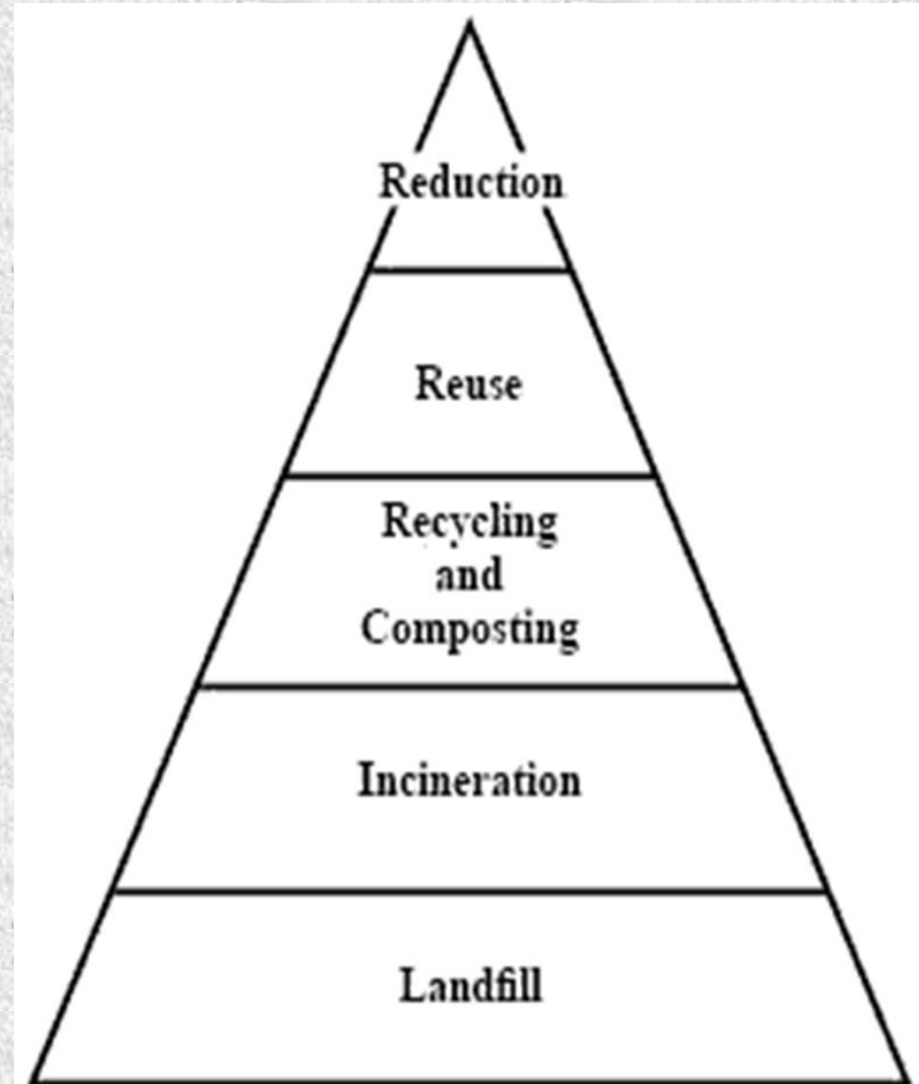


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Solid Waste Management

It is planned process of collection, storage, transportation and disposal of the solid waste in such a way that it will not affect the environment.



Benefits of Recycling



- USA recycles about 83 million tons of SW annually.
- This provides an annual benefit of 182 million metric tons of carbon dioxide equivalent emissions reduced.
- Comparable to removing the emissions from 33 million passenger cars.
- But the ultimate benefits from recycling are cleaner land, air, and water, overall better health, and a more sustainable economy.

