

# Introduction to Biomass (Dendro) Electricity Generation Technology

## 1. What is Biomass in the context of Energy or Electricity?

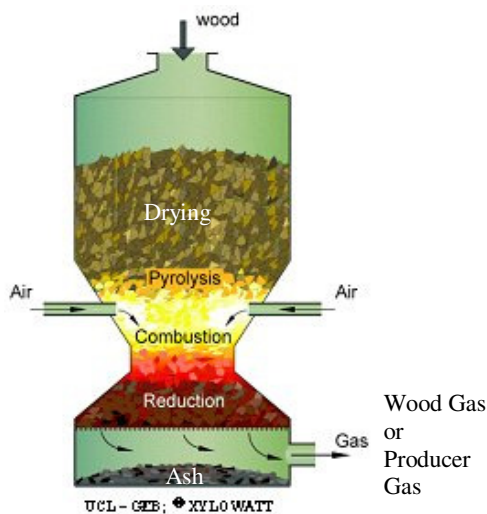
Biomass in electrical generation refers to the use of wood, preferably grown **in a sustainable manner**, as the fuel to be converted to energy or electricity. Biomass is alternatively referred to as Dendro, from the Greek word for wood. **Sustainable growing of wood instead of cutting down forest to obtain the fuel ensures that Biomass is a renewable energy source** having positive environmental impact.

## 2. What are the Technology Options to convert Biomass to Electricity?

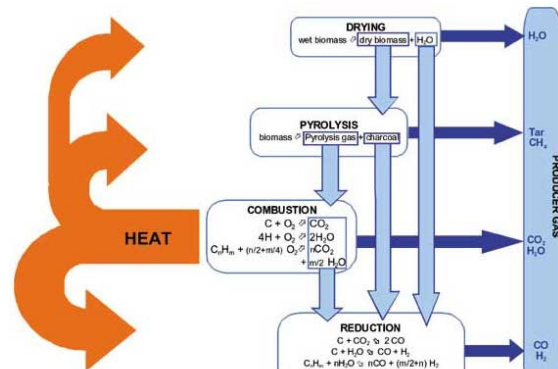
There are two primary ways of converting biomass to electricity.

1. **Gasification** option where the biomass is converted to a combustible gas that is used as the fuel to run an engine coupled to a generator.
2. **Steam Turbine** option where the biomass is combusted in a furnace to produce heat that in turn makes a boiler produce high pressure steam that drives a steam turbine coupled to a generator.

