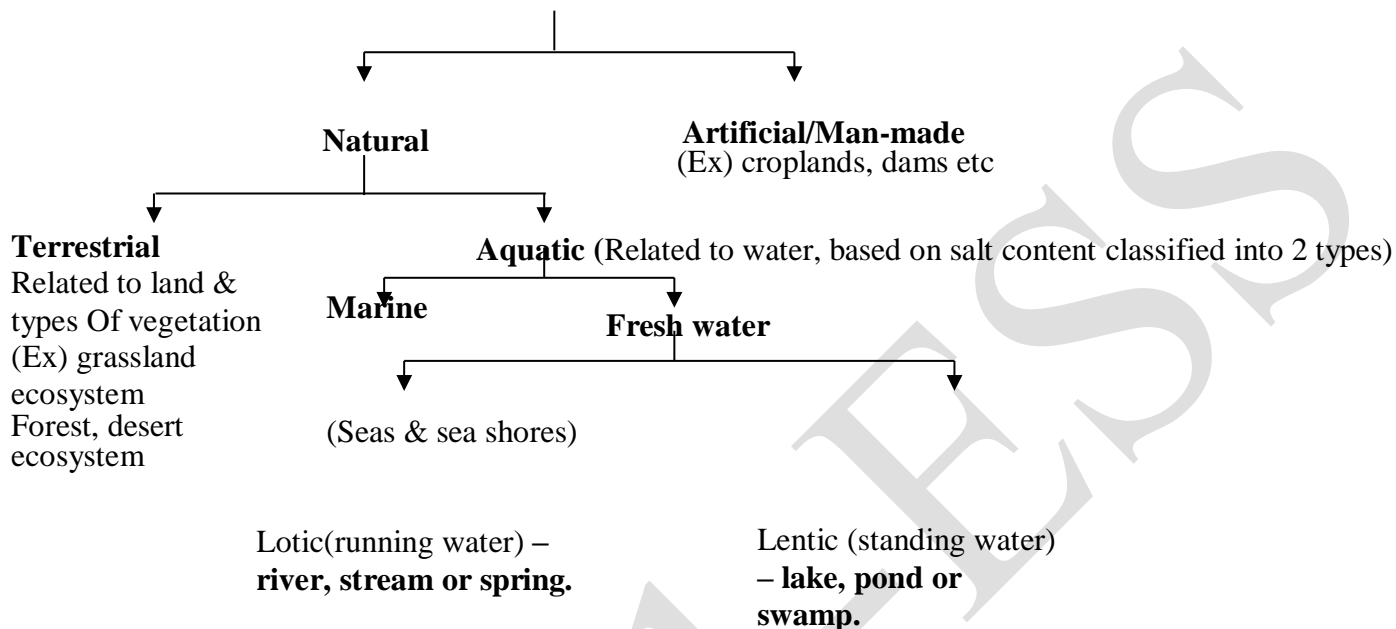




**UNIT -1-ECOSYSTEMS AND BIODIVERSITY**

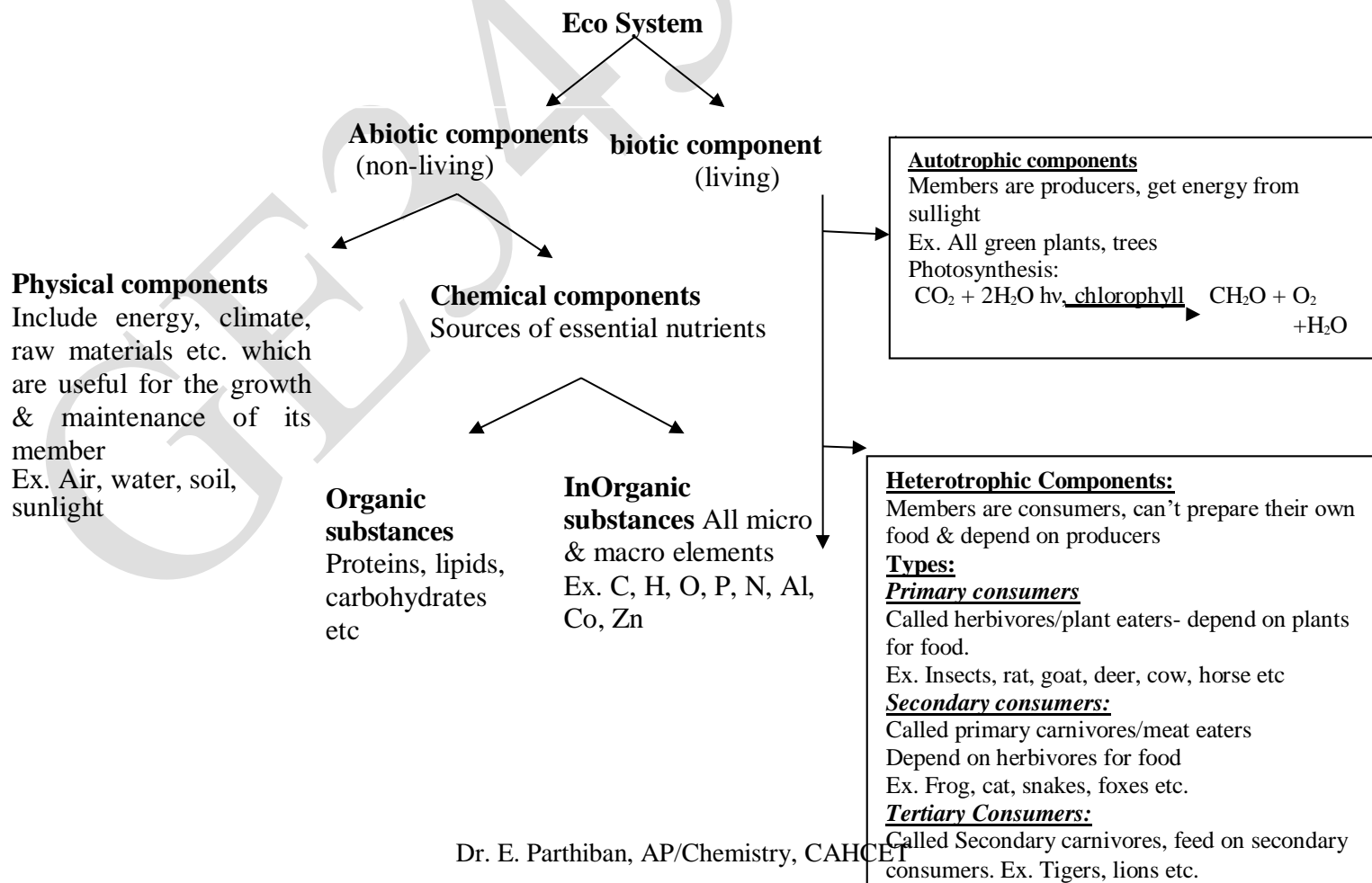
**Ecosystem**—A group of organisms interacting among themselves and with environment is known as ecosystem. (2M)

**Types of Ecosystems**



**Ecology** - Study of interactions among organisms, with their environment. the flows of energy and materials between abiotic and biotic components of ecosystems.

**1. STRUCTURE/ COMPONENTS OF AN ECOSYSTEM (8 M)**



**Decomposers:**

Organisms which feed on dead organisms, plants & animals & decompose into simpler compounds

Ex. Microorganism like bacteria & fungi

## **2. ENERGY FLOW THROUGH ATMOSPHERE TO AN ECOSYSTEM (7 M)**

Sun the ultimate source of energy is absorbed by producers (plants) to produce organic matter through photosynthesis. The conversion of solar energy is governed by law of thermodynamics.

### **Ist Law of Thermodynamics:**

Energy can neither be created, nor be destroyed, but it can be converted from one form to another

(Ex) photosynthesis- solar energy converted to chemical energy.

**Photosynthesis Equation:**  $\text{CO}_2 + 2\text{H}_2\text{O} \xrightarrow{\text{hv, sunlight}} \text{CH}_2\text{O} + \text{O}_2 + \text{H}_2\text{O}$

Plants are used by herbivores, herbivores are used by carnivores as their food.

Thus energy is transferred & conversion of solar energy is governed by law of thermodynamics

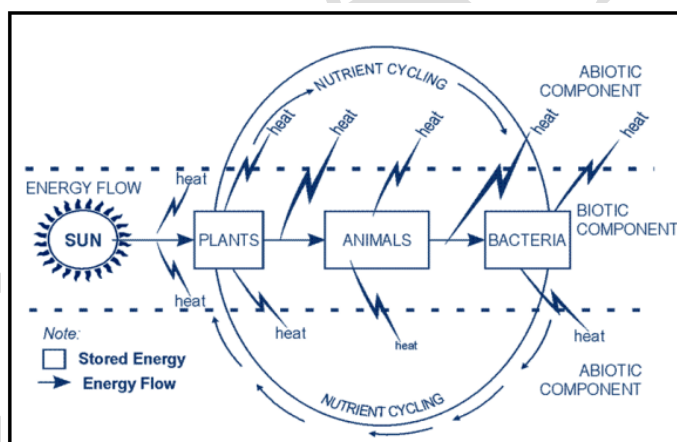
### **IInd Law of Thermodynamics:**

Whenever energy is transformed, there is a loss of energy through the release of energy in the form of heat.

(Ex). Respiration process:  $\text{CH}_2\text{O} + \text{O}_2 \longrightarrow \text{CO}_2 + 2\text{H}_2\text{O}$

### **Relationship between structure & function:**

Hence biotic components and abiotic components are linked through energy flow and nutrient cycle.



## **3. ECOLOGICAL SUCCESSION (8 M or 13 M)**

The progressive replacement of one community by another till the development of stable community in a particular area is ecological succession.

### **Stages of ecological succession:**

Pioneer community – First group of organisms established their community in the area.

Seral or seres stage- Various developmental stages of a community.

### **Types of ecological succession:**

*Primary succession* → involves gradual establishment of biotic communities on a lifeless ground

Hudrarch / Hydrosere → establishment starts in watery area like pond and lake

Xerarch / Xerosere → establishment starts in a dry area like desert and rock

*Secondary succession* → Involves establishment of biotic communities in an area, where biotic community already present there.

**Process of Ecological Succession:** i) Nudation ii) Invasion–migration and establishment  
iii) competition iv) Reaction and v) Stabilization.

i) **Nudation** - Development of bare area without any life form.

ii) **Invasion** – One or more species in bare area through migration and establishment.

