4.2 ENERGY FROM BIOMASS:

There are a variety of ways of obtaining energy from biomass. These may be broadly classified as direct methods and indirect methods.

I. Direct Methods

Raw materials that can be used to produce biomass energy are available throughout the world in the following forms:

1. Forest wood and wastes
2. Agricultural crops and residues
3. Residential food wastes
4. Industrial wastes
5. Human and animal wastes
6. Energy crops

- Properly managed forests will always have more trees, and agricultural and energy crops management will always have crops; further, the residual biological matter are taken from those crops.
- Raw biomass has a low energy density based on their physical forms and moisture contents and their direct use are burning them to produce heat for cooking. The twin problems of traditional biomass use for cooking and heating are the energy inefficiency and excessive pollution.
- Inefficient way of direct cooking applications, inconvenient and inefficient methods of raw biomass transportation and storage and high environmental pollution problems made them unsuitable for efficient and effective use. This necessitated some kind of pre-processing and conversion technology for enhancing the usefulness of biomass.

II. Indirect Methods

- Biomass can also be used indirectly by converting it either into electricity and heat or into a convenient usable fuel in solid, liquid, or gaseous form. The efficient conversion processes are as follows:

1. **Thermo-electrical conversion**: The direct combustion of biomass material in the boiler produces steam that is used either to drive a turbine coupled with an electrical generator to produce electricity or to provide heat for residential and industrial system. However, the boiler

equipment are very expensive and energy recovery is low. Fortunately, improved pollution controls and combustion engineering have advanced to the point that any emissions from burning biomass in industrial facilities are generally less when compared to the emissions produced when using fossil fuels (coal, natural gas, and oil).

2. **Biomass conversion to fuel:** Under present conditions, economic factors seem to provide the strongest argument of considering biomass conversion to fuel such as fermentation and gasification. In many situations, where the price of petroleum fuels is high or where supplies are unreliable, the biomass gasification can provide an economically viable system, provided the suitable biomass feedstock is easily available.

Biomass conversion processes can be classified under two main types:

(a) Thermo-chemical conversion includes processes such as destructive distillation, pyrolysis, and gasification.

(b) Biological conversion includes processes such as fermentation and anaerobic digestion.

Gasification produces a synthesis gas with usable energy content by heating the biomass with less oxygen than needed for complete combustion. Pyrolysis yields bio-oil by rapidly heating the biomass in the absence of oxygen. Anaerobic digestion produces a renewable natural gas (methane gas) when organic matter is decomposed by bacteria in the absence of oxygen.

As a result, it is often advantageous to convert this waste into more readily usable fuel form like producer gas. Hence, it is the attractiveness of gasification.

The efficiency of a direct combustion or biomass gasification system is influenced by a number of factors such as including biomass moisture content, combustion air distribution and amounts (excess air), operating temperature and pressure, and flue gas (exhaust) temperature.