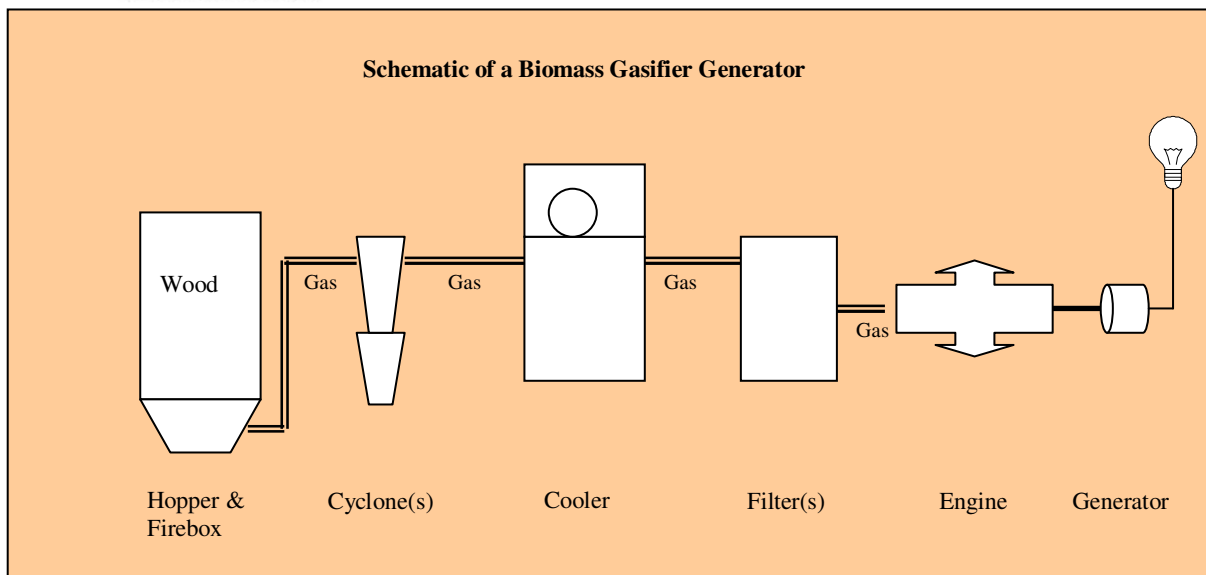
Stages of Gasification

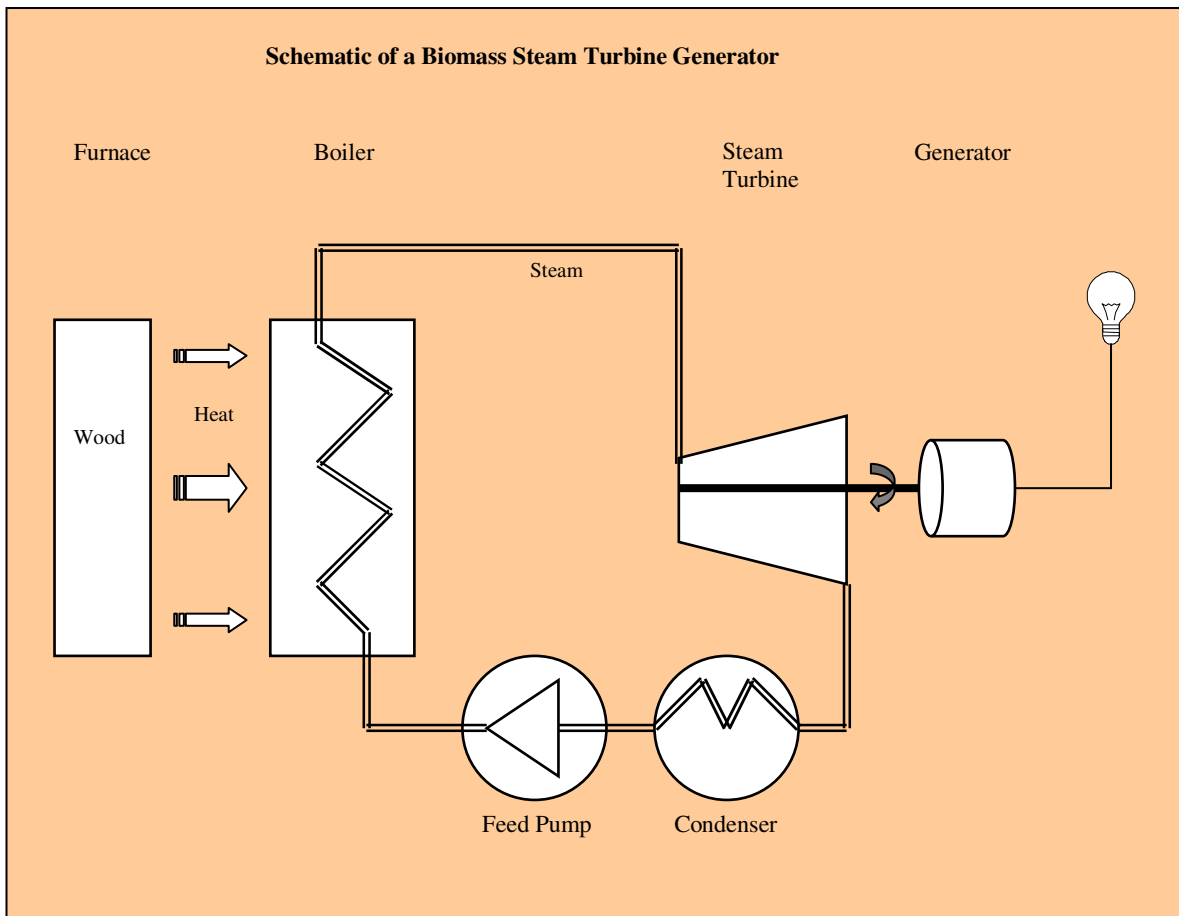


Gasification Process



Schematic of a Biomass Gasifier Generator





### 3. Capacity of Systems

Gasification option is usually feasible and economical for systems of capacity 5 to 500 KW. Steam turbine option is suitable for systems of capacity of 500 KW or more and going up to several MW.

### 4. Fuel-wood Composition, Consumption and Cost

Wood has to be chopped to pieces of 3 cm or so diameter and length up to 15 cm, depending on the design of the gasifier and then dried. For the furnace in the case of a steam turbine, larger sizes can be used. It takes 1.5 to 2 Kg of 20% moisture content wood to produce 1 unit or KWH of electricity. This makes the cost of generation competitive compared to fossil fuel based generation.

### 5. Operation & Maintenance

Gasifier generator systems use straightforward technology and standard internal combustion engines. Therefore, they are well suited for general applications and can be maintained locally including in rural areas, at reasonable cost. However, the design of the gasifier will determine the quality of the gas (its purity, moisture content and tar content) that will impact the reliability of the engine as well as determine the level of preventive maintenance required. Therefore, it is important to ensure that the design of the gasifier is of a high standard before investing in a system.

Steam turbine systems are complex and require dedicated and well trained maintenance support. They can be used in critical and continuous use applications where high quality and high reliability power is required. Therefore, they are more suited for large industrial applications and grid connected generation applications where economies of scale allow skilled operations and maintenance support.

## 6. Environmental Aspect and Carbon Neutrality

When biomass is grown in a sustainable manner using Short Rotation Coppicing (SRC) plants like *gliricidia* (*Gliricidia sepium*) where the branches are harvested leaving the tree to keep rejuvenating, the process of generating electricity becomes greenhouse gas or carbon neutral. It is because the carbon cycle is completed as the harvested wood would have previously absorbed the same amount of carbon dioxide as would be released to the atmosphere from the combustion. Further, the emissions do not carry toxic pollutants like nitrous oxides and sulphur dioxides in any significant quantity unlike fossil fuels.

- Many species of SRC plants can be grown in degraded or scrub lands without requiring irrigation or fertilizer.
- They can restore lands and lead to the re-greening of the environment.
- Foliage can be used as fodder or fertile mulch.
- Plants such as *gliricidia* are nitrogen fixing and enrich soil.

Long-term research conducted in Sri Lanka has established *gliricidia* as the best plant for biomass power generation due to its versatility as a source of food, fodder, fertiliser, and of course fuel.



A 12 KW Biomass Gasifier Generator developed and manufactured in Sri Lanka



The Steam Turbine of the 1 MW Grid Connected Biomass Plant at Walapane, Sri Lanka