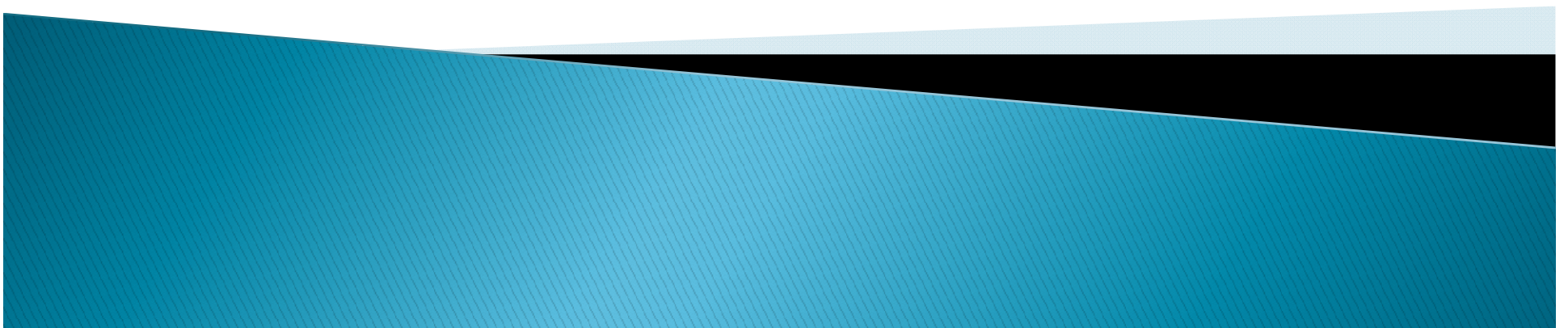


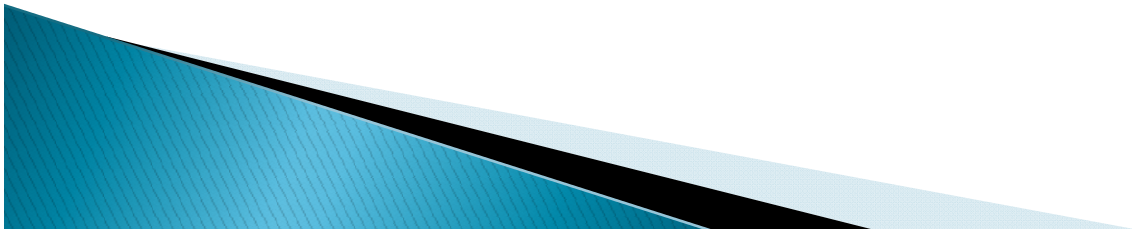
Renewable Energy Systems

EE—325



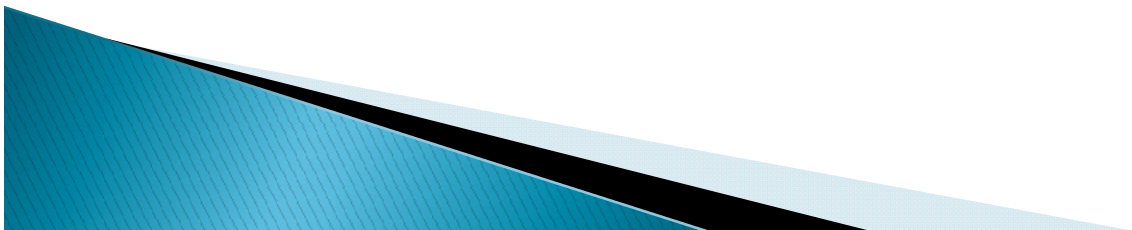
Lecture

Biomass / Biogas



Biomass Energy

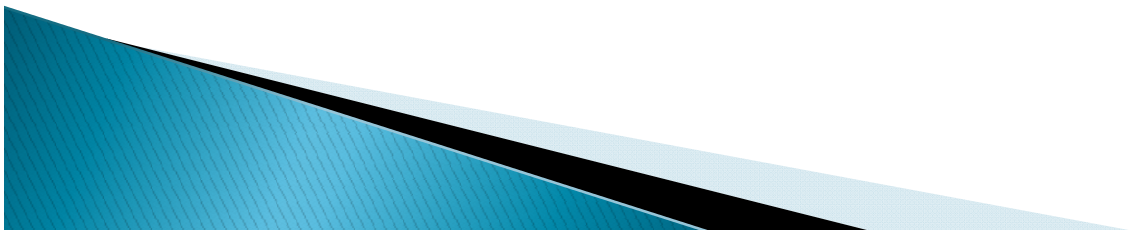
- ▶ Biomass energy is the fuel energy that can be derived directly or indirectly from biological sources.
- ▶ Biomass energy from wood, crop residues, and dung remains the primary source of energy in developing regions



Biomass Energy

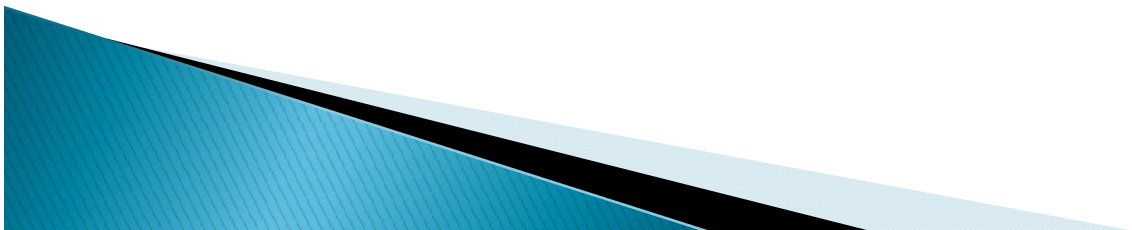