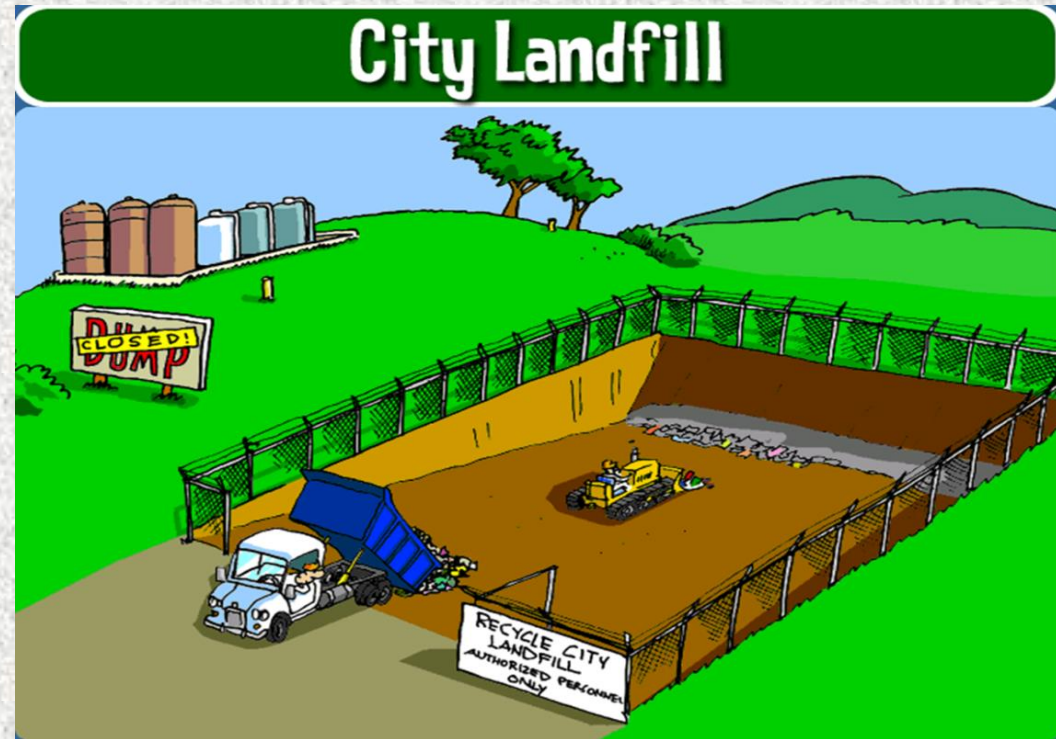
Waste treatment and disposal

Waste disposal

- Sanitary Landfills
- composting
- Incineration

Sanitary Landfill

- Layer of compacted waste covered with a layer of earth once a day and a thicker layer when the site is full
- Require impermeable barriers to stop escape of leachates: can cause problem by overflow
- Gases produced by decomposing garbage needs venting
- 1 acre/10,000 people: acute space problem: wastes piling up over 150 million tons/year;

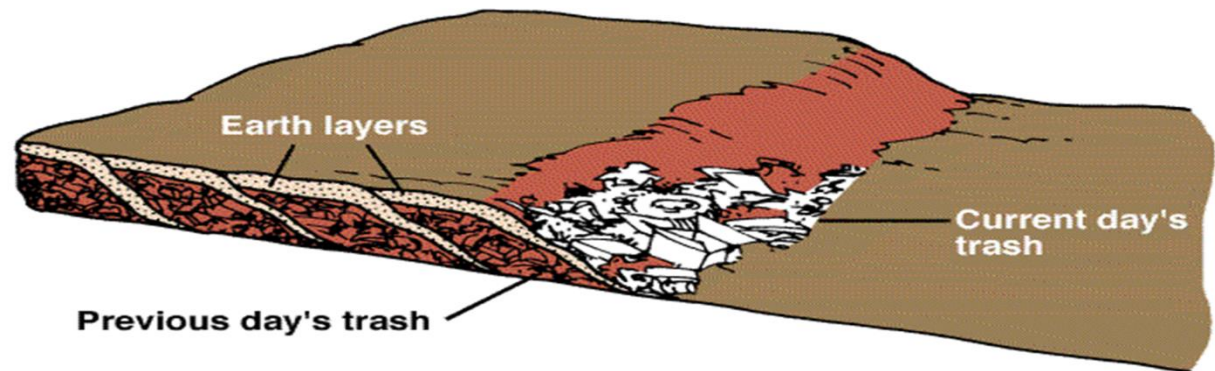


Problems with landfills...

- Landfills require space
- Produce methane gas (can be used for energy or can cause climate change)
- Leach-ate must be collected and treated
- Potential for water pollution
- NOT a long-term remedy

Carla W. Montgomery, Environmental Geology, 5th edition. Copyright © 1998 The McGraw-Hill Companies, Inc. All rights reserved.

Design of a Sanitary Landfill



A

Composting

- Due to shortage of space for landfill, the biodegradable waste is allowed to decompose in an oxygen rich medium.
- This method improves the soil condition and fertility.