**migration** - Seeds migration through water, air and bird.

**establishment** – Seeds grow on the land and establish.

iii) **competition** – Competition with the same species and different species for space, water and nutrients.

iv) **Reaction** – Living organisms, take water, nutrients and grow and modify the environment.

v) **Stabilization** – Equilibrium with the environment.

**4. What is environment? List its types. Explain its scope and significance of environment studies. (8 M)**

**Definition-** The sum of all living and non-living things around us influence one another. (2 M)

**Types-**i) Natural environment – naturally created all biotic and non-biotic components.

ii) Man-made environment- Created by man.

**Scope of environmental studies**

(2 M)

i) Awareness and sensitivity + related problems.

ii) Motivate active participation.

iii) Identification and solving environmental problems.

iv) Awareness on conservation of natural resources.

(4 M)

**Significance or importance**

i) Environment issues being of internal importance.

ii) Problems cropped in the wake of development.

iii) Explosively increase in pollution.

iv) Need for an alternative solution.

v) Need to save Humanity from extinction.

vi) Need for Wise planning of development.

## 5. BIODIVERSITY (2 M)

**Definition:** The variety and variability among all groups of living organisms and the ecosystem in which they occur.

### Classification of Biodiversity:

- 1) **Genetic diversity** → Diversity within the species is genetic diversity. (ex) teak wood varieties, Indian, Burma, malasian
  - 2) **Species diversity** → diversity between different species. (ex) plant species = apple, mango, grapes, animal species = lion, tiger, elephant etc.
  - 3) **Ecosystem diversity** → Diversity at the ecological or habitat level is ecosystem diversity. Ex. River ecosystem.
- 

## 6. VALUES OF BIODIVERSITY (13 M)

### 1. Consumptive use:

**Drugs:** Many plants are used in primary health care.

70% of modern medicines are derived from plant and plant extracts.

(Ex) Penicillin – fungus is the source – Antibiotic

Quinine – Chincona bark - Malaria treatment

Morphine – Poppy bark – Analgesic

**Fuels:** Fire woods are directly consumed by villagers.

**Food:** A large number of wild plants and wild animals are consumed by human beings as food.

### 2. Productive use:

Biodiversity products have commercial value.

These products are marketed and sold. These are derived from animals and plants.

**Animal products:** Silk from silk worm

Wool from sheep

Musk from musk deer

Leather from animals

**Plant Products:** Wood for paper and Plywood

Cotton for textile industry

Pearl for pearl industry

### 3. Social value:

\*It refers to the manner in which the bio-resources are used in the society.

\*These are associated with the social life, religion and spiritual aspects of the people.

e.g., Holy plants: Tulsi, Lotus, Neem trees

Holy animals: Cow, snake, bull, peacock

### 4. Ethical value:

It means that a species may or may not be used but its existence in nature gives us pleasure.

e.g., Holy river: River Ganga

Holy tree: Tulsi, Vengai

### 5. Aesthetic value:

The beautiful nature of plants and animals insists us to protect the biodiversity.

Ex) eco-tourism, colour of butterfly, flowers etc.

### 6. Optional value:

The optional value of biodiversity suggests that any species may be proved to be a valuable species after someday.

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## 7. HOT- SPOTS OF BIODIVERSITY (2 M)

The hot spots are the geographic areas which possess high endemic species.

An area is designated as a hot spot when it contains at least 0.5% of plant species as endemic.

**Area of hot spot:** There are 25 Hotspots of biodiversity on worldwide. Out of which 2 are present in India.

**Eastern Himalayas** → Nepal, Bhutan, Indo-Burma region, 30% of endemic species, **Western Ghats** → Srilanka region, ex – Maharastra, Karnataka, tamilandu, kerela. 1500 endemic species.

## **8. THREATS TO BIODIVERSITY (13 M)**

Any disturbance in a natural ecosystem tends to reduce its biodiversity. Various threats to biodiversity are:

**1. HABITAT LOSS:** Loss of population of interbreeding organism.

**Factors influencing Habitat Loss:**

**Deforestation:**

- Forest & grasslands are cleared for agricultural lands or developmental projects.
- Many species disintegrate due to loss of natural habitat.

**Destruction of wetlands:**

- Wetlands are destroyed due to pollution, draining etc.

**Developmental activities:**

- Construction of dams in forest, industrial effluents kill birds & aquatic organisms.

**Habitat fragmentation:**

- Habitat is divided into small & scattered
- So, many animal & birds are vanishing.

**Raw materials:**

- For the production of hybrid seeds, wild plants are used as raw materials.

**Production of Drugs:**

- Pharmaceutical companies collect wild plants for drugs production.
- So, no of medicinal plants are on the verge of extinction.

**Illegal Trade:**

- Trade on wild life reduces bio-diversity

## **2. MAN-WILDLIFE CONFLICTS:**

**Examples:**

**Sambalpur – orissa:**

195 humans were killed by elephants,  
In retaliation- 98 elephants were killed,  
30 injured by villagers.

**Kote – Chamrajanagar –Mysore:**

Sugarcane & cotton crop, explosives

**Royal Chitwan National Park – Kathmandu**

Man-eating tiger killed 16 nepalese, 4 yrs child

**Sanjay Gandhi National Park – Mumbai**

Leopards killed– 14 persons

## **2. POACHING:**

Killing / Hunting of animals is poaching.

**Types:**

*Subsistence Poaching*- killing animals for surviving.

*Commercial Poaching*- hunting animals for selling

**Factors influencing Poaching:**

***Human Population:*** increase in population increases pressure on forest resources.

***Commercial activities:*** Smuggling of wild life products for high profit.

***Wildlife products***=Furs, horns, tusk, live specimen, herbal products.

***Importers of wild life*** = Europe, North America, Japan, Taiwan, Hong Kong

**Examples:**

- Male gorilla for its body parts
- Blue morpho butterfly – making attractive trays
- Snowy large egret – used for white feather in ladies hat.US
- Elephant feet – for making Ash trays
- Elephant – for ivory
- Bengal tiger – soled for \$1,00,000 in foreign market
- Dynamite fishing – high tech fishing, exhaust marine life. Sea horses, Sea turtles

***Factors Influencing man-animal conflicts:***

1. Shrinking of forest compels wildlife to move outside the forest
2. Electric wiring around crops
3. Animals suffer pain and attack humans
4. Female wildlife attack human more to safe its cubs.
5. Forest dept. don't cultivate foods for wild
6. Cash compenstn by Govt – 400/- per quintal  
But market price 2400/-
7. Garbage near human settlement attract wild

***Remedial Measures for conservation of biodiversity:***

1. Make Available of Adequate food & water for wildlife, 2. Construction works in forest must be stopped.
3. Solar powered fencing must be used to prevent animals

Dr. E. Parthiban, AP/Chemistry,

## **9. ENDANGERED & ENDEMIC SPECIES OF INDIA (7 M or 2M)**

### **ENDANGERED SPECIES OF INDIA:**

A species is said to be endangered when its no has been reduced to a critical level. Unless it is protected it is in danger of extinction

#### **No of threatened species of India:**

|            |                |
|------------|----------------|
| Plants     | 250            |
| Birds      | 70             |
| Mammals    | 86             |
| Reptiles   | 25             |
| Amphibians | 3              |
| Fishes     | 3              |
| Molluscs   | 2, Insects -50 |

#### **Important Endangered Species:**

Reptiles → Tortoise, green sea turtle, gharial, python  
Birds → Peacock, Siberian white crane, pelican, Indian Bustard  
Mammals → Indian wolf, red fox, tiger, Indian lion, golden cat, desert cat.  
Primates → lion tailed monkey, capped monkey, golden monkey  
Plants → medicinal plants, sandal wood tree

**RED-data Book** = Data book which contains the list of endangered species of plants and animals.

#### **Factors affecting Endangered Species:**

- **Pollution:** Human disposal in nature. Travel through food chain and leads to death
- **Over-exploitation:** over usage of natural resources & poaching leads to extinct of wild life
- **Climate change:** ozone depletion, flood etc, threatens organisms and ecosystem

#### **Remedial Measures:**

- CITES – Convention on International Trade in Endangered Species is signed
- 2900 and other 900 endangered species are restricted for trade.

## **10. ENDEMIC SPECIES:**

- The species, which are found only in a particular region are known as endemic species.
- 62% of endemic species are found in Himalayas and Western Ghats

#### **Fauna:**

- Animals present in a particular region or period is Fauna. 62% amphibians & 50% lizards are endemic to Western Ghats. (ex) Monitor lizards, reticulated python, Indian salamander, viviparous toad.

#### **Flora:**

- Plants present in a particular region or period is Flora
- (ex) *Sapria himalayana*, *ovaria lurida*, pteridophyta, angiosperms etc.

#### **Factors affecting endemic species:**

Habitat loss, fragmentation, pollution

## 11. CONSERVATION OF BIODIVERSITY (13M)

**Definition :** The management of biosphere for the sustainable benefit to meet the needs of future generation.

### **Factors affecting biodiversity:**

- Human activities like construction of dams in forest, industrial wastes, using pesticides etc
- Poaching of wild animals, over exploitation of natural resources.
- Discharge of effluents disturbs the marine ecosystem
- The climatic factors-global warming, ozone depletion, acid rain affect the biodiversity

### **Advantages or Need of Biodiversity:**

- Recreation, tourism, Drugs, herbs, food, important raw materials, preserves plants & animals, hence leads to life supporting systems.

### **Types of Biodiversity:**

- In-situ conservation (within habitat)
- Ex-situ conservation (outside habitat)

### **IN-SITU CONSERVATION:**

Involves protection of fauna & flora within its natural habitat.

#### **1. Biosphere Reserves:**

- Covers area of more than 5000 sq. km.
- Protect species for long time

|                        |                       |
|------------------------|-----------------------|
| <b>(ex)</b> Nanda devi | U.P                   |
| Nokrek                 | Meghalaya             |
| Nilgiri                | Kerala, TN, Karnataka |
| Manas                  | Assam                 |
| Sunderbans             | West Bengal           |
| Gulf of Mannar         | TN                    |

#### ***Role of Biosphere reserves:***

- Protects endangered species
- Site of recreation & tourism
- Useful for education & research purpose
- Gives long term survival

#### ***Restriction:***

No tourism & explosives are permitted.