The term “biomass” is related to the quantity of all living matter from the five Kingdoms in biology:

- ▶ Plants
- ▶ Animals
- ▶ Fungi
- ▶ Bacteria
- ▶ Algae.



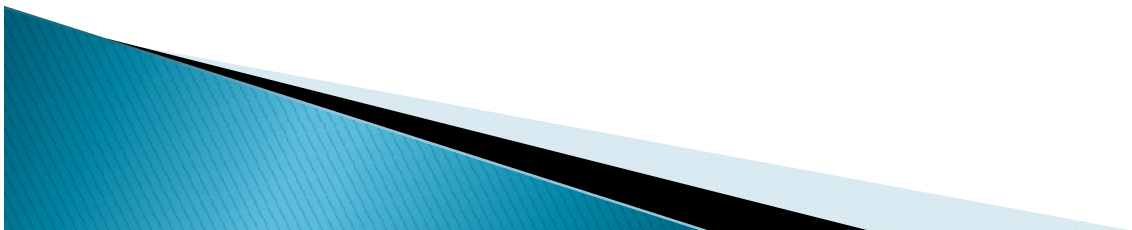
Biomass Energy

- Unlike solar, wind or micro-hydroelectric systems, modern biomass energy systems can be set up in virtually at any location where plants grown or land usage is minimum.
- Renewable sources of energy such as solar, wind & hydroelectric system require additional capacity to produce adequate energy when conditions are right such as water flow or wind speed