Composting: some benefits



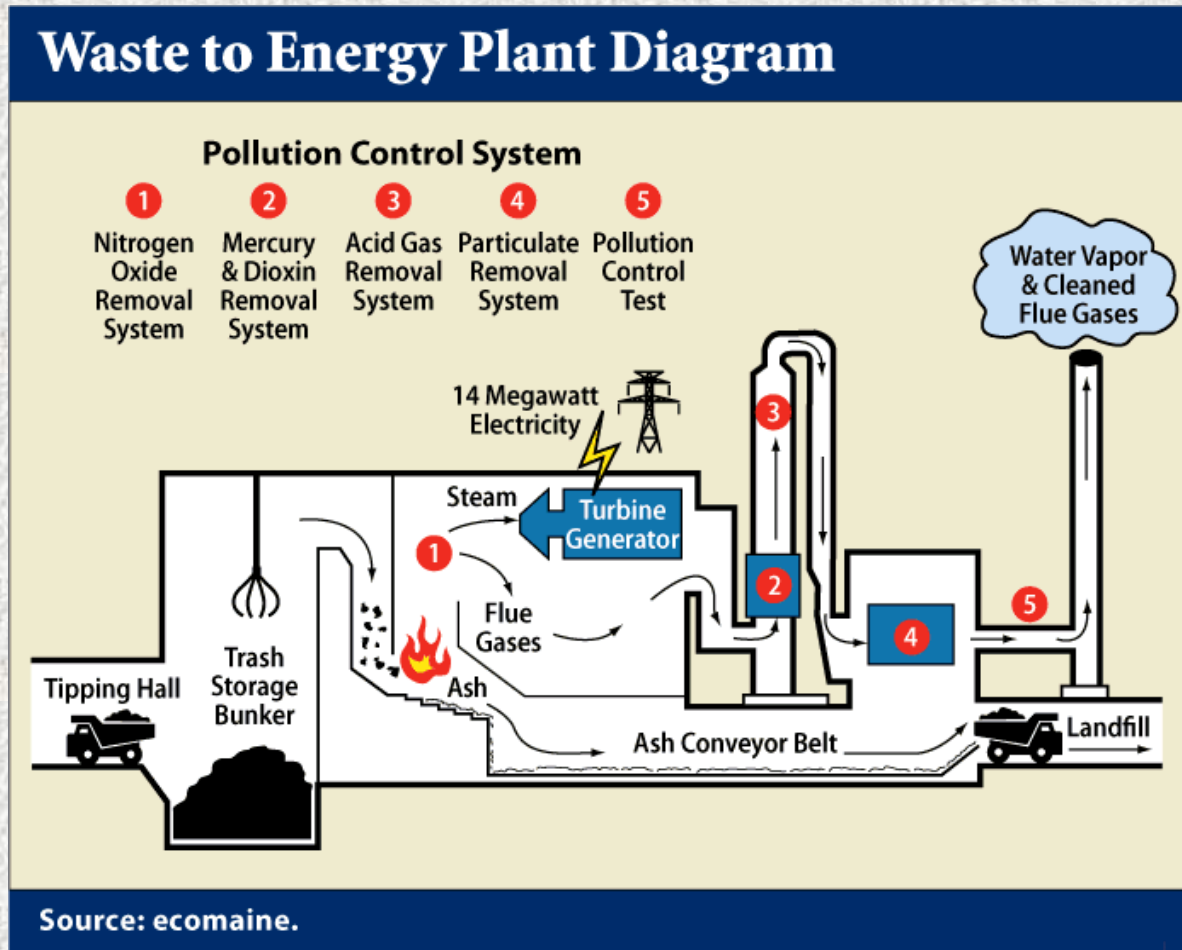
Compost allows the soil to retain more plant nutrients over a longer period.

- 1.It supplies part of the 16 essential elements needed by the plants.
- 2.It helps reduce the adverse effects of excessive alkalinity, acidity, or the excessive use of chemical fertilizer.
- 3.It makes soil easier to cultivate.
- 4.It helps keep the soil cool in summer and warm in winter.
- 5.It aids in preventing soil erosion by keeping the soil covered.
- 6.It helps in controlling the growth of weeds in the garden.

INCINERATION (burning):

- Significantly reduces the volume of garbage
- Produces heat energy for generating electricity
- Materials such as batteries, glass etc. are NOT suitable for incineration
- Causes air pollution
- Creates toxic ash and other solid waste

INCINERATION (burning):



Impacts of solid waste on Environment

- Waste breaks down in landfills to form methane, a potent greenhouse gas
- Change in climate and destruction of ozone layer due to waste biodegradable
- Littering, due to waste pollutions, illegal dumping, Leaching: is a process by which solid waste enter soil and ground water and contaminating them.

Preventive Measure



- Proper management of solid waste
- Involving public in plans for waste treatment and disposal
- Provide the public accurate, useful information about the whole projects, including the risks and maintain formal communication with public
- Educate people on different ways of handling waste.
- Waste Minimization is a process of reducing waste produce by individuals, communities and companies, which reduces the impact of chemical wastes on the environment to the greatest extent.
- Household level of proper segregation of waste, recycling and reuse.
- Process and product substitution e.g. use paper bag instead of plastic bags.

