

### UNIT - 3

#### ENERGY SOURCES

green work

'in' means in  
'origin' means work

#### Energy sources

##### Priamry sources

Renewable/  
non conventional

Eg: solar, wind,  
tidal, wood

Non-renewable/  
conventional

Eg: coal, petroleum,  
natural gas, nuclear fuels.

##### Secondary sources

Eg: petrol

electrical energy by  
burning coal

##### CONVENTIONAL

(i) Storage of energy sources.  
are easy

(ii) Energy sources are having  
high density

(iii) Energy that has been  
used from ancient times  
is known as conventional  
energy

(iv) Energy is generated from  
natural resources like  
fossil fuels

(v) These sources cause a lot  
of environmental pollution

(vi) Commonly prevalent source  
of energy

(vii) Low in generation cost

##### NON-CONVENTIONAL

(i) Storage are  
unconomical

(ii) lower density

(iii) There are those which  
are exposed to risk  
from modern  
technological advancement

(iv) The energy is  
generated from other  
alternative sources like  
tidal, geothermal

(v) Do not contribute to  
environmental pollution

(vi) Not so commonly used  
as a source of energy

(vii) Higher generation cost

Kinetic energy of motion  
potential energy stored  
6<sup>th</sup> position

100 million tonnes of coal

325 million tonnes of oil

40 billion tonnes of coal - 2020

### NON-RENEWABLE ENERGY SOURCES

- FOSSIL Fuels (coal, oil, natural gas)
- Nuclear energy

#### COAL

About 250-350 million years ago coal was formed on earth in hot humid regions. Jharkhand, Mahanarla are the major coal producing states of India.

- a) Anthracite or hard coal (90% carbon content)
- b) Bituminous or soft coal (85% c content)
- c) Lignite or brown coal (70% c content)

#### ADVANTAGES

- (i) abundant supplies
- (ii) High net energy yield
- (iii) Low cost (with huge substitutes)

(iv) Mining & Generation

(v) Transport infrastructure to move coal is well established

(vi) Coal power stations are relatively easy to build.

#### DISADVANTAGES

- (i) Very high environmental impact
- (ii) Severe land pollution, air, water pollution
- (iii) High land use including mining

(iv) Air pollution can be reduced with development

(v) High CO<sub>2</sub> emission

(vi) Releases radioactive particles & mercury into air

(vii) A lot of water is used

2 Ash particles are the burnt fuel material  
It leads to soil & ground water pollution  
Petroleum & natural gas generate less ash particles  
PETROLEUM than coal, diesel & gasoline

- clean fuel  
356.2 billion metric tonnes  
Natural gas,  $\text{CH}_4$ , ethane & propane  
Dipura, Bombay & Krishna-Godavari delta

### ENVIRONMENTAL EFFECTS OF USING FOSSIL FUELS

#### 1 Acid rain:

When FF are burnt, S, N & C from the emissions combine with  $\text{O}_2$  to form oxides. These oxides when released into atmosphere react with water forming  $\text{H}_2\text{SO}_4$ , nitric acid & carbonic acid. These acids can harm biological environment like soils, lakes, streams.

#### 2 Flyash particles coal, diesel, gasoline

#### 3 Global Warming

$\text{CO}_2$  is a major by-product of burning fossil fuel & this gas is known as green house gas. It absorbs solar heat reflected off the earth's surface & retains this heat keeping the earth warm for living organisms.

Rapid industrialisation has resulted in the of fossil fuel emissions increasing % of  $\text{CO}_2$  by 28%. This drastic ↑ has led to global warming, environmental problems including disrupted weather patterns & polar ice cap melting.

4. Dusty burning of coils results in emission of particle matter causing air pollution.
5. Climate change is due to usage of fossil fuels
6. Mining it also cause environmental pollution
7. Biodiversity is affected.

### NUCLEAR ENERGY

- (i) It is obtained during fission or fusion of radioactive materials which yields large amount of nuclear energy.
- (ii) In nuclear fission, nucleus of certain isotopes (Uranium 235) are split into lighter nuclei by bombardment by neutrons. It releases large amount of energy through chain reactions.
- (iii) In nuclear fusion, fusion of nucleus of light elements are forced together at extreme high temp. until they fuse to form a heavier nucleus releasing large amount of energy.
- (iv) Nuclear power appears to be only hope for large scale energy requirements when Fossil fuels are exhausted.