#### **3. Wildlife Sanctuaries:**

- ☐ Conserve animals & Birds only

#### **(examples)**

|                              |             |
|------------------------------|-------------|
| Mudumalai wildlife sanctuary | -TN         |
| Vedanthangal Bird sanctuary  | - TN        |
| Sultanpur Bird sanctuary     | - Haryana   |
| Ghana Bird sanctuary         | - Rajasthan |
| Wild Ass sanctuary           | -Gurajat    |

#### ***Role of wildlife Sanctuaries:***

Protects animals only  
Harvesting of timber,  
Collection of forest products

#### ***Methods of In-Situ conservation:***

|                     |     |
|---------------------|-----|
| Biosphere reserves  | – 7 |
| National Parks      | 80  |
| Willife sanctuaries | 420 |
| Gene sanctuaries    | 120 |

#### **2. National Park:**

- Covers area of about 100 to 500 sq.kms
- Conserves wildlife & environment

|                               |           |
|-------------------------------|-----------|
| <b>(ex)</b> Gir National Park | Gujarat   |
| Periyar                       | Kerala    |
| Dudwa                         | UP        |
| Sariska                       | Rajasthan |
| Ranthambore                   | Rajasthan |
| Kaziranga                     | Assam     |

#### ***Role of National Park:***

- For tourism without affecting environment
- Protect, propagate & develop wild life

#### ***Restrictions:***

#### **4. Gene Sancturay:**

- ☐ Conserve Plants

#### ***Examples:***

|                  |               |
|------------------|---------------|
| Citrus sanctuary | – North India |
| Pitcher plant    | -North India  |

#### **5. Other Projects for conservation of animals:**

#### ***Examples:***

Gir Lion Project, Crocodile Breeding Project,  
Project Elephant, Project Tiger etc.

#### **Merits of In-situ conservation:**

Very cheap & convenient method  
Species adjust to floods, drought, forest fires  
etc.

#### **Demerits**

Large area is needed, Maintenance is not proper due to  
pollution and lack of staff.

**Restrictions:**

Killing, hunting, shooting of wildlife is prohibited

**EX-SITU CONSERVATION:**

Involves protection of fauna & flora outside the natural habitats.

**Role of Ex-situ conservation:**

Maintenance of endangered plant & animal species under controlled conditions

Preserves more important species

**Methods of Ex-situ conservation:**

**1. NBPGR**

**National Bureau of Plant Genetic Resources** → uses cryo technique

Cryo Technique: Preservation of seeds, vegetables, fruits, crops, etc by using liquid nitrogen at  $-196^{\circ}\text{C}$

**2. NBAGR :**

**National Bureau of Animal Genetic Resources** → preserves semen of bovine animals

**3. NFPRCR:**

**National Facility for Plants Tissue Culture Repository** → preserves crops or trees by tissue culture

**Merits**

Survival / life span of species increase by special care

Species are assured for food, water, shelter etc

Endangered species are preserved

**Demerits:**

Expensive method

Freedom of wildlife is lost

Animal can't survive in natural environment

**India is a mega diversity nation? Account (2M)**

India is one among the 12 mega diversity countries in the world.

It has 7.31% of world faunal species & 10.8% of the world floral species. The loss of biodiversity is about 33%.

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## UNIT - 2 -ENVIRONMENTAL POLLUTION

### 1. AIR POLLUTION

The presence of one or more contaminants like dust, smoke, mist and odour in the atmosphere which are injurious to human beings, plants and animals.

#### *Sources of air pollution*

- Natural pollution - volcanic eruptions, forest fires, biological decay.
- Man – made activities – Thermal power plants, agricultural activities.

#### *Classification*

- *Primary pollutant* – these are those emitted directly in the atmosphere in harmful form like CO, NO.
- *Secondary pollutant* – these may react with one another or with the basic components of air to form new pollutants.

#### *Common air pollutants sources & their effects:*

| Substance                           | Nature  | Sources   | Health effects  | Environmental effects   |
|-------------------------------------|---|---|---|---|
| Carbon monoxide (CO)                | Colourless, odourless, poisonous gas. Formed during incomplete combustion of fuels $2C + O_2 \rightarrow 2CO$                       | Cigarette smoking, incomplete burning of fuels, motor vehicle exhaust           | Causes headaches, anemia, coma, irreversible brain cell damage & death    | Increases the globe temperature   |
| Nitrogen dioxide (NO <sub>2</sub> ) | Reddish-brown irritating gas & gives photochemical smog, Can be converted to nitric acid $NO_2 + \text{Moisture} \rightarrow HNO_3$ | Fuels burning in vehicles, industrial plants                                    | Lung irritation & damage  | HNO <sub>3</sub> acid deposition damage trees, soils, & aquatic life. It corrode metals, stones on buildings, statues, monuments etc. |
| Sulphur dioxide (SO <sub>2</sub> )  | Colourless, irritating gas. Formed by combustion of coal & oil. Can be converted to sulphuric acid in atmosphere                    | Burning of coal, industrial process   | Breathing problems  | Reduce visibility, acid deposition on trees, soils & aquatic life   |
| Suspended particulate matter (SPM)  | Includes variety of particles & droplets (aerosols).  | Burning coal in industries, diesel in vehicles, agriculture, unpaved roads, etc | Nose & throat irritation, lung damage, bronchitis, asthma, cancer         | Reduce visibility, acid deposition, H <sub>2</sub> SO <sub>4</sub> droplets damage trees, soils & aquatic life                        |
| Ozone (O <sub>3</sub> )             | Highly reactive irritating, unpleasant odour gas. A major component of photochemical smog.  | Nitrogen oxides, chemical reaction with volatile organic compounds              | -   | Moderates the climate   |
| Photochemical smog                  | Brownish smoke formed during automobile traffic   | Formed due to chemical reaction among nitrogen oxides & hydrocarbon             | Breathing problems, cough, eye, nose & throat irritation, heart diseases, | Damage plants & trees. Smog reduce visibility   |

## **Control Measures**

### **1. Source control**

- ⌘ Use only unleaded petrol
- ⌘ Use fuels that have low sulphur and ash content
- ⌘ Plant trees along busy streets because they remove particulates and carbon monoxide and absorb noise.
- ⌘ Industries and waste disposal sites should be situated outside the city centre.
- ⌘ Houses, schools, restaurants & park should not be located on busy street

### **2. Control measures in Industrial centers**

- ⌘ Emission rates should be restricted to permissible levels
- ⌘ Air pollution control equipments must be made mandatory
- ⌘ Continuous monitoring of the atmosphere to know the emission level

### **3. Equipments used to control air pollution:**

Mechanical devices such as scrubbers, cyclone separator, bag houses & electro-static precipitators, reducing particulate pollutants.

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## **2. WATER POLLUTION**

It may be defined as “the alteration in physical, chemical and biological characteristics of water which may cause harmful effects on human and aquatic life.

### **Types, effects and sources of water pollution**

#### **1. Infectious agents:**

**Example:** Bacteria, viruses, protozoa and parasitic worms.

**Sources:** Human and animal wastes.

**Effects:** Variety of diseases.

#### **2. Oxygen demanding wastes:**

**Example:** Animal manure and plant debris that can be decomposed by aerobic bacteria.

**Sources:** Sewage, paper mills, and food processing facilities.

**Effects:** Wastes can degrade quality by depleting water of dissolved oxygen, make aquatic life to die

#### **3. Inorganic Chemicals:**

**Example:** Water soluble inorganic chemicals. Compounds of toxic metals such as lead, arsenic and selenium. Salts such as NaCl in water.

**Sources:** Surface runoff, industrial effluents, household cleansers

**Effects:** skin cancers & neck damage  
Damage nervous system, liver & kidneys  
Lower crop yields, Harm fish & other aquatic life  
Accelerate corrosion of metals

#### **4. Organic Chemicals:**

**Examples:** Oil, gasoline, plastics, pesticides, cleaning solvents, detergents

**Sources:** Industrial effluents, household cleansers, runoff from farms

**Effects:** Causes nervous system damage, cancer, harm fish & wild life

### 5. Radio active materials:

**Example:** radioactive isotopes of iodine, radon, uranium, cesium, and thorium

**Sources:** Nuclear power plants, mining, nuclear weapons production.

**Effects;** genetic mutation, birth defects, and certain cancers.

### 6. Point and non-point sources of water pollution

**Point sources:** These are discharged pollutants at specific locations through pipes, ditches or sewers  
eg: factories, sewage treatment plants

**Non-point sources:** They are usually large areas or air shed that pollute water by runoff  
**Eg:** runoff of chemical from cropland to surface water.

### Control measures of water pollution

- The administration of water pollution should be in the hand of state or central government.
- Scientific techniques are needed to control pollution in river, ponds or streams.
- Industrial plants should be based on recycling operations.
- The national goal should be “conservation of forests” and campaign should be “plant more trees”.
- Highly qualified and effective persons should be consulted for effective control or water pollution.
- Awareness to public through radio, tv etc>
- Suitable laws, standards and practices should be framed to regulate pollution.
- Basic and applied research in public health engineering be encouraged.
- The possible of reuse or recycling of waste material should be encouraged.
- Companies should not discharge any type of waste either treated or untreated into rivers, lakes, ponds etc.

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## 3. SOIL POLLUTION

It may be defined as “the contamination of soil by human and natural activities which may cause harmful effects on living beings”.

### *Types*

#### 1. Industrial wastes

**Sources:** Pulp and paper mills, chemical industries, oil refineries, sugar factories, tanneries, textile, steel, fertilizers etc.

**Effects:** Affect and alter the chemical and biological properties of soil.

Hazardous chemicals enter into human food chain from the soil and finally lead to serious effects.

#### 2. Urban wastes

**Sources and effects:** Plastics, Glasses, metallic cans, fibers, papers, rubbers, street sweepings, and other discarded manufactured products. These are also dangerous.

#### 3. Agricultural practices

**Sources and effects:** Huge quantities of fertilizers, pesticides, herbicides, and weedicides are added to increase the crop yield. Apart from these farm wastes, manure, slurry, are reported to cause soil pollution.

#### **4. Radioactive pollutants**

**Sources and effects:** These are resulting from explosions of nuclear dust and radio active wastes penetrate the soil and accumulate there by creating land pollution.

#### **5. Biological agents**

**Sources and effects:** Soil gets large quantities of human, animal and birds excreta which constitute the major source of land pollution by biological agents.

