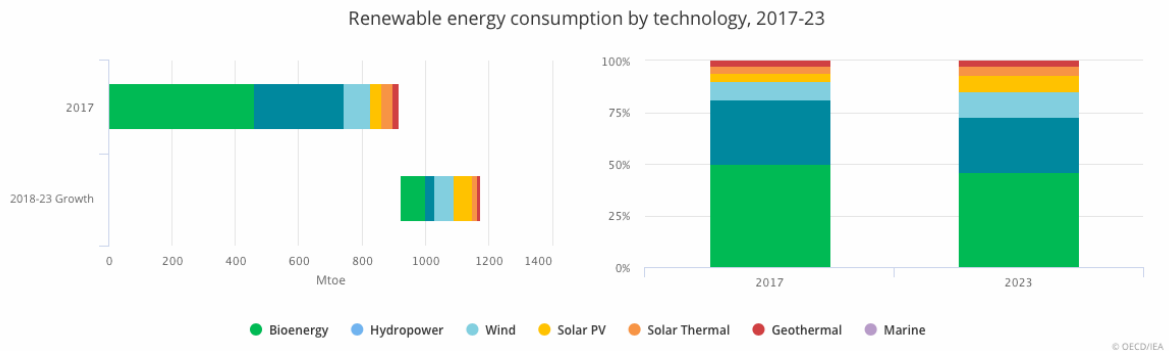


BIOENERGY SHARE AMONG RENEWABLE ENERGY CONSUMPTION



<https://www.iea.org/renewables2018/>

Energy Crops

- Perennial Grasses - herbaceous plants
- Grow easily, rapidly and may be harvested several times a year

Examples are:

- Giant Reed (*Arundo donax* L.)
- Miscanthus (*Miscanthus X giganteus*)
- Sweet Sorghum (*sorghum bicolor* L. Moench)
- Switchgrass (*Panicum virgatum* L.)

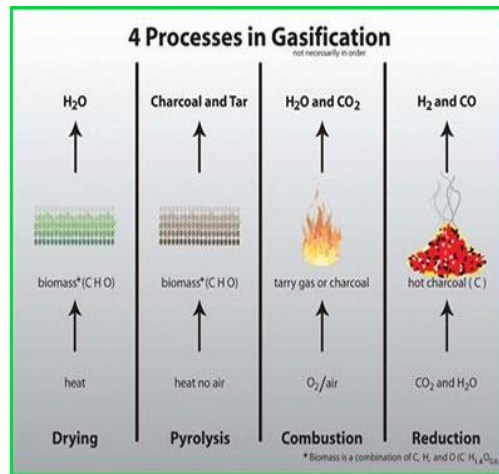
Electricity generation from Biomass

Options for generating electricity from biomass include:

Direct combustion of biomass with coal to produce steam and operate a turbine generator.

Hydrothermal conversion of biomass into valuable gaseous or liquid products through high T and P processes in the presence of catalysts – Gasification and pyrolysis.

Gasification takes place in an oxidizing medium under elevated temperatures (>1100 K) for partial oxidation of carbonaceous material to produce useful gaseous products: hydrogen and syngas.



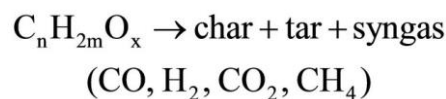
<http://www.ankurscientific.com/technology.html#prettyPhoto>

- Flue gases are a mixture of combustion products including water vapor, carbon dioxide, particulates, heavy metals, and acidic gases.
- SYNGAS = CO + H₂

WATER GAS SHIFT REACTION

The effluent gas stream contains carbon monoxide, carbon dioxide, hydrogen, and excess steam produced in a steam reformer, and then passes through a reactor called a shift converter for water-gas shift (WGS) reaction. In WGS reaction, carbon monoxide produced by steam reforming reaction is reacted with steam to generate more hydrogen.

Pyrolysis is the thermal decomposition of organic material in the absence of an oxidizing medium, yielding pyrolysis bio-oil in addition to solid and gaseous products.



<http://www.btgworld.com/en/rtd/technologies/fast-pyrolysis>

Pyrolysis bio-oil is a dark brown, viscous liquid substantially different from petroleum regarding its much higher oxygen and water content, 30–50% and 20–30%, respectively. Bio-oil is a mixture of oxygenated hydrocarbons. Owing to its high oxygen content, low heating value, and its organic acid content, the crude bio-oil cannot directly be blended with gasoline (Ren et al. 2014). Therefore, bio-oil needs to be upgraded through several reaction routes to obtain gasoline- and diesel-grade compounds.