Thumb rules to manage solid waste

- Follow the four R's of resource use: Refuse, Reduce, Reuse, and Recycle.
- Ask yourself whether you really need a particular item.
- Rent, borrow, or barter goods and services when you can.
- Buy things that are reusable, recyclable, or compostable, and be sure to reuse, recycle, and compost them.
- Do not use throwaway paper and plastic plates, cups, and eating utensils, and other disposable items when reusable or refillable versions are available.
- Use e-mail in place of conventional paper mail.
- Read newspapers and magazines online.
- Buy products in concentrated form whenever possible.

E- Waste Management

Electronic waste, popularly known as ‘e-waste’ can be defined as electronic equipments or products connected with power plug, batteries which have become obsolete due to:

1. Advancement in technology
2. Changes in fashion, style and status
3. Nearing the end of their useful life.



Increase in E-waste due to

1. Increase in use of electronic and electrical products
2. Use and throw approach in developed and developing countries.
3. Less resell value.



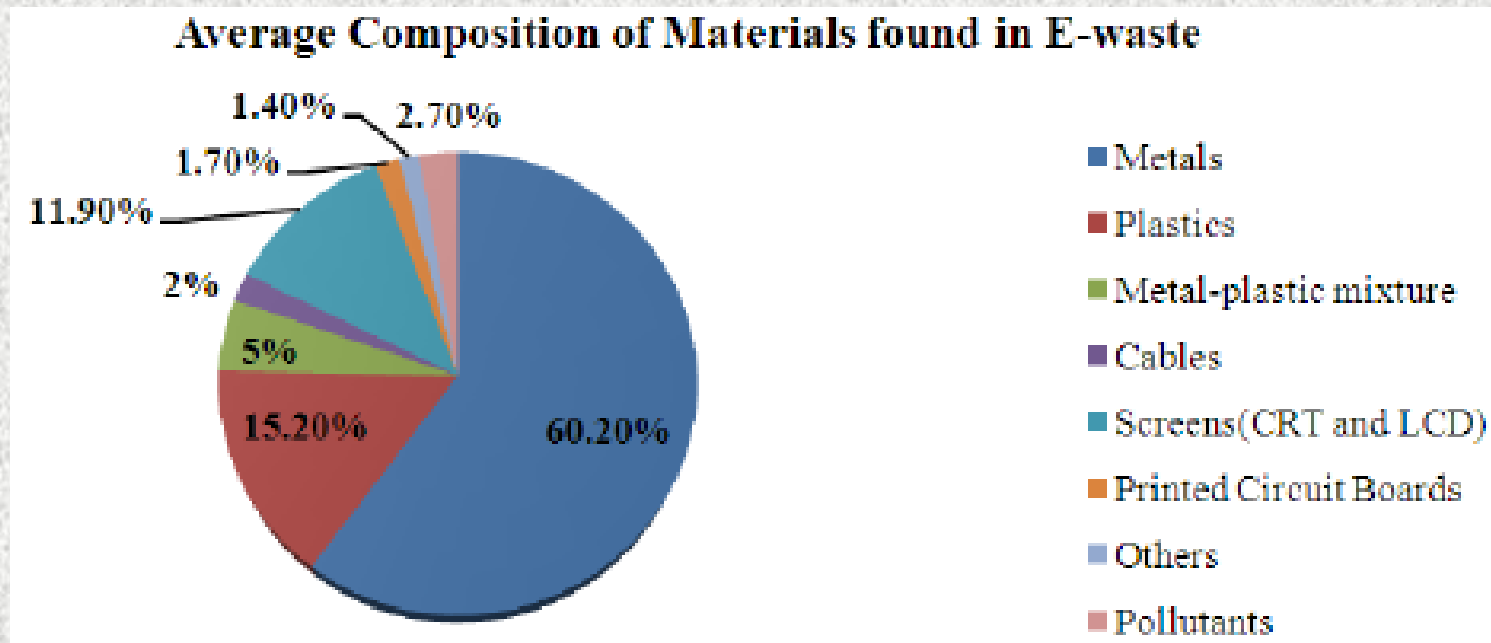
Classification of e-waste

E-waste encompasses ever growing range of obsolete products classified as

1. **Electronic devices** such as computers, servers, main frames, monitors, TVs & display devices
2. **Telecommunication devices** such as cellular phones & pagers, calculators, audio and video devices, printers, scanners, fax machines, refrigerators, air conditioners, washing machines, and microwave ovens.
3. **Recording devices** such as DVDs, CDs, floppies, tapes, printing cartridges, military electronic waste, automobile catalytic converters.
4. **Electronic components** such as chips, processors, mother boards, printed circuit boards, industrial electronics such as sensors, alarms, sirens, security devices, automobile electronic devices.