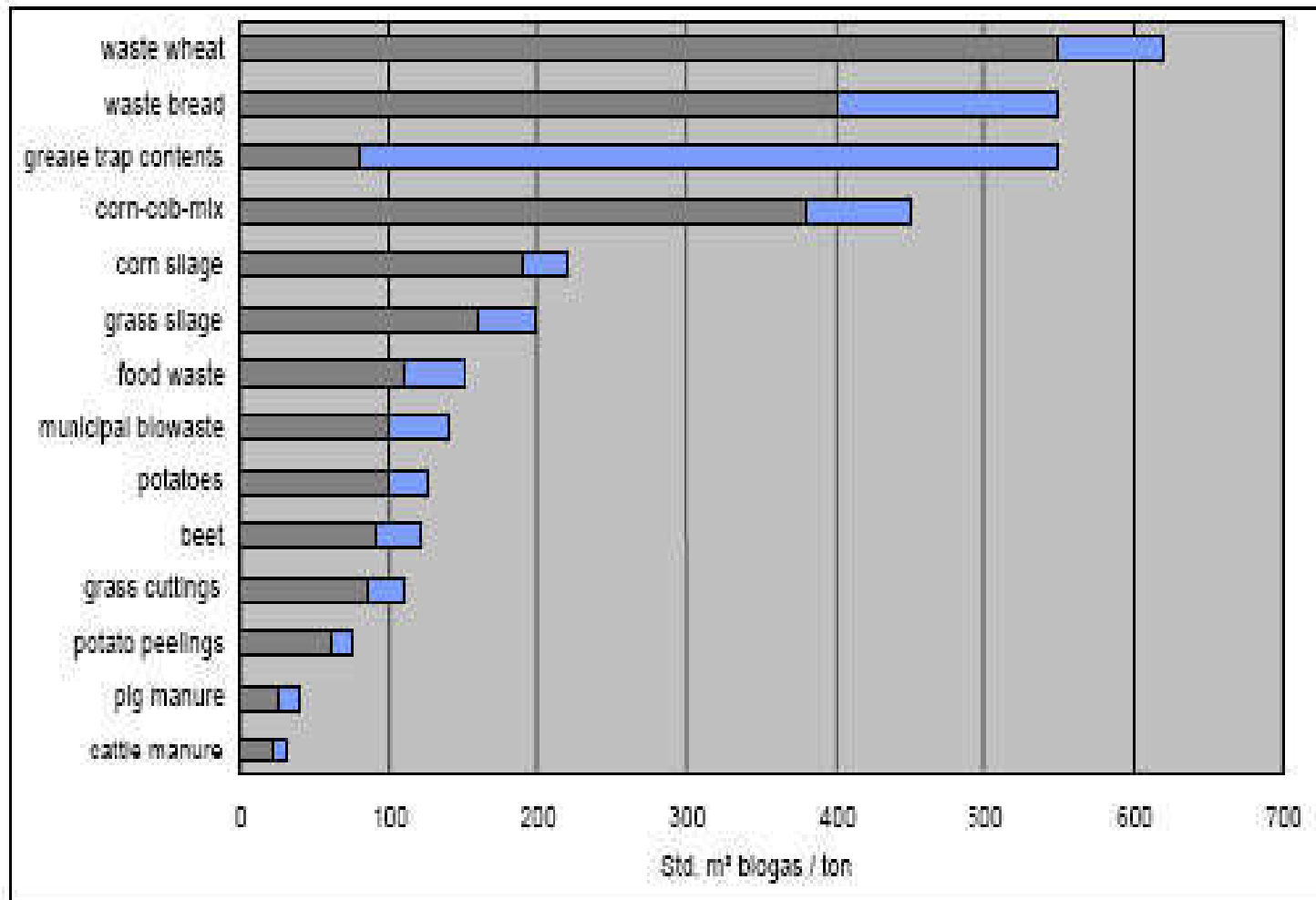


Useful Biomass Fuels

- Residues are the most economical biomass fuels for generating electricity.
- These are the organic byproducts of food, fiber, and forest production such as sawdust, rice husks, and bagasse (the residue remaining after juice has been extracted from sugar cane).
- In the future, much larger quantities of biomass power could come from fast-growing trees and crops (called "energy crops")