***Control measures of soil pollution (give explanation for each topic on your own)***

- ┌ Population growth
  - ┌ Decrease of the available farm land due to urbanization
  - ┌ Forestry and farm practices
  - ┌ Proper dumping of unwanted materials
  - ┌ Production of natural fertilizers
  - ┌ Proper Hygienic condition
  - ┌ Public awareness
  - ┌ Recycling and Reuse of wastes
  - ┌ Ban on Toxic chemicals.
- 

#### **4. NOISE POLLUTION**

It may be defined as “the unwanted, unpleasant or disagreeable sound that causes discomfort for all living beings”. Sound intensity is measured in decibel (dB).

##### **Types of noise**

- ♣ Industrial noise (drilling sound, mechanical saws)
- ♣ Transport noise (bus, trucks, motors, scooters, rail traffic noise)
- ♣ Neighborhood noise (Musical instruments, TV, VCR, Radios, telephones, loudspeakers etc)

##### **Effects of Noise pollution**

- ┌ This affects human health, comfort and efficiency.
- ┌ It causes muscles to contract leading to nervous breakdown, tension.
- ┌ It affects health efficiency and behavior.
- ┌ loss of hearing due to excessive noise,
- ┌ Brain is also adversely affected by loud and sudden noise as that of jet and aero plane noise.
- ┌ Ultrasound can affect the digestive, respiratory, cardio vascular system.

##### **Control and preventing measures**

- ⊗ **Source control** – acoustic treatment to machine surface, design changes, limiting the operational timings.
- ⊗ **Transmission path intervention**- the source inside a sound insulating enclosure, construction of a noise barrier or provision of sound absorbing materials.
- ⊗ **Oiling** – Proper oiling will reduce the noise from the machines.
- ⊗ **Receptor control**: Protection of the receiver by altering the work schedule, by using ear plugs etc

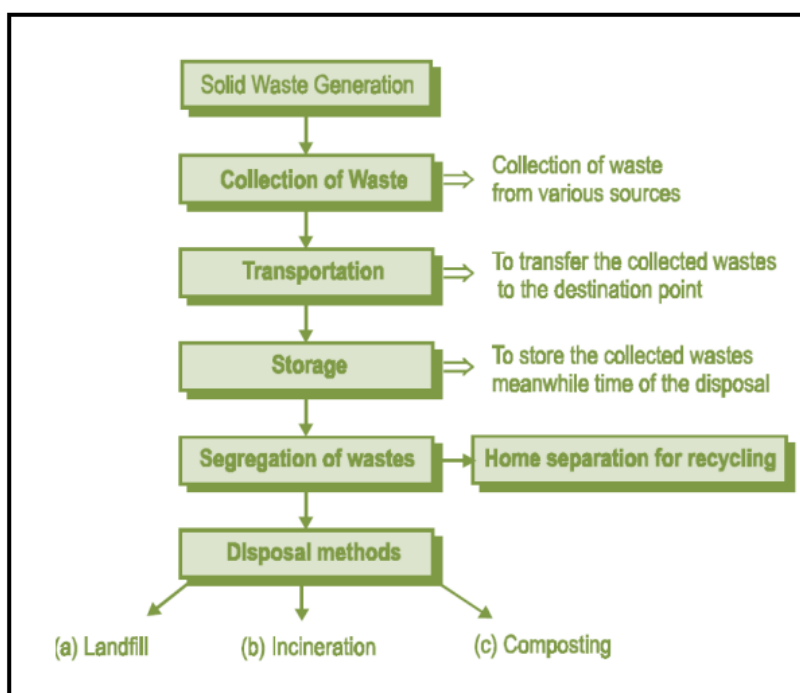
- ☞ *Planting trees also act as effective noise barriers*
- ☞ *Different absorptive materials can be used to control interior noise.*

## **5.PROCESS OF SOLID WASTE MANAGEMENT (13M)**

**Definition:** The process of collecting, treating and disposing of solid waste.

### **Types of solid waste:**

1. **Municipal waste:** including following wastes domestic waste (food waste, cloth, waste paper), Commercial waste (plastic, cans, bottle), construction waste and biomedical waste.
2. **Industrial waste:** Radioactive wastes, fly ash waste, hazardous and toxic materials, paint, dyes, acids, bases etc.



### **Steps Involved**

#### **I Reduce, Reuse, Recycling (3R)**

- a) **Reduce the usage of raw materials:** Usage of raw materials is reduced.
- b) **Reuse: refillable container which is discarded after using can be reused.**  
Throwing rubber ring from cycle tubes can be used again in the manufacture of rubber bands.
- c) **Recycling:** recycling of discarded materials into new products.  
Eg:
  - i) Preparation of new cans and bottles from old aluminum cans and glass bottles.
  - ii) Preparation of fuel pellets from kitchen waste.

#### **II Discarding wastes:**

**Methods:** a) Land fill b) Incineration c) Composting

##### **a) Land fill:**

- ☐ Solid wastes are placed in sanitary landfill system in alternate layers of 80 cm thickness of refuse

- ☐ Covered with selected earth fill of 20 cm thickness
- ☐ After 2- or 3-days solid wastes volume shrinks by 25-30%
- ☐ Then the land is used for parks, roads, small buildings etc.

|  |  |
|--|--|
| <b>Advantages:</b> <ul style="list-style-type: none"> <li>▪ Simple and economical</li> <li>▪ Segregation is not required</li> <li>▪ Landfill areas can be used for other purposes Natural resources are retained to the soil.</li> </ul> | <b>Disadvantages:</b> <ul style="list-style-type: none"> <li>▪ Large area is required</li> <li>▪ Transportations cost is heavy.</li> <li>▪ Bad odors, if landfill is not properly managed Insecticides, pesticides should be applied at regular intervals</li> <li>▪ Causes of fire hazards due to formation of methane</li> </ul> |
|--|--|

#### b) Incineration (or) Thermal process:

- ☐ In this method combustible substances (rubbish, garbage, dead organisms) & non-combustible substances (glass, porcelain, metals) are separated first.
- ☐ The combustible waste substances are first dried in a preheater
- ☐ Then it is taken in a large incinerating furnace which incinerate about 100 to 150 tonnes per hour
- ☐ The temperature is maintained between 700°C to 1000°C
- ☐ The left-out ashes & clinkers from the furnace is further disposed by landfill method
- ☐ The heat produced in the incinerator is used for generating electricity through turbines
- ☐ The non-combustible substances are left out for recycling & reuse.

|  |  |
|--|--|
| <b>Advantages:</b> <ul style="list-style-type: none"> <li>▪ Require little space</li> <li>▪ Cost of transportation is not high</li> <li>▪ Safest and hygienic</li> <li>▪ Capacity 300 tonnes per day and can generate 3MW of power.</li> </ul> | <b>Disadvantages:</b> <ul style="list-style-type: none"> <li>▪ Capital and operating cost is high</li> <li>▪ Need skilled persons</li> <li>▪ Formation of smokes, dusts, and ashes.</li> </ul> |
|--|--|

#### c) Composting:

In this method the bulk organic waste is converted into fertilizer by biological action

- ☐ The separated compostable waste is dumped in underground trenches(1.5m)
- ☐ Covered with earth of 20 cm and left over for decomposition
- ☐ Microorganism (actinomyces) is introduced to start decomposition.
- ☐ After 2 or 3 days the organic waste is destroyed microorganism and produce heat
- ☐ Composting will happen at 75°C
- ☐ Finally, the refuse can convert to powdery brown coloured odourless mass called Humus(fertilizer).
- ☐ It contains lots of nitrogen, plants growth phosphates and other minerals.

|   |  |
|---|--|
| <b>Advantages:</b> <ul style="list-style-type: none"> <li>▪ Increase of water retention and ion exchange character of soil</li> <li>▪ Number of industrial wastes can also be treated by this method</li> </ul> | <b>Disadvantages:</b> <ul style="list-style-type: none"> <li>▪ Non-combustible have to disposed separately</li> <li>▪ No assured market</li> </ul> |
|---|--|

### **6. What is BOD and COD (2M)**

**Biochemical Oxygen Demand (BOD)** = It is the amount of oxygen required for the biological decomposition of organic matter present in the water

**Chemical Oxygen Demand (COD)** = It is the amount of oxygen required for chemical oxidation of organic matter using oxidizing agent like  $K_2Cr_2O_7$  &  $KMnO_4$

### **7. ENVIRONMENTAL PROTECTION ACTS (7 M)**

#### **Environment Act 1986:**

It is a general legislation law to rectify the gaps & laps in above acts.

This act empowers the Central Govt. to fix the standard of quality of air, water, soil & noise.

**Objectives:**

To protect & improvement of the environment

To prevent hazards to all living creatures & property

To maintain peaceful relationship between humans & their environment

**Important Features of Environment Act:**

Empowers safeguard measures to Prevent accidents which cause pollution. Gives remedial measures if accident occurs.

The Govt. has authority to close or prohibit or regulate any industry & its operation One who violates the act will be punishable with fine upto one lakh

If the violation continues, an additional fine of Rs. 5000/- per day is imposed

The act empowers the officers of Central Government to inspect the site / plant / machinery for preventing pollution. Collects samples of air, water, soil or other material from any factory.

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**WATER ACT 1974:**

This act provides for maintaining & restoring the source of water Provides for preventing & controlling water pollution.

**Objectives:**

- ☐ To protect water from all kinds of pollution
- ☐ To preserve the quality of water
- ☐ Establishment of Central & State Boards for preventing water pollution
- ☐ Restrain any person for discharging sewage/effluent into any water body
- ☐ Any contravention of the standards leads to prison for 3 to 6 months
- ☐ Requires permission to set up an industry which discharges effluent.

**State pollution Control Board:**

- ☐ Take step to establish any industry, disposal system, extension/addition in industry, discharge of effluent into river
- ☐ Use any new / altered outlet for discharge of sewage
- ☐ Begin to make any new discharge of sewage.

**Punishment:**

Stoppage of supply of electricity, water / any other services Imprisonment for 1½ years to 6 years & Rs.

5000/- fine.

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**AIR ACT 1981:**

Enacted in the Conference held at Stockholm in 1972.

Deals with problems related to air pollution, quality of air etc.

**Objectives of air act:**

To prevent, control & abatement of air pollution To maintain the quality of air

**Important features of air pollution:**

- ☐ The Central Board settle disputes between state boards, provide technical assistance & guidance to State board.