Eg: A ton of U can produce an energy equivalent to 3 million tonnes of coal or 12 million barrel of oil.

(v) Nuclear energy has been successfully used in space ships, marine ships & food processing.

### ADVANTAGES

- (i) The space required is less when compared to other conventional power plants.
- (ii) A nuclear power plant consumes a very small qty. of fuel.
- (iii) Success in reliability of operation.
- (iv) Functioning of the plant is not affected by the adverse weather conditions.

### DISADVANTAGES

- (i) The initial cost of the power plant is high.
- (ii) Not suited for varying conditions.
- (iii) The radioactive waste is not disposed carefully will have an adverse effect on inhabitants.
- (iv) Maintenance cost of the plant is high.

### SOLAR ENERGY

Solar energy originates from thermonuclear fusion reaction taking place in the sun. It is one of the potential non-conventional energy source which provides earth with a major part of energy, heat and light. The earth continuously receives energy from the sun part of which is absorbed & which is emitted back in space. In India photo voltaic system is being installed by different sources of non-conventional energy for lighting, running of TV sets, water pumping, etc.

Solar cells are used to convert the solar radiation directly & no mechanical work

of parts is needed. The renewability of the operation is extraordinarily high even under severe fan conditions. A maintenance free life span of 10 or more years has been achieved.

#### ADVANTAGES

- (i) The solar energy is available globally in abundance.
- (ii) Solar energy is pollution free.
- (iii) Systems are easy to install, generate & maintain.
- (iv) System can be specifically designed according to individual requirements.
- (v) Supply of hot water is instant & uninterrupted.
- (vi) Running fuel costs are zero.

#### DISADVANTAGES

- (i) Solar energy can be easily diffused.
- (ii) Solar energy varies with time & weather conditions.
- (iii) Need a large area for solar panels to get the required amt. of power and expensive to build solar power stations.

#### ALTERNATIVE TO FOSSIL FUELS

##### 1. BIODENERGY OR BIOMASS ENERGY

It is produced by burning of various natural & human artifacts organic materials which has been transformed by geological processes into substances like coal, petroleum. Biomass power generation uses crops that can grow quickly and can be easily used & replanted on.

### rotation basis

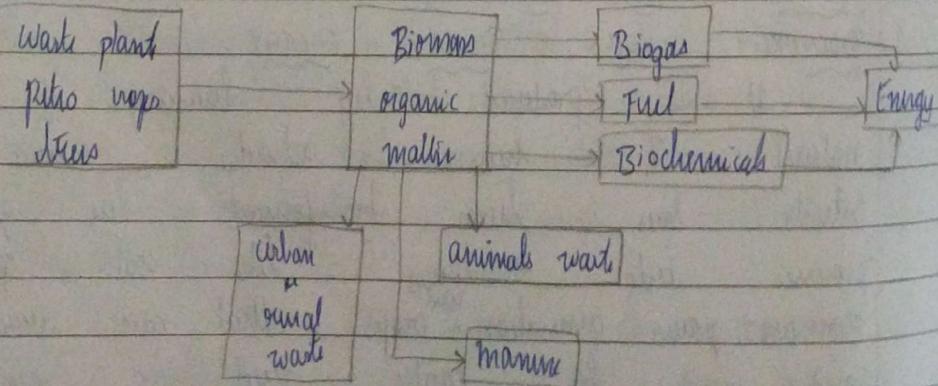
Biomass harvesting may cause impacts include soil damage and erosion, habitat loss, pollution is not managed properly.

### ADVANTAGES

- (i) Biomass can be used for fuel production
- (ii) It does not add  $\text{CO}_2$  to the atmosphere as it absorbs the same amt. of  $\text{CO}_2$  in growing
- (iii) It can be used to generate electricity in the same equipment
- (iv) It is suitable to run waste products where we can
- (v) Biomass fuel generally tends to be less expensive
- (vi) Use of biomass places less demand on earth's resources to thereby reduce dependence on foreign oil