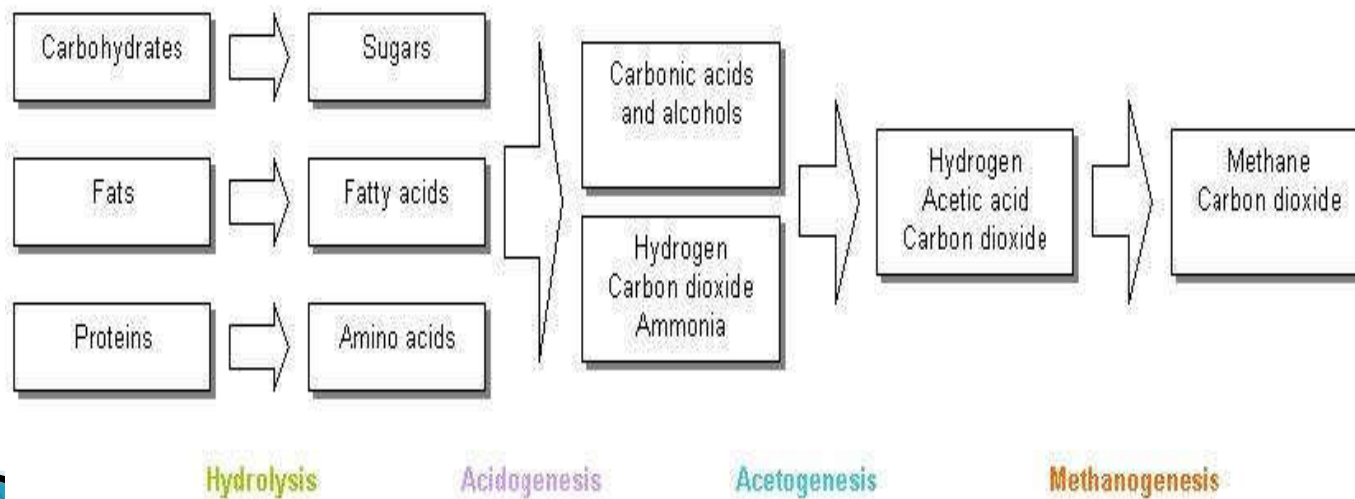


Biogas Yield by different Feed Stocks



Biogas

- ▶ Biogas is a combustible gas produced by anaerobic fermentation of organic materials by the action of methanogenic bacteria as carbohydrates, proteins, fats.



Biogas

Composition of Biogas Compounds

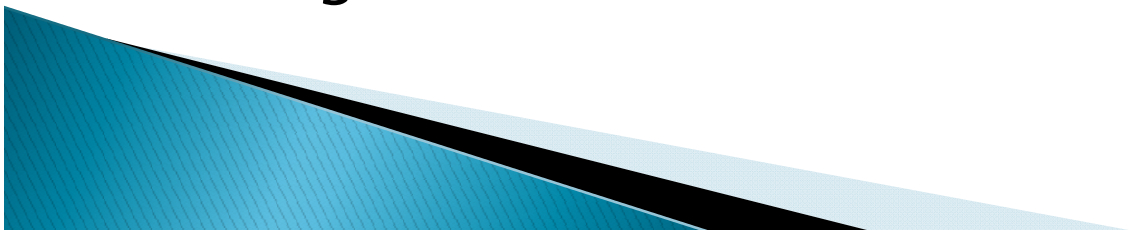
Substance	Symbol	Percentage
Methane	CH ₄	50-70
Carbon dioxide	CO ₂	30-40
Hydrogen	H ₂	5-10
Nitrogen	N ₂	1-2
Water Vapour	H ₂ O	0.3
Hydrogen Sulphide	H ₂ S	Traces



Biogas

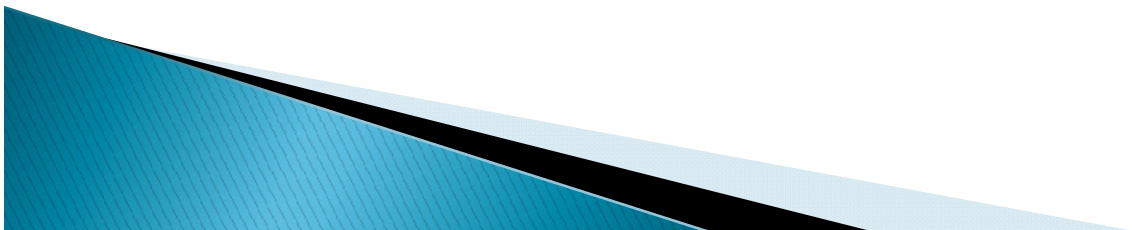
In order to increase efficiency, the following suggestions have been made:

- ▶ Organic matter should be high in carbon (cellulose, sugars, lipids and proteins).
- ▶ It is not practical to operate digesters using meat, animal, dung or urine.
- ▶ Retention times of stabilized digesters should be maintained at about 10 days. At high temperature bio-digestion occurs faster, reducing the time requirement. A normal period for the digestion of dung would be two to four weeks.

