

4.1 BIOMASS RESOURCES:

- Biomass resources for energy production encompass a wide spectrum of materials ranging from silviculture (forest), agriculture (field), aquaculture (fresh and sea water) and industrial and social activities that produce organic wastes residues (food processing, urban refuse, etc.). When plants are cultivated especially for the purpose of energy, it is known as energy farming.

1. Forests

- Forests; natural as well as cultivated, serve as a source of fuel wood, charcoal and producer gas. Forest waste and residues from forest processing industries can be utilized at the mill itself. Forest resource is consumed, not just for firewood but also for sawn timber, papermaking and other industrial purposes. Some fast growing energy intensive trees such as eucalyptus, poplar, pine are specially cultivated for the purpose of energy.
- Some plants produce seeds (or nuts) to yield vegetable oil on pressing. This serves as a liquid bio-fuel (bio-diesel).
- There are two categories of oil- producing plants: (a) wild plants, e.g. Jojoba (a shrub, producing nuts), Karanj (a tree generally used on roadsides in India, produces seeds), etc., which take care of themselves and (b) agricultural crops, e.g. Jatropha curcas (Ratanjot, produces seeds) etc., which require common agricultural techniques.
- There are more than 300 different species of oil bearing trees; most of them are wild and do not require much care and effort. These plants are quite hardy, require little water, can resist severe drought and pest, can survive in hot and cold climates and can grow on most soil types.
- In India, the experience with a wild, oil-bearing tree, Karanj (*Pongamia pinnata*) has been encouraging. It is estimated that the plantation of Jatropha on 30 million-hectares would produce equivalent bio-fuel that can completely replace the current use of fossil fuels in the country.

2. Agricultural Residues

Crop residues such as straw, rice husk, coconut shell, groundnut shell, sugarcane bagasse etc., are gasified to obtain producer gas. Alternatively, these are converted to fuel pellets or briquettes and used as solid fuel.

3. Energy Crops

Certain cultivated plants produce raw material for bio-fuels. The greatest potential for energy farming occurs in tropical countries, especially those with adequate rainfall and soil condition.

- (a) **Sugar Plants** Sugarcane is a major raw material source for bio-ethanol. Various products from sugarcane are shown in Fig. Alcohol represents only 30 per cent of the total sugarcane energy. About 35 per cent is available in bagasse and another 35 per cent in leaves and tops of the sugarcane plant. Sweet sorghum also supplies raw material for ethanol production, especially during off-season supply for the sugar mills. Sugar beet supplies raw material for ethanol production.

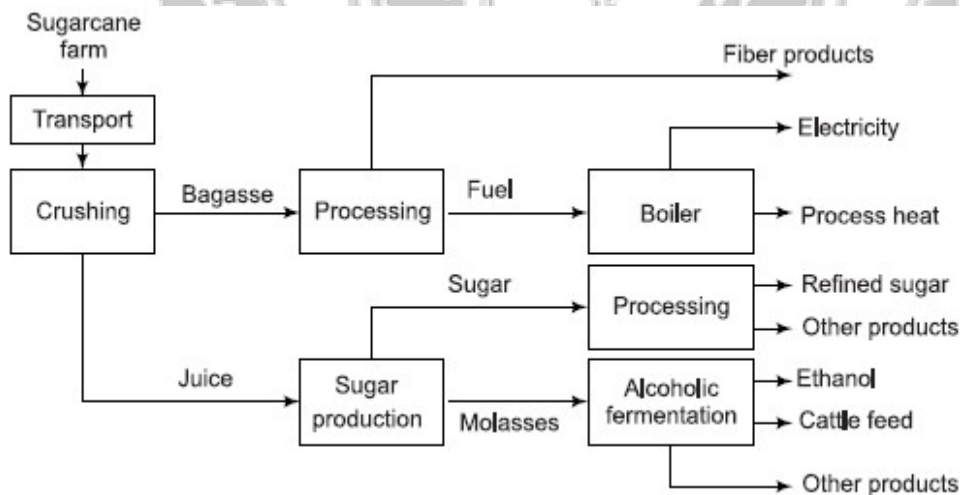


Figure: 4.1.1

[Source: "Renewable Energy Sources and Emerging Technologies" by D.P.Kothari, K.C Singal, Rakesh Ranjan, Page: 278]

- (b) **Starch Plants** Jerusalem artichoke provides raw material for bio-ethanol. It is a tubular plant and can be grown on marginal lands and relatively poor soil. It is able to withstand

adverse conditions such as cold and draught conditions. Cassava is also a tubular plant. It is seen as complementary to sugarcane as it can be cultivated in areas with acidic infertile soils, whereas cane requires more amenable soil. It also provides raw material (starch) for bio-ethanol. Potato, sweet potato, etc. also fall in the same category. Grains, such as maize, barley, rice and wheat provide starch, which can be converted to ethanol.

- (c) Oil Producing Plants In a short-term diesel engine test, over 40 different plant derived oils have been evaluated including sunflower, rapeseed, palm oil, castor oil, soybean, groundnut and cottonseed

4. Aquatic Plants

Some water plants grow faster than land based plants and provide raw materials for producing biogas or ethanol. These are water hyacinth, kelp, seaweed and algae, etc.

5. Urban Waste

Urban waste is of two types:

- (a) Municipal Solid Waste (MSW or garbage) (b) sewage (liquid waste)

Energy from MSW can be obtained from direct combustion (incineration) or as and fill gas. Sewage can be used to produce biogas after some processing.