### DISADVANTAGES

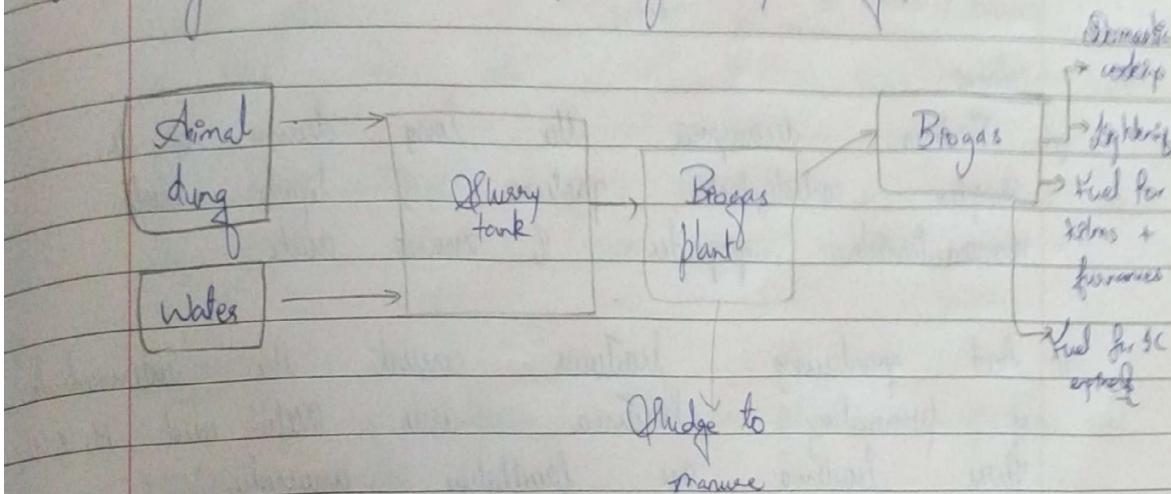
- i) Collecting sufficient qty of waste can be difficult.
- (ii) Burning the fuel creates green house gas to some extent.
- (iii) Certain materials required are not always available.



## 2 BIOMAS

65% methane 35% co<sub>2</sub>

It is considered as renewable source of energy because organic matter is produced. Biogas is a gaseous fuel obtained by anaerobic digestion of biomass. Wood, agricultural residues, garbage, animal waste maybe the input for generating biogas.



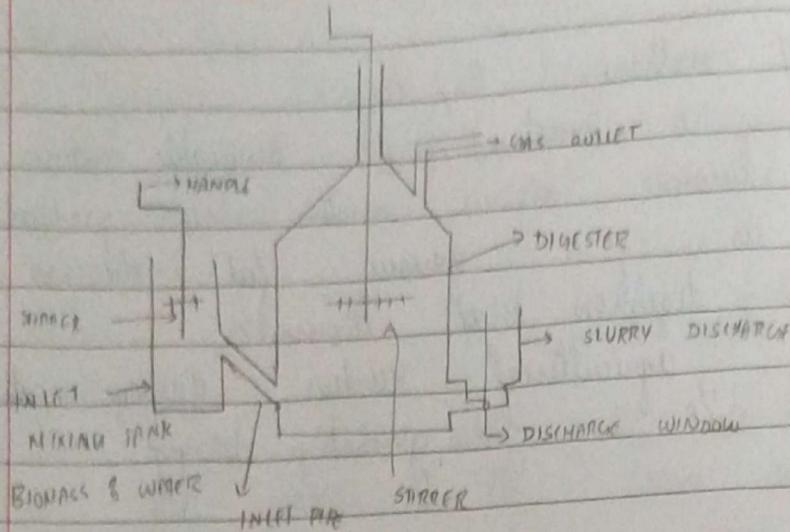
### Biogas plant

The gas calorific value of biogas is 5300 kcal/m<sup>3</sup>. Raw materials or temperature, nutrients, feeding the microorganisms, rate of feeding 45-160 litres.

5 types more

Biogas production depends upon raw materials, temp. (35-55°C), nutrients, seeding specific type of microorganisms, rate about (45-160 litres).

generation of biogas using condensing generator is times of more energy than burning dry wood qty. of dry coke

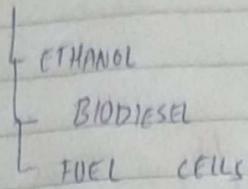


### PROCESS

- (i) Bacteria decompose the long chains of the complex carbohydrates, proteins & lipids into monosaccharides, peptides & amino acids.
- (ii) Acid producing bacteria convert the intermediates into acetic acid,  $H_2$ , etc. These bacteria are facultative, anaerobic & can grow under such conditions.
- (iii) To produce acidic acid, they utilize  $O_2$  solution for creating anaerobic condition essential for methane production.
- (iv) Finally, methane producing bacteria decompose the compounds to methane &  $CO_2$ .