Composition of E - waste

1. Steel and Iron – 50%
2. Plastic – 21%
3. Non-ferrous metal-13%
(copper, aluminum, silver, gold, platinum)
4. Remaining is lead, mercury, arsenic, cadmium etc.



Need of E-Waste Management

- Industrial Revolution.
- Advancement in Information Technology.
- There mismanagement can lead to the pollution.
- From the data collected, in a single year the production is around 1200 tons of electronic scrap.
- Production of E-Waste is on mass basis in many developed countries including India.
- This waste is not Eco-friendly.
- Hence there is a need to check this electronic waste pollution by proper management.
- It is taking up valuable landfill space.
- E-waste contains hazardous material



Sources of E-Waste



Effects of E-Waste constituent on health

Source of e-waste	Constituent	Health effects
Solder in printed circuit boards, glass panels and gaskets in computer monitors	Lead (PB)	Damage to nervous and blood systems. Kidney damage. Affects brain development.
Chip resistors and semiconductors	Cadmium (CD)	Toxic irreversible effects. Accumulates in kidney and liver.
Relays and switches, printed circuit boards	Mercury (Hg)	Neural damage. Damage to brain. Respiratory and skin disorders.
Front panel of CRTs	Barium (Ba)	Muscle weakness, Damage to heart, liver and skin.
Cabling and computer housing	Plastics including PVC	Immune system damage, Interfere with regulatory hormones.
Motherboard	Beryllium (Be)	Lung cancer, Skin diseases such as warts.

Management Of E-waste

- Due to advancement in techniques the old instruments are becoming outdated.
- This necessitates implemental management measures.
- India as a developing country needs simpler, low cost technology for proper management of E-waste.
- In industries management of e-waste should begin at the point of generation.
- Waste minimization in industries involves adopting:
 1. *inventory management,*
 2. *production-process modification,*
 3. *volume reduction,*
 4. *Recovery and reuse.*





The Devastating Effects of Pollution.mp4



E-Waste Management and Processing Techniques.mp4

Thank You

Reuse	Recycle	Dispose
<ul style="list-style-type: none"> • Preventing waste in the first place is the preferred mngt option • This can be achieved through repairing,upgrading used electrical equipment • Example- adding memory to a computer,upgrading software 	<ul style="list-style-type: none"> • Make use of take back programs • Through recycling units are either reused or dismantled for recycling. • The silver,gold,lead and other heavy metal are recyclable 	<ul style="list-style-type: none"> • The least preferred option is to landfill electronic waste. • This should only come as a last option but care to consult with state regulations on disposal of any hazardous waste.