- ☐ The State Board verify the emissions of air pollutants from industrial / automobile units
- ☐ The State Board Collect information about air pollution
- ☐ SB examine the standards of manufacturing process & control equipment
- ☐ SB can advise State Government to declare the heavily polluted areas & advice to avoid burning of waste products.
- ☐ Operation of industrial unit is prohibited in a heavily polluted areas
- ☐ Violation of law is punishable with imprisonment & Fine

### **FOREST ACT 1980:**

Provides conservation of forests & related aspects. Arrest deforestation

#### ***Objectives:***

To protect & conserve the forest  
To ensure judicious use of forest products

#### ***Important Features of Forest Act:***

Forests are not diverted without the prior permission of the Central Government Land registered for forest may not be used for non-forest purposes

Any illegal activity in a forest area can be stopped immediately Clearance of forest land for re-afforestation is forbidden

One who violates the forest law is punishable.

### **Wildlife Act 1972:**

Aimed protect & preserve wildlife. Wildlife refers to all animals & plants

It is declining due to human actions for wildlife's skins, furs, feathers, ivory etc.

#### ***Objectives:***

To maintain ecological process & life supporting system To preserve biodiversity  
To ensure a continuous use of species.

#### ***Important Features:***

Covers the right & non-rights of forest dwellers  
Provides restricted grazing in sanctuaries & prohibits in national parks Prohibits the collection of non-timber forest.



## UNIT - 3 -RENEWABLE SOURCES OF ENERGY

### 1. NEW ENERGY RESOURCES (13 M)

#### **Renewable Energy Resources:**

**Definition:** They are natural resources which can be regenerated continuously

**Examples:** *Solar energy* = Solar cells, Solar heat collectors, Solar water heater

*Wind energy* = Wind mills, Wind farms

*Ocean energy* = Tidal energy, Ocean Thermal energy, Geothermal energy

*Biomass energy* = Biogas, Bio fuel, Hydrogen fuel

#### **SOLAR ENERGY:**

The Energy that we get directly from the sun is called solar energy

#### **Methods of Harvesting Solar Energy**

##### 1. Solar cells (or) photovoltaic cells (or) PV cells

- Solar cells consist of a p-type semiconductor and n-type semi-conductor
- They are in close contact with each other.
- When the solar rays fall on the top layer of p-type semi-conductor, the electrons from the valence band get promoted to the conduction band and cross the p-n junction into n-type semi-conductor.
- Thus potential difference produced between two layers causes flow of electrons (ie.,an electric current)

#### **Uses**

Used in calculators, electronic watches. Street lights, water pumps to run radios and TVs.

#### **Solar Battery**

- Large number of solar cells is connected in series to form a solar battery.
- Solar battery produce more electricity which is enough to run water pump, to run street-light, etc.,

##### 2. Solar heat collectors

- Solar heat collectors consist of natural materials like stones, bricks, (or) materials like glass.
- They can absorb heat during the day time and release it slowly at night.

#### **Uses**

Used in cold places, where houses are kept in hot condition using solar heat collectors.

##### 3. Solar water heater

It consists of

- ⌘ An insulated box inside of which is painted with black paint.
- ⌘ Provided with a glass lid to receive and store solar heat.
- ⌘ Inside the box it has black painted copper coil, which heats the cold water.
- ⌘ Then flows out into a storage tank.
- ⌘ From the storage tank water is then supplied through pipes.

### **Significance of Solar energy:**

- They are noise & pollution free
- Solar water heaters, cookers require no fuels
- Solar cells can be used in remote & isolated forest & hilly regions.

## **WIND ENERGY**

### ***Definition***

Moving air is called wind.

- } Energy recovered from the force of the wind is called wind energy.
- } The energy possessed by wind is because of its high speed.
- } The wind energy is harnessed by making use of wind mills.

### **Methods of Harvesting wind energy**

#### **1. Wind Mills**

- ☐ The strike of wind on the blades of the wind mill rotates it continuously.
- ☐ The rotational motion of the blade drives machines like water pump, flour mills, electric generators etc.

#### **2. Wind farms**

- ☐ Wind farm consists of large number of wind mills .
- ☐ The wind farms produce a large amount of electricity.

### **Conditions**

The minimum speed required for satisfactory working of a wind generator is 15 km/hr.

### **Advantages**

- It does not cause any air pollution
- It is very cheap.

## **OCEAN ENERGY**

It can be generated by following ways.

### **1. Tidal energy (or) Tidal power**

Ocean tides, produced by gravitational forces of sun and moon, contain enormous amount of energy.

- ☐ The “high tide” and “low tide” refer to the rise and fall of water in the oceans.
- ☐ The tidal energy can be harnessed by constructing a tidal barrage.
- ☐ During high tide, the sea-water which flow into the reservoir of the barrage, rotates the turbine, which in turn produces electricity by rotating the generators

### ***Significance of tidal energy:***

- Do not require large areas
- Pollution free energy source
- No fuel is used & does not produce any wastes.

### **2. Ocean thermal energy (OTE)**

- ◆ The temperature difference between the surface level & deeper level of the oceans are used to generate

electricity.

- ♦ The energy available due to the difference in temperature of water is called ocean thermal energy.

### **Condition**

The temperature difference should be of  $20^{\circ}\text{C}$  or more between surface water and deeper water.

### **Process**

- The warm surface water of ocean is used to boil a low boiling liquid like ammonia.
- The high vapour pressure thus produced turns the turbine of the generator and generates electricity.

**Significance:** OTE is Continuous, renewable, pollution free, used to produce  $\text{H}_2$ ,

## **2. ENERGY CONSERVATION (13 M)**

**Definition:** The practice of using less energy in order to lower the costs and reduce environmental impact.

**Objectives of energy conservation:** Energy conservation is the key element. The main objectives are

- ♦ To reduce overall energy demand.
- ♦ To lower energy cost
- ♦ To lower the overall greenhouse gas emission.

### **Principle (or) Law of conservation of energy:**

The principle of energy of conservation states that energy can neither be created nor destroyed but it can be transformed from one type to another.

### **15 ways to conserve energy (or) conservation**

There are 15 ways to start conserving energy

#### **1. Adjust your day-to-day behaviors**

Switch off lights (or) appliances when you do not need them

#### **2. Replace your light bulbs**

Traditional incandescent light bulbs consume more amount of electricity and must be replaced by energy efficient alternatives like CFL and LED bulbs.

#### **3. Use smart power strips**

"Phantom loads" (or) the electricity used by electronics, when they are turned off (or) standby mode, are the major source of energy waste.

#### **4. Install a programmable (or) smart thermostat**

It automatically turn-off (or) reduces heating and cooling during the time when you are asleep (or) away.

#### **5. Purchase energy efficient appliances**

These will consume less energy during use.

#### **6. Reduce your water heating expenses**

Efficient water heaters can be 8% to 300% more energy efficient than a conventional storage

water heater.

**7. Install energy efficient windows**

To prevent heat loss through your windows, (you can replace single-pane windows with double-pane windows.

**8. Upgrade your HVAC system**

Most energy efficient way to upgrade your home's HVAC system is installing air source heat pump.

**9. Weatherize your home**

Air leaks into your home are windows, doors and vents.

**10. Insulate your home**

Insulation retains heat during the winter and keeping heat out of our home during summer.

11. Wash your clothes in cold water.
12. Replacing dirty air filters regularly can reduce energy consumption upto 15%.
13. As microwave is more energy efficient, microwave oven can be used instead of ordinary stove.
14. Using natural light, like sun, we can reduce the energy consumption.
15. Dress appropriately for the weather inside and outside.

### **3. APPLICATIONS OF HYDROGEN ENERGY (7 M)**

1. Hydrogen is a reagent, used in many industries, including chemicals, textile fiber manufacturing, glass, electronics and metallurgy.
2. It is also used as a fuel for rocket launchers.
3. In electronics, hydrogen is used as a carrier gas, for the manufacture of electronic components.
4. Hydrogen is used in industries for many applications.

#### **(i) Stationary power sources.**

- (a) These are used to power office buildings, data centers, grocery stores and off-grid telecommunication towers.
- b) It is used as a part of uninterruptible power supply (UPS) system, where continuous uptime is critical.

#### **(ii) Hydrogen fuel cell vehicles (FCVs)**

- a) The heat produced by the hydrogen fuel cell can be used for space and water heating (or) industrial process.
- b) Hydrogen fuel cells power clean trucks, fork lifts, etc.
- c) Hydrogen fuel cell trains have now appeared.

### **Advantages hydrogen fuel cells**

- 1) Hydrogen is readily available.
- 2) It does not produce harmful emissions.
- 3) It is environmentally friendly. It can be used as fuel in rocket.
- 4) It is renewable.

### **Disadvantages hydrogen fuel cells**

- ◆ It is expensive.
- ◆ It is difficult to store.
- ◆ It is highly inflammable.

### **4. GEOTHERMAL POWER PLANT (GTE) (13 M)**

#### **Geothermal Power**

It is the electrical power generated from geothermal energy.

#### **Geothermal Energy**

It is the heat produced deep in the earth's core

#### **Origin**

Geothermal energy is the thermal energy found in the earth's crust which originates from the formation of the planet and from radioactive decay of materials.

#### **Concept**

Geothermal technology extracts the heat found within the subsurface of the earth, which can be used directly for heating and cooling (or) converting it to electricity.

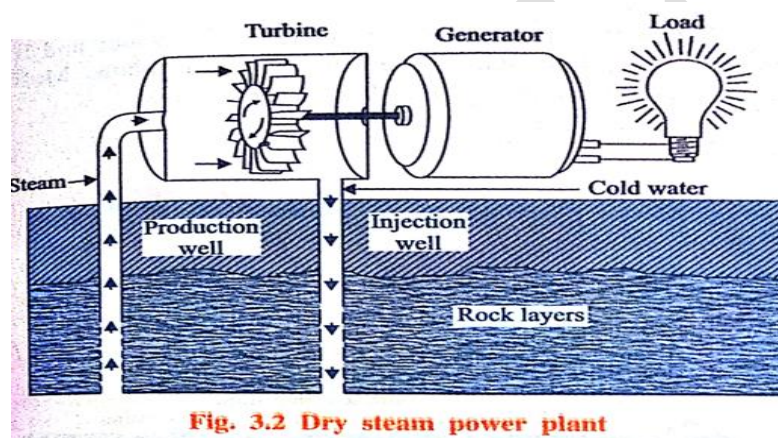
### **Power plants of GTE**

Geothermal power plant uses hydrothermal resources that have both water (hydro) and heat (thermal). Geothermal power plants requires high temperature (300°F to 700°F) hydrothermal resources that come from either dry steam wells (or) from hot water wells.