Biogas plant in a small is adopted in households, agricultural as residue of animal waste. Gas is utilized for cooking & domestic lighting process is left over as manure.

## LIQUID BIOFUELS



### ETHANOL

- (i) It is a fuel made from sugar found in plants
- (ii) Most of the ethanol now being used for gasoline (90% gasoline + 10% ethanol)
- (iii) A small amt. of ethanol is produced as a by-product in some paper mills.

### ADVANTAGES

- (i) It is cleaner than gasoline & does not pollute the air.
- (ii) It is non-toxic & is also biodegradable.  
It breaks down quickly into harmless substances if it is spilled.
- (iii) Made from plants, comes from renewable energy sources.
- (iv) All engines which use gasoline can use ethanol without making any changes to engines.

### BIODIESEL

- (i) It is a domestically produced renewable fuel that can be manufactured from vegetable oil & animal fats.  
It is used in diesel vehicles.
- (ii) Its physical properties are similar to those of petroleum diesel but it is a cleaner burning alternative.

(iii) Using biodiesel in place of petroleum diesel reduces ~~petroleum~~ emissions

#### ADVANTAGES

- (i) Biodiesel fuel is a renewable energy source unlike petroleum based diesel.
- (ii) less polluting than petroleum diesel
- (iii) less sulphur in 100% biodiesel extends the life of catalytic converter.
- (iv) Biodiesel fuel can also be used in existing oil heating systems & diesel without making any alterations.
- (v) It can also be distributed through existing diesel fuel pumps.
- (vi) The lubricating life of engines of engines

#### DISADVANTAGES

- (i) At present, biodiesel fuel is about 1½ times more expensive than petroleum diesel fuel.
- (ii) It requires energy to produce biodiesel fuel from crops.
- (iii) As biodiesel cleans dirt from the engine, the dirt gets collected in fuel filter thus blocking it.
- (iv) Biodiesel fuel distribution infrastructure needs improvement.

FUEL CELLS

converts chemical energy through a chemical reaction from fuel to electrical energy with the help of O<sub>2</sub> & oxidizing agents.

- (i) Hydrogen is the most common fuel but hydrocarbons such as natural gas & alcohols like methanol are sometimes used.
- (ii) Fuel cells are different from batteries they require a constant source of fuel & O<sub>2</sub> to run.
- (iii) Electricity produced can be used to power cars, buses, laptops & mobiles.