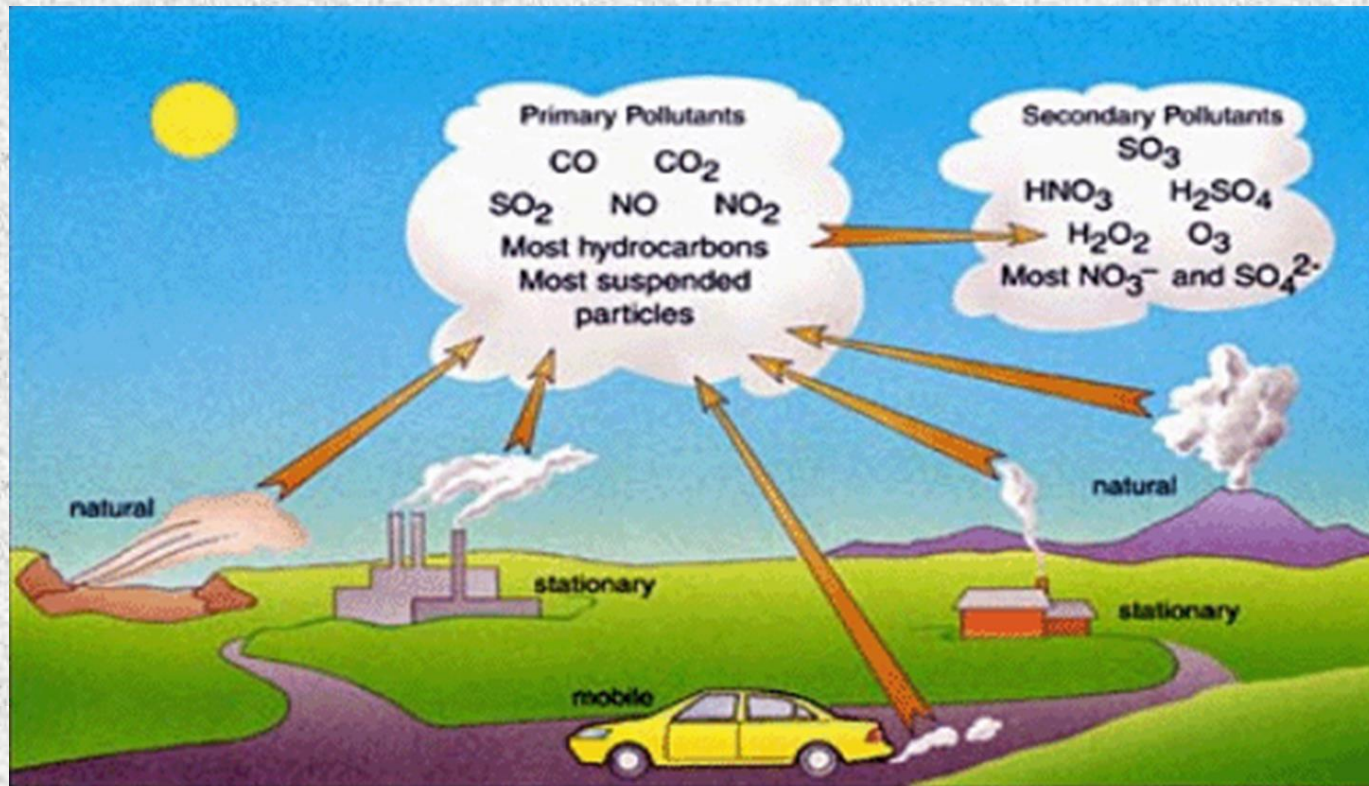
Air pollution

Air pollution is the presence of harmful gases or particulates in the air which cause diseases, damage to other living organisms or the environment.

Classification of Air pollutants

- Natural and Manmade
- Mobile and Stationary
- Primary and Secondary
- Organic and Inorganic

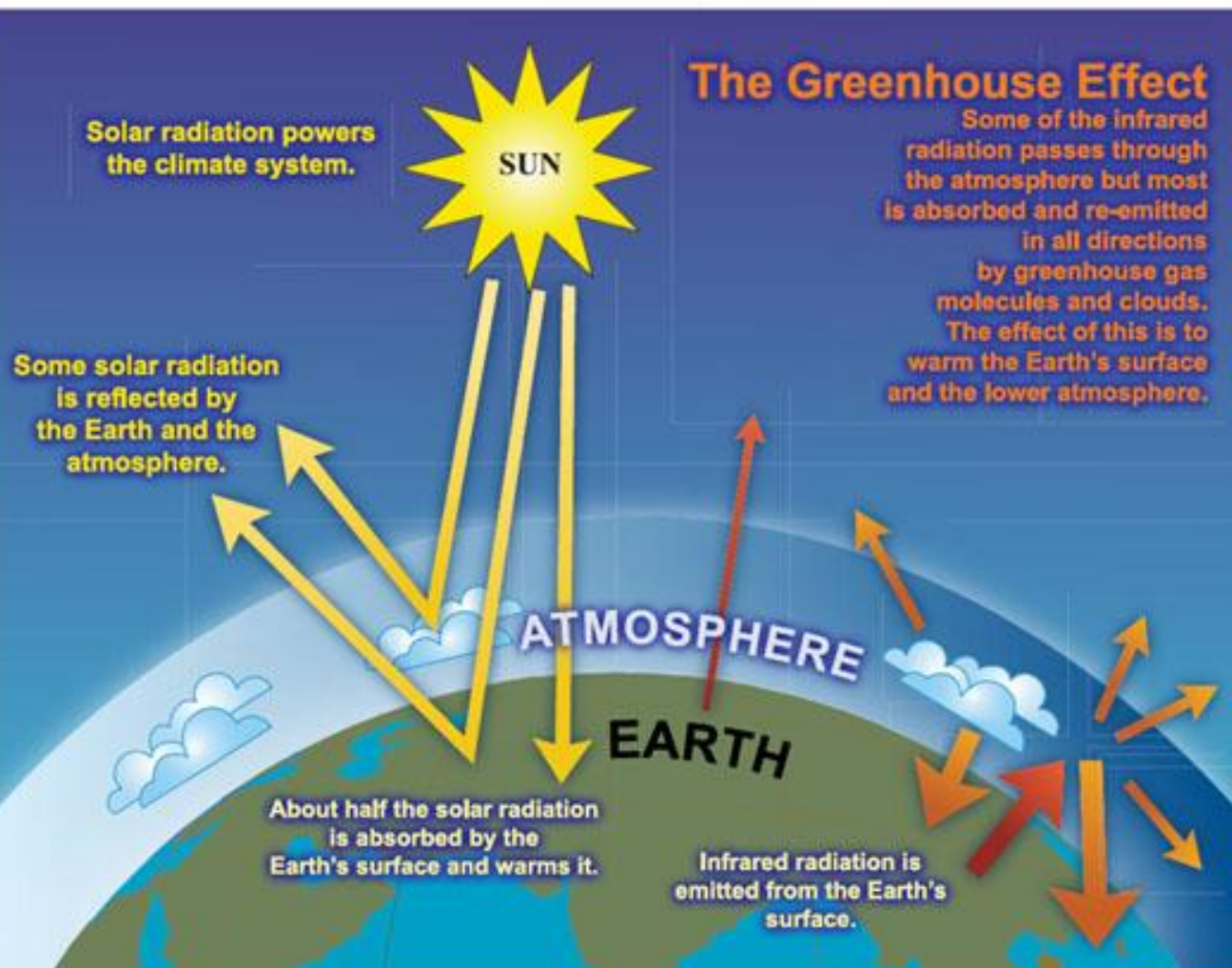
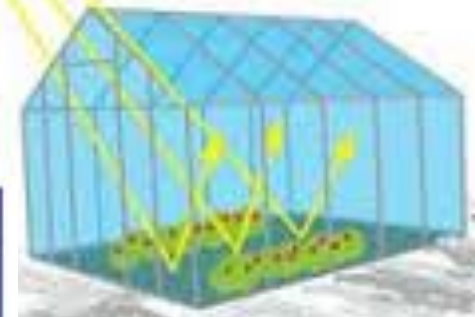
- Increase in Population
- Deforestation
- Emission from Vehicles
- Rapid Industrialization
- Burning of Fossil Fuels and fires