### **Types of geothermal power plants**

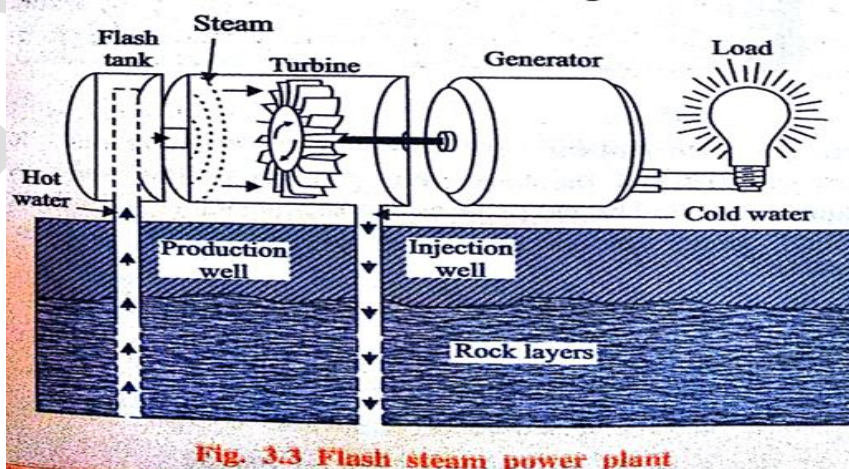
#### **1. Dry steam power plant**

- ❖ It uses steam directly from a geothermal reservoir to drive generator's turbines.



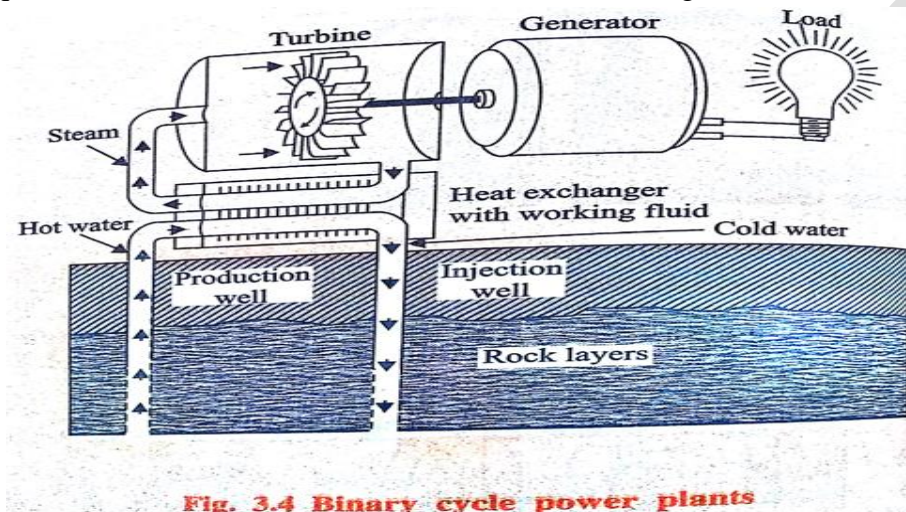
#### **2. Flash steam power plant**

- ❖ It takes high-pressure hot water from deep inside the earth and converts it into steam to drive generator's turbine.
- ❖ When the steam cools, it condenses to water and is injected back into the ground to be used again. Most geothermal power plants are flash steam plants.



### 3. Binary cycle power plants

- ❖ It transfers the heat from geothermal hot water to another liquid. The heat causes the second liquid to convert it into steam, which is used to drive a generator's turbine.



#### Advantages and disadvantages of GTE

##### Advantages

1. GTE is environmentally friendly.
2. GTE is a source of renewable energy.

##### Disadvantages

- 1) Location is restricted.
- 2) May cause earthquakes.

##### Applications of GTE

1. GTE is used for space heating and cooling
2. GTE is used to generate electricity.

## **UNIT - 4 -SUSTAINABILITY AND MANAGEMENT**

### **1. MILLENNIUM DEVELOPMENT GOALS (6 M)**

The Millennium Development Goals (MDGs) were 8 international development goals.

To eradicate extreme poverty and hunger.

To achieve universal primary education.

To promote gender equality and empower women.

To reduce child mortality.

To improve maternal health.

To combat HIV/AIDS, malaria, and other diseases

To ensure environmental sustainability.

To develop a global partnership for development

### **2. SUSTAINABILITY PROTOCOLS**

Sustainability protocols are sustainability des and certifications. These are voluntary guidelines used by producers, manufacturers, traders, retailers and service providers to demonstrate their commitment to good environmental, social, ethical and food safety practices.

There are over 400 such standards across the world. The sustainability protocols listed below are important because they build awareness and policy support, create der guideline and goals. They have third-party verification and maintain consistency within a portfolio while developing Green economy.

#### **Few sustainability protocols**

1. LEED
2. WELL
3. Fitwel
4. Living building challenge
5. BREAM
6. Passive house
7. National Green Building Standard
8. Built green
9. Introduction of eco-labels and standards for organic food and other food products.
10. Triple bottom line, it includes a set of practices (or) criteria for how a crop should be sustainably



grown for) a resource should be ethically harvested.

### **3. CARBON FOOTPRINT (7 M)**

#### **Definition**

It is the total amount of greenhouse gases (including CO<sub>2</sub>, and CH<sub>4</sub>) that are generated (emitted) by our direct and indirect activities.

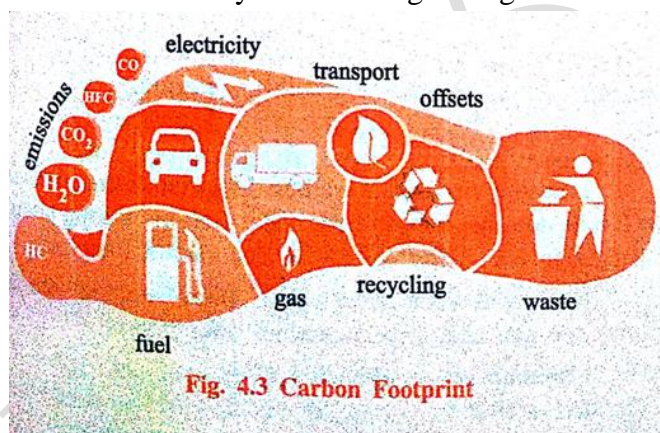
#### **Individual carbon footprint**

Smaller your carbon footprint: better for the future

Bigger your carbon footprint: Have bigger negative impact on environment.

#### **Sources of carbon footprint**

- 1) Climate change. Natural process like volcanos.
- 2) Greenhouse gases emitted from human activities.
- 3) Pollution released by human beings doing human things.



**Fig. 4.3 Carbon Footprint**

#### **Causes of a carbon footprint**

The major contributors to carbon footprints are

- (i) food: (especially meat (beef))
- (ii) consumption

#### **How to lower (control) carbon footprint (or) 15 ways to reduce your carbon footprint**

- 1) Travel smart
- 2) consider solar panels
- 3) Don't waste water
- 4) Eat less meat
- 5) Start a home garden.

#### **4. ENVIRONMENTAL MANAGEMENT (13 M)**

Environmental management is a set of practices and processes that enable any organization, whether private (or) public, to reduce its environmental impacts and increasing its operating efficiency.

##### **Objective (or) Aim of EM**

- 1) To establish limits and standards
2. To protect environmental resources.
3. To enhance the value of environmental components where possible.
4. To prevent and solve environmental problems.

##### **Principles of environmental Management**

There are 7 basic principles, which are some guiding principles of environmental management. These principles are helpful in environmental decision making

##### **The precautionary principle**

It states that a substance (or) activity, posing a threat to the environment, is prevented from adversely affecting the environment.

##### **1. Principle of effectiveness and efficiency**

The efficiency of resource use may be accomplished by the use of policy instruments that create incentive minimize wasteful use.

##### **2. The principle of responsibility**

It is the responsibility of all person, to use the environmental resources in an ecological sustainable, economically efficient and socially fair manner.

##### **3. The principle of participation**

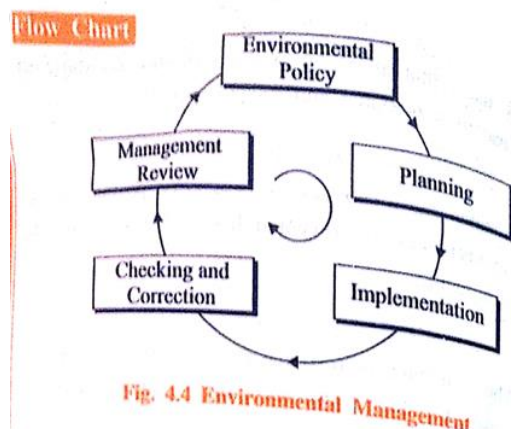
It is the duty of all the persons to participate in collectively environmental decision-making activities.

##### **4. The principle of proportionality**

It is based on the concept of balance. A balance is to maintain between the economic development on the one hand and environmental protection on the other hand.

##### **Steps involved in environmental management**

The following 5 steps are involved in environmental management.



##### **Step 1: Environmental policy**

It is the mission of an organization, which starts with establishing an environmental policy.

### **Step 2: Planning**

It involves identifying the resources, processes, significant impacts and pollution prevention opportunities. It also includes objectives and targets for improvement efforts.

### **Step 3: Implementation**

This step consists of defining the structure, responsibilities and programs. It also develops and implements standard operating procedures and training.

### **Step 4: Checking and correction**

It includes monitoring and measuring problems identification and corrective and preventive action implementation.

Benefits of Environmental

### **Benefits of Environmental Management**

- 1) Improved environmental performance
- 2) Enhanced compliance
- 3 Pollution prevention

## **UNIT - 5 -SUSTAINABILITY PRACTICES**

### **1. R CONCEPT (OR) 3R CONCEPT (REDUCE, REUSE AND RECYCLE) (13 M)**

#### **Definition**

The principle of reducing waste, reusing and recycling resources and products is often called 3Rs.



#### **Reduce**

Reducing means choosing to use things with care to reduce the amount of waste generated.

