



Biotechnology and Energy Conservation

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10th Lecture Bioenergy

The Aim:

- Students can explain type, source of bioenergy and the requirements of their sustainability

Idea of discussion in this lecture:

- ▶ Bioenergy (green energy)
 - ▶ Biomass
 - ▶ Wood
 - ▶ Charcoal
 - ▶ Biofuel
 - ▶ Bioethanol
 - Cellulose based
 - Starch based
 - ▶ Biodiesel
 - Vegetable oil based
 - Algae oil based
 - ▶ Biogas (methane based)
 - Plant and biological waste based
 - ▶ Bio-hydrogen
 - Algae based

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Bioenergy

- ▶ Source: sun energy caught by plant / chlorophilic organism
- ▶ $\text{CO}_2 + \text{H}_2\text{O} \xrightarrow{\text{UV}} \text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2$

Sustainable energy???

- ▶ The simple form of bioenergy (biomassa)
 - ▶ Wood
 - ▶ Charcoal
 - ▶ Advantage : simple to use
 - ▶ Disadvantage: not broad range technology available

Need another form of bioenergy source to run in appropriate technology (in the form of biofuel)

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Biofuel

► Bioethanol

- Cellulose based (soft wood, sugar cane bagasse)
- Starch based (corn, cassava, and sago palm)
- Sugar based (by product of sugar industry)

► Biodiesel

- Vegetable oil based (Jatropha, rapeseed, oil palm, coconut, castor)
- Algae oil based (Algae)

► Bio-gas (methane based)

- Plant based (corn biomass, biological waste)

► Bio-hydrogen

- Algae based (Algae)

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Type and source of bioenergy

Energy source	Biomass source	Type of process	Plant / organism source
Bioethanol	Cellulose	Chemical/enzymatic hydrolysis, fermentation	Soft wood
	Starch		Corn, cassava, sago
Biodiesel	Oil (triglycerides)	Chemical, enzymatic (lipase)	Jatropha, oil palm, rapeseed, castor, algae
	Methanol		
Biogas	Biological waste, biomass	Anaerobic fermentation	Biological waste, corn biomass, manure
Biohydrogen		Photosynthetic microorganism culture	Algae

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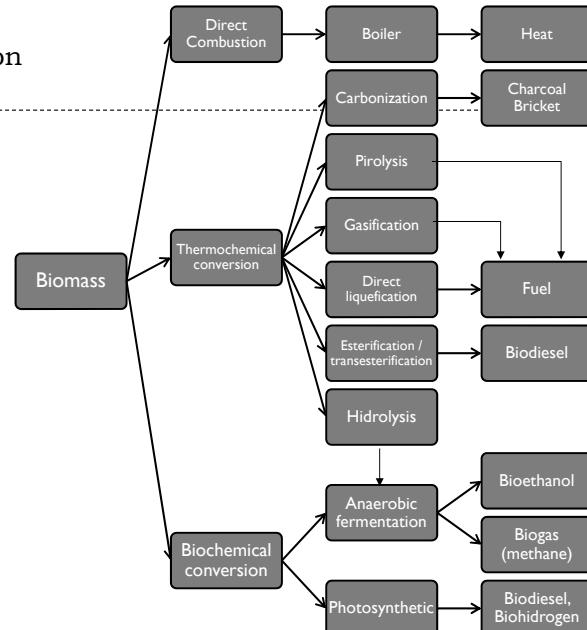
Oil / starch source plant



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Biomass conversion chart



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