STRUCTURE

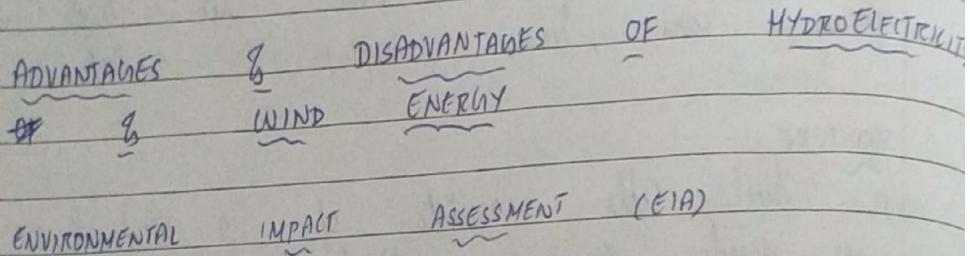
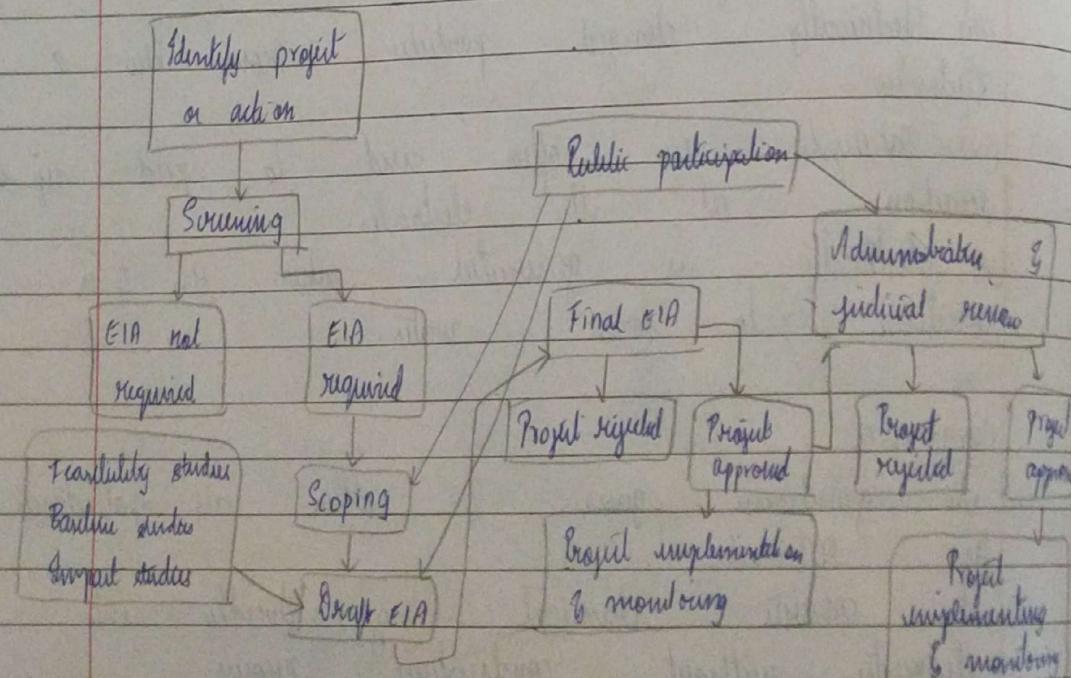
- (i) Fuel cells consists of 2 electrodes - an anode & the cathode.
- (ii) Electrodes are separated by a solid or liquid electrolyte.
- (iii) Electrically charged particles move b/w 2 electrodes.
- (iv) Catalysts are often used to speed up the reaction at the electrodes.
- (v) Electricity is generated when H<sub>2</sub> & O<sub>2</sub> combine to form water.

ADVANTAGES

- (i) No greenhouse gases & other air pollutants are released.
- (ii) It converts chemical energy directly into electricity without combustion process.
- (iii) The nature of fuel cells is quiet in operation.
- (iv) Safer than gasoline.

DISADVANTAGES

- (i) Storage & distribution of hydrogen fuel
- (ii) is difficult
- (iii) the operation of cells in very cold weather is a problem
- (iv) transporting and dispensing the gas also requires new methods.
- (v) Presently the cost of fuel cell is not competitive

FLOWCHART

EIA is defined as the activity designed to identify & predict the impact of legislation, proposals, policies, programmes, projects.

operational procedures on the physical environment  
on health & well being of human  
being is to integrate information about the impact.  
The major objectives or goals of EIA are:

- (i) Resource conservation
- (ii) Waste minimisation
- (iii) Use efficient equipment
- (iv) Recovery of by-products
- (v) Recycle & reuse.

### BENEFITS OF EIA

- (i) Promoting integrated development discussion & making environment
- (ii) Reduced time & cost of project implementation.
- (iii) Facilitating the design of environmentally sustainable policies & plans
- (iv) Cost saving modification in project planning
- (v) Consideration of a large range of alternatives
- (vi) Increased project acceptance
- (vii) Avoiding environmental impacts & mitigation of laws & regulation
- (viii) Reduction of waste treatment expenses
- (ix) Maintenance of biodiversity.
- (x) Reduced resources utilization
- (xi) Improved human health
- (xii) Promotion for public engagement & sustainability

## STEP BY STEP PROCEDURE FOR EIA

### 1) Screening

To determine whether a proposal should be subject to EIA & if so at what level it needs

### 2) Scoping

To identify the important issues, impact prepare terms of reference for EIA.

### 3) Impact analysis

To identify & predict the likely effects of environmental, social & other related effects of proposal

### 4) Mitigation & impact management

To establish measures to prevent, reduce or compensate for impacts.

### 5) Reporting

To prepare the information necessary for decision making.

### 6) Review

To check the quality of EIA report, whether the report made its terms, provides a satisfactory assessment.

### 7) Decision making

To approve or reject the proposal & set conditions

- 8) Follow up  
To monitor, manage and audit  
impacts of project implementation
- 9) Public involvement  
To inform & consult the participating  
public professional groups, NGOs, general  
community, etc.