#### **Reuse**

Reusing involves the repeated use of items (or) parts of items which still have usable aspects.

- (a) The refillable containers, which are discarded after use, can be reused.
- (b) Rubber rings can be made from the discarded cycle tubes, which reduces the waste generation during manufacturing of rubber bands.

#### **Recycle**

- ❖ Recycling means the use of waste itself as the resources.
- ❖ It involves reprocessing of the discarded materials into new useful products.

#### **Examples**

- ❖ Old aluminum cans and glass bottles are melted and recast into new cans and bottles. (i Preparation of cellulose insulation from paper.

#### **Concept of 3R**

The concepts of 3R refers to reduce, reuse and recycle, particularly in the topic of production and consumption.

#### **Principle**

3R is the order of priority of actions to be taken to reduce the amount of waste generated and to improve overall waste management processes and programs.

#### **Importance of 3 Rs**

- ❖ The most effective way to reduce the garbage is reducing the amount of solid waste produced.
- ❖ By reducing waste at the source, the resources like water and energy can be saved.
- ❖ Like reducing, reusing avoids creating waste rather than trying to recycle it once it's already there.

#### **Advantages of 3 Rs (or) Benefits of 3 Rs**

- ❖ Reduce greenhouse gas emissions.
- ❖ Saves en.

### **Disadvantages of 3 Rs**

- 1) 3R generates pollutants.
- 2) Processing cost is high.

## **2. ENVIRONMENTAL IMPACT ASSESSMENT (EIA) (7 M)**

EIA is defined as a formal process of predicting the environmental consequences of any development projects. It is used to identify the environmental, social and economic impacts of the project prior to decision making.

### **Purpose (or) Aim of EIA**

The main purpose of EIA is to determine the potential environmental, social and health effects of a proposed developmental projects.

### **Objectives of EIA**

1. To identify the main issues and problem of the parties.
2. To identify who is the party.

### **Benefits of EIA**

1. Cost and time of the project is reduced.
2. Performance of the project is improved.

### **Process of EIA (or) Key Elements of EIA**

The key elements used in the process of EIA are

- 1) Scoping
- 2) Screening
- 3) Identifying and evaluating alternatives
- 4) Mitigating measures dealing with uncertainty
- 5) Issuing environmental statements

### **Scoping**

- It is used to identify the key issues of the concern in the planning process at an early stage. It is also used to aid site selection and identify any possible alternatives.

### **Screening**

- It is used to decide whether an EIA is required (or) not based on the information collected.

### **Identifying and evaluating alternatives**

- It involves knowing alternative sites and alternative techniques and their impacts.

### **Mitigating measures dealing with uncertainty**

- It reviews the action taken to prevent (or) minimize the adverse effects of a project.

### **Environmental statements**

- This is the final stage of the EIA process. It reports the findings of the EIA.

## **3. GREEN MATERIALS (7 M)**

Green materials also called eco-friendly materials, building construction materials that have low impact on the environment.

### **Criteria for green materials**

Following criteria can be used to identify the green materials.

- i) Local availability of materials.
- (ii) Embodied energy of materials.

### **Characteristics of green materials**

Common characteristics of green materials are

- Green materials are energy efficient products, it uses less energy to do the same task.
- It lowers energy cost and lessens pollution.
- 3. Green materials are mostly renewable, can be regenerated again and again.

**Example** Bamboo grows quickly while pine grows more slowly, but both are renewable.

### **Important green building materials**

Green building is construction that primarily uses natural materials and renewable resources. These structures look really cool.

- ❖ Stone: It is low maintenance and durable.
- ❖ Cob: (mud mixture of natural ingredients like soil, sand, straw and lime). It is cheap and energy efficient.
- ❖ Bamboo: It is durable and light weight.
- ❖ Cork: (Cork comes from oak trees). It is a very good thermal insulator and mold resistant
- ❖ Adobe brick: (brick made of clay and straw). Natural noise protection and possesses unique design (can be easily cut and transformed).
- ❖ Straw bale: Easily renewable and cheap.

### **Examples of green materials**

- (1) Bamboo floorings.
- (ii) LED lightings.
- ii) Reclaimed wood.
- (iii) Energy efficient appliances.

### **4. CARBON CYCLE (7 M)**

#### **Definition**

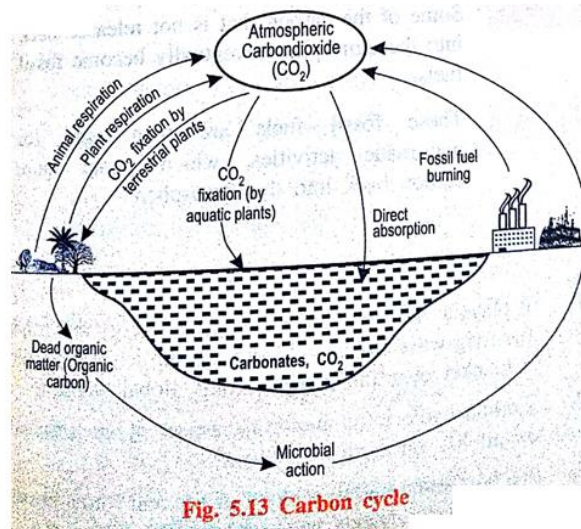
Carbon cycle is the movement of carbon (or) carbon compounds continuously from the atmosphere to the earth and then back into the atmosphere.

#### **Sources of CO<sub>2</sub> in atmosphere**

- 1) During respiration, plants and animals liberate CO<sub>2</sub> in the atmosphere.
- 2) Combustion of fuels also releases CO<sub>2</sub>
- 3. Volcanic eruptions also release CO<sub>2</sub>.

#### **Various steps involved in carbon cycle**

Carbon cycle involves the following 5 important steps.



**Step1:** Carbon present in the atmosphere is absorbed by plants by the processes photosynthesis, which involves the absorption of CO by plants to produce carbohydrates (producen)



**Step 2:** These plants are then consumed by animals and carbon gets bioaccumulated into their bodies (consumers).

**Step 3:** These animals and plants eventually die and decomposers eat the dead organism and return the carbon from their body back into the atmosphere (decomposers)



**Step 4:** Some of the carbon that is not released back into the atmosphere eventually become fossil fuels.

**Step 5:** These fossil fuels are then used for man-made activities, which pump more carbon back into the atmosphere.

### **Importance (or) benefits of carbon cycle**

1. It plays a vital role in balancing the energy and traps the long-wave radiations from the sun ie., it acts like a blanket over the planet, avoids global warming.

## **5. GREEN ENGINEERING (13 M)**

### **Definition**

Green engineering is the design, commercialization and use of processes and products that minimizes pollution, promotes sustainability and promotes human health without affecting environment.

### **Examples for green engineering**

1. Biodegradable cups and straws.
2. Enhanced industrial emission filters.

### **Goal of green engineering**

1. Decrease in the amount of pollution that is generated by a construction.

2. Minimization of human population exposure to potential hazards (reducing toxicity).

### **Principles of green engineering**

1. All materials and energy inputs and outputs are inherently non-hazardous as possible
2. It is better to prevent waste than to treat (or) clean up waste after it is formed.
3. Separation and purification operations should be designed to minimize energy consumption and material use.
4. Products, processes and systems must be designed to maximize mass, energy, space and time efficiency.
5. Products, processes and system should be "output pulled" rather than "input pushed" through the use of energy and materials.

### **Benefits of green engineering**

1. This process enhances business practices by eliminating improper production methods.
2. It improves a company's reputation by showing consumers it cares about the environment.
3. It minimizes energy (or) production waste.

### **Limitations (or) disadvantages of green engineering**

1. R & D costs, production and implementation costs are high.
2. Implementation will take many years.
3. Green technology is still quite immature.

## **6. NON-CONVENTIONAL SOURCES OR RENEWABLE ENERGY SOURCES (13 M)**

### **Renewable Energy Resources:**

**Definition:** They are natural resources which can be regenerated continuously

**Examples:** *Solar energy* = Solar cells, Solar heat collectors, Solar water heater

*Wind energy* = Wind mills, Wind farms

*Ocean energy* = Tidal energy, Ocean Thermal energy, Geothermal energy

*Biomass energy* = Biogas, Bio fuel, Hydrogen fuel

### **SOLAR ENERGY:**

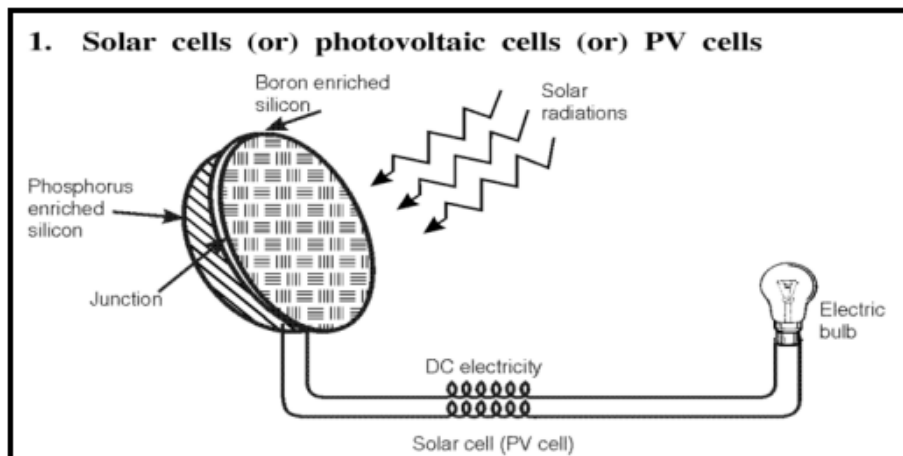
The Energy that we get directly from the sun is called solar energy

#### **Methods of Harvesting Solar Energy**

#### **Solar cells (or) photovoltaic cells (or) PV cells**

- Solar cells consist of a p-type semiconductor and n-type semi-conductor
- They are in close contact with each other.
- When the solar rays fall on the top layer of p-type semi-conductor, the electrons from the valence band get promoted to the conduction band and cross the p-n junction into n-type semi-conductor.
- Thus potential difference produced between two layers causes flow of electrons (ie., an electric current)



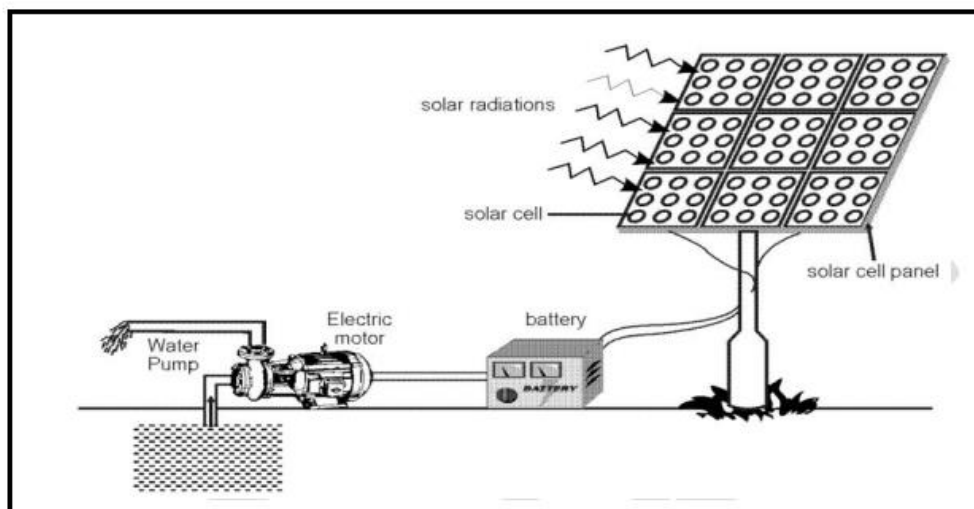


### Uses

Used in calculators, electronic watches. Street lights, water pumps to run radios and TVs.