Types and sources of air pollutants

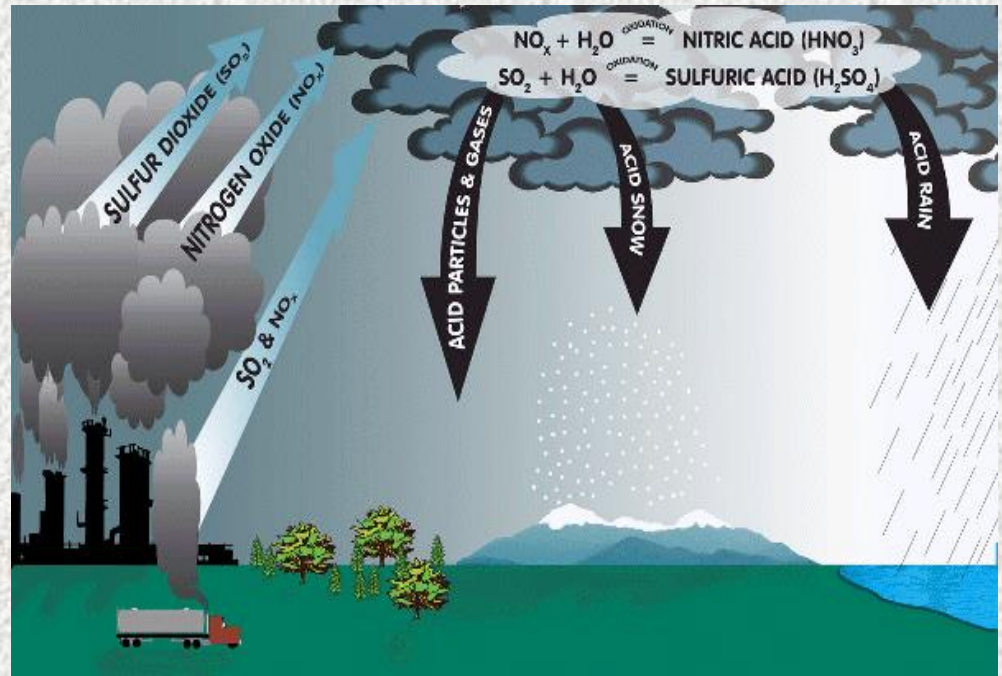
Green house Effect

A greenhouse traps the Sun's energy inside and keeps the plants warm.