### Solar Battery

- Large number of solar cells is connected in series to form a solar battery.
- Solar battery produce more electricity which is enough to run water pump, to run street-light, etc.,



### Solar heat collectors

- Solar heat collectors consist of natural materials like stones, bricks, (or) materials like glass.
- They can absorb heat during the day time and release it slowly at night.

### Uses

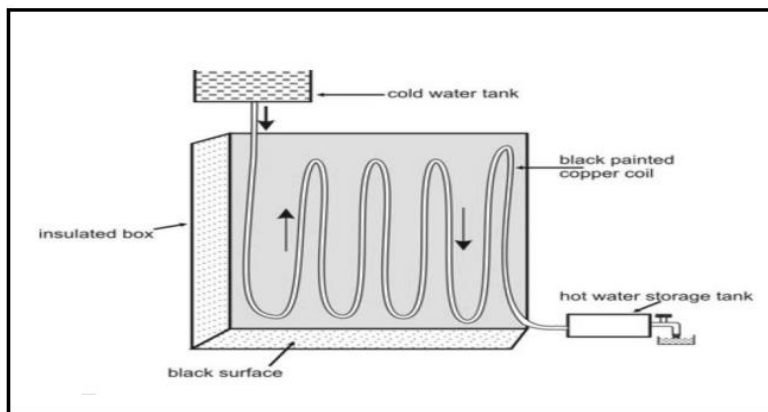
Used in cold places, where houses are kept in hot condition using solar heat collectors.

### Solar water heater

It consists of

- ☞ An insulated box inside of which is painted with black paint.
- ☞ Provided with a glass lid to receive and store solar heat.
- ☞ Inside the box it has black painted copper coil, which heats the cold water.
- ☞ Then flows out into a storage tank.

☞ From the storage tank water is then supplied through pipes.



### Significance of Solar energy:

They are noise & pollution free

Solar water heaters, cookers require no fuels

Solar cells can be used in remote & isolated forest & hilly regions.

## WIND ENERGY

### Definition

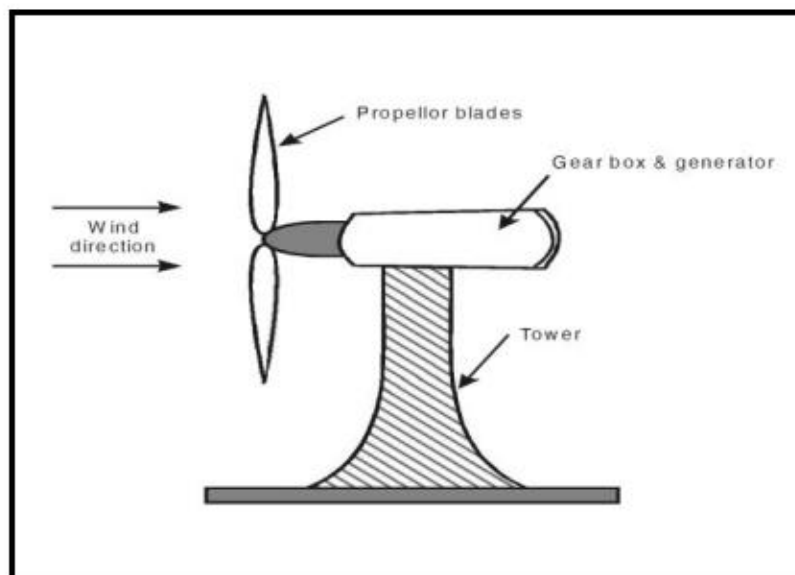
Moving air is called wind.

- ┌ Energy recovered from the force of the wind is called wind energy.
- ┌ The energy possessed by wind is because of its high speed.
- ┌ The wind energy is harnessed by making use of wind mills.

### Methods of Harvesting wind energy

#### Wind Mills

- ☐ The strike of wind on the blades of the wind mill rotates it continuously.
- ☐ The rotational motion of the blade drives machines like water pump, flour mills, electric generators etc.



#### Wind farms

- Wind farm consists of large number of wind mills .
- The wind farms produce a large amount of electricity.

### **Conditions**

The minimum speed required for satisfactory working of a wind generator is 15 km/hr.

### **Advantages**

It does not cause any air pollution  
It is very cheap.

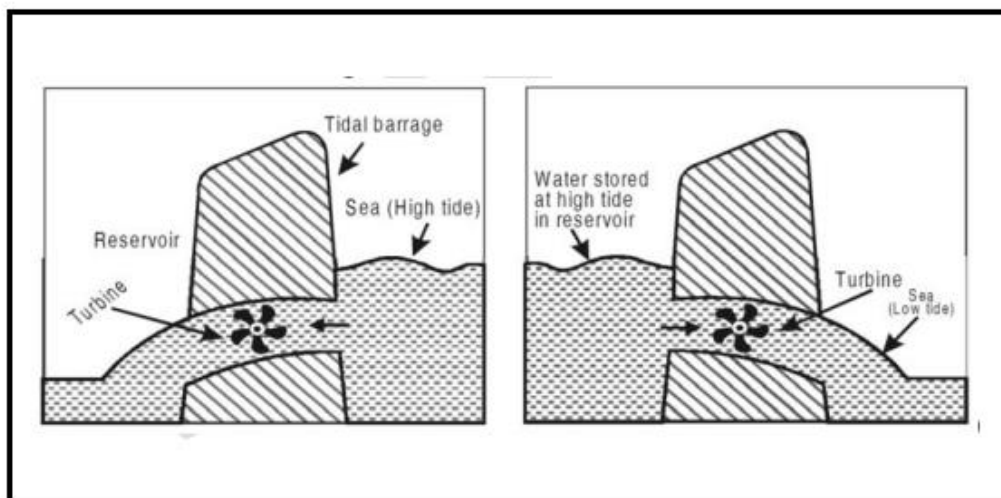
## **OCEAN ENERGY**

It can be generated by following ways.

### **Tidal energy (or) Tidal power**

Ocean tides, produced by gravitational forces of sun and moon, contain enormous amount of energy.

- The “high tide” and “low tide” refer to the rise and fall of water in the oceans.
- The tidal energy can be harnessed by constructing a tidal barrage.
- During high tide, the sea-water which flow into the reservoir of the barrage, rotates the turbine, which in turn produces electricity by rotating the generators



### ***Significance of tidal energy:***

Do not require large areas  
Pollution free energy source  
No fuel is used & does not produce any wastes.

## **OCEAN THERMAL ENERGY (OTE)**

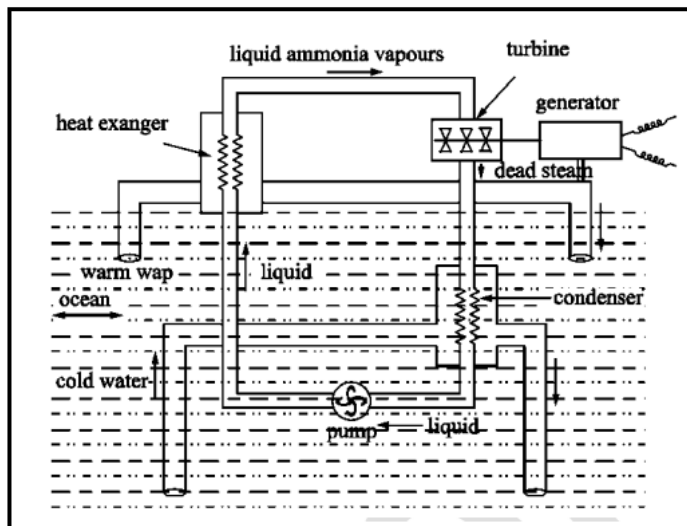
- ◆ The temperature difference between the surface level & deeper level of the oceans are used to generate electricity.
- ◆ The energy available due to the difference in temperature of water is called ocean thermal energy.

### ***Condition***

The temperature difference should be of 20°C or more between surface water and deeper water.

### ***Process***

- The warm surface water of ocean is used to boil a low boiling liquid like ammonia.
- The high vapour pressure thus produced turns the turbine of the generator and generates electricity.



***Significance:*** OTE is Continuous, renewable, pollution free, used to produce H<sub>2</sub>,

### **GEO-THERMAL ENERGY**

The energy harnessed from high temperature & pressure present inside the earth is called geothermal energy.

#### **1. Natural geysers**

In some places, the hot water (or) steam comes from the ground through cracks naturally

#### **2. Artificial geysers**

In some places, we can drill a hole up to the hot region & make the hot water to rush out through the pipe with very high pressure.

Thus, the hot water (or) steam coming out from the natural (or) artificial geysers is allowed to rotate the turbine of a generator to produce electricity.

#### ***Significance:***

- ❖ Power generation is higher than solar & wind energies, can be brought online quickly,
- ❖ Used for direct uses such as hot water bath, resorts, aquaculture, greenhouses.

\*\*\*\*\*ALL THE BEST\*\*\*\*\*