Acid Rain

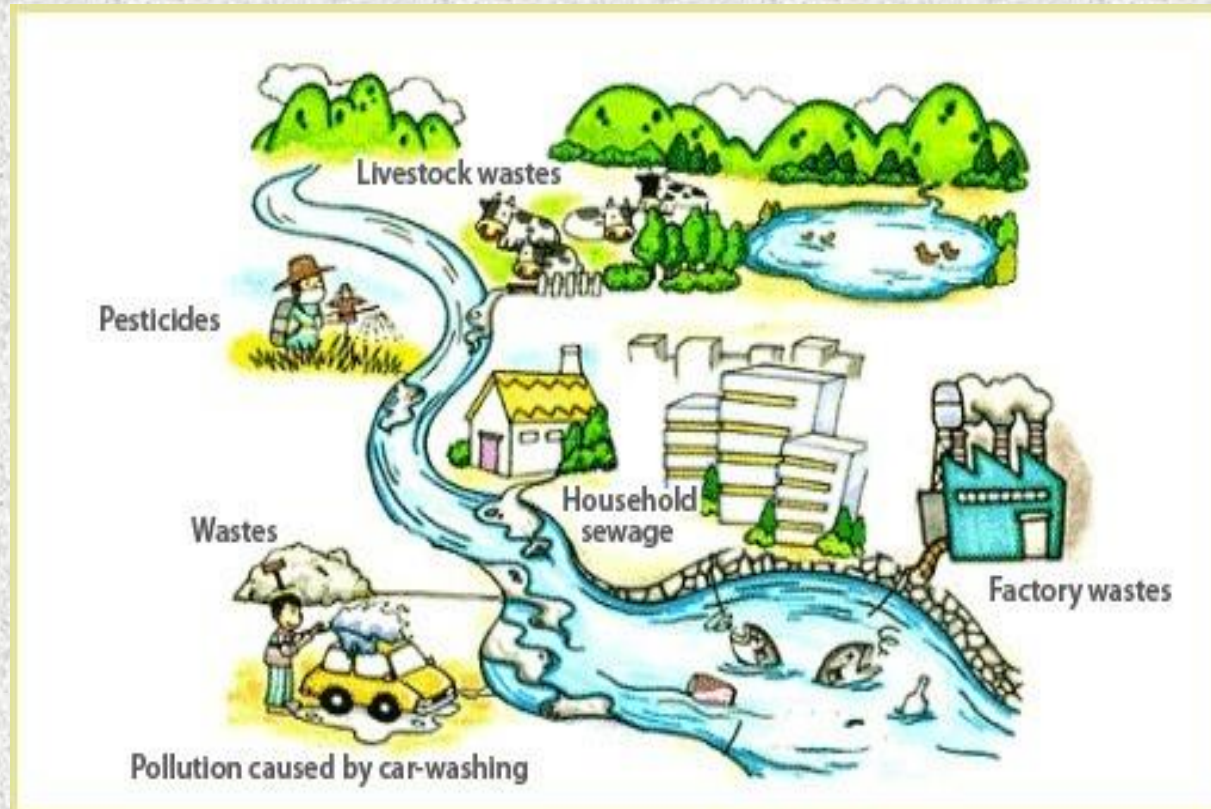
- Acid Rain is a rain or any other form of precipitation that is unusually acidic, meaning that it possesses elevated levels of hydrogen ions (low pH).
- It can have harmful effects on plants, aquatic animals and infrastructure.
- Acid rain is caused by emissions of SO_2 and NO_x , which react with the water molecules in the atmosphere to produce acids.



WATER POLLUTION

- Water pollution is the contamination of water bodies e.g. lakes, rivers, oceans, aquifers and groundwater. Water pollution occurs when pollutants are directly or indirectly discharged into water bodies

without adequate treatment to remove harmful compounds



NOISE POLLUTION

- Noise pollution is displeasing human, animal or machine-created sound that disrupts the activity or balance of human or animal life.

Noise Pollution Causes by...

- Traffic Noise
- Air craft Noise
- Noise from construction and civil engineering works.
- Noise from the Industries.
- Noise from other sources.

Noise Pollution Effects:

- Hearing Loss
- High Blood Pressure
- Stress
- Sleep Disturbance

Land Pollution

- It is the destruction of Earth's land surfaces through misuse of land resources by human activities. Polluted land has deposits of liquid and solid waste such as rubbish, garbage, paper, glass and plastic objects.
- Land Pollution Causes by...
 - Accidental Spills
 - Industrial Accidents
 - Landfill and illegal dumping
 - Agricultural practices
 - Mining and other industries
 - Oil and fuel dumping
 - Buried wastes
 - Drainage of contaminated surface water into the soil.