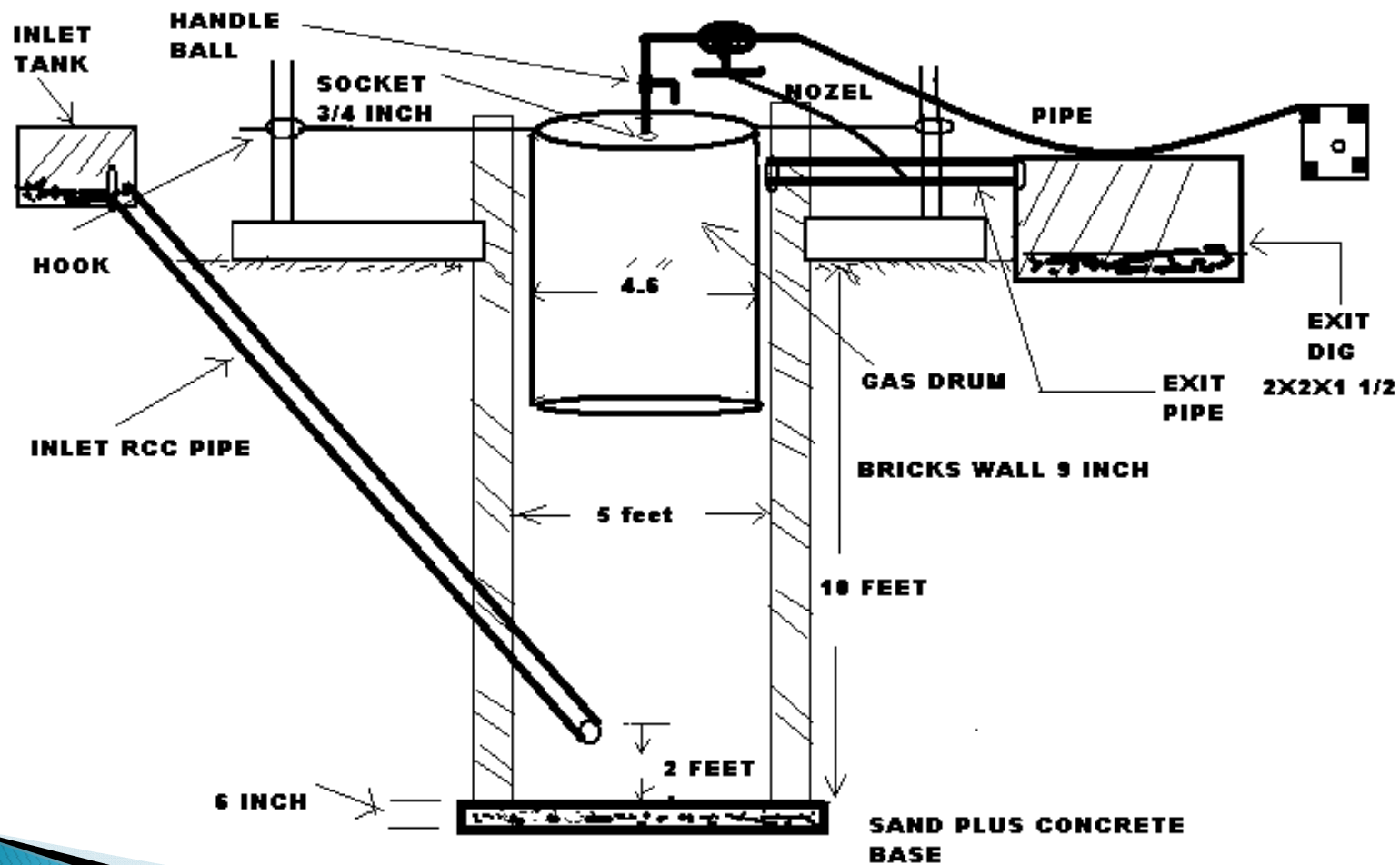


Biogas

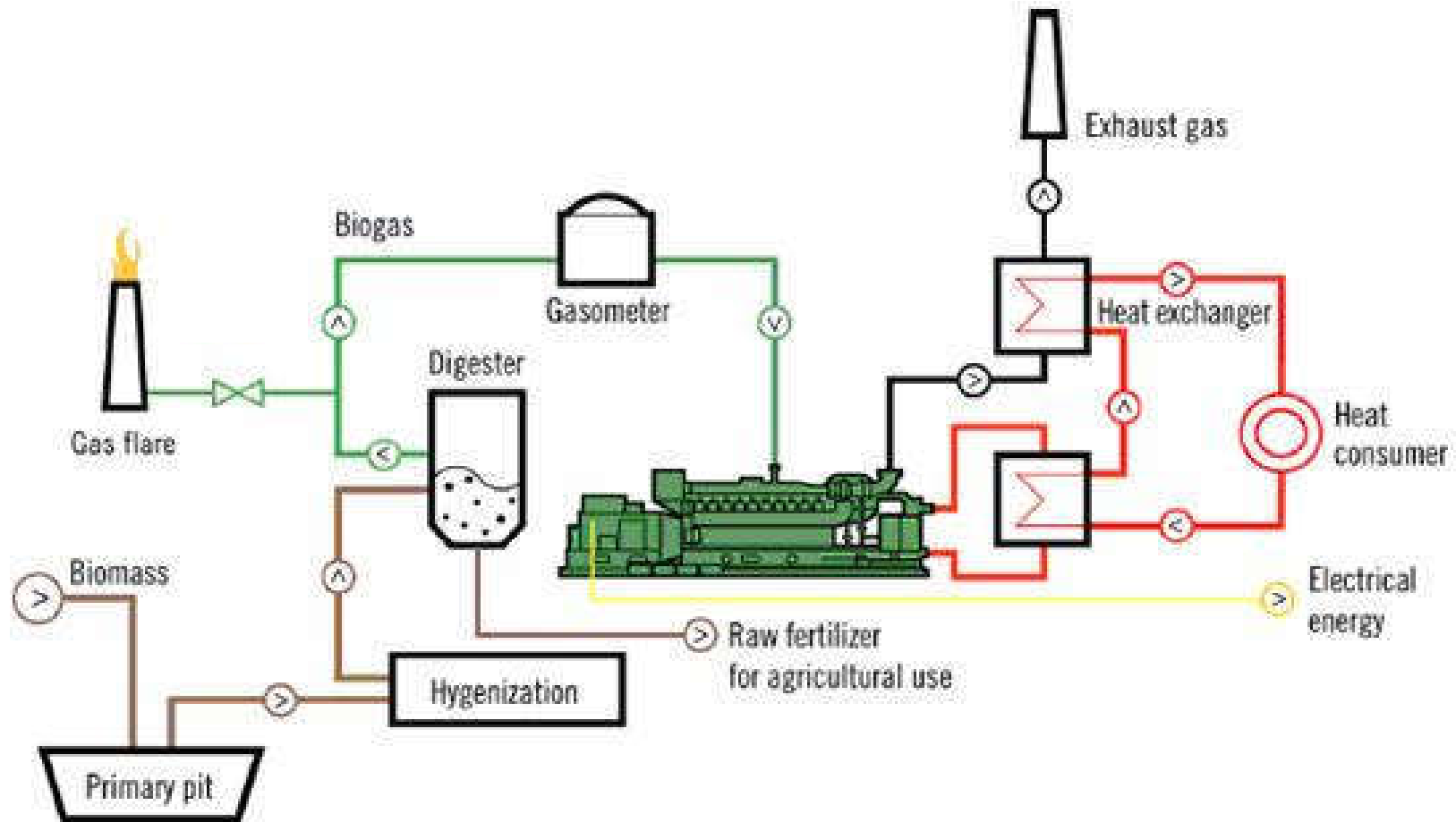
- Temperature needs to be controlled. Sudden fluctuations in temperature will slow down or possibly stop the process
- Waste vegetable matter, food processing wastes and crop residues can enhance gas production
- The optimal ratio of carbon to nitrogen is essential



Biogas Plant



Biogas Power Plant system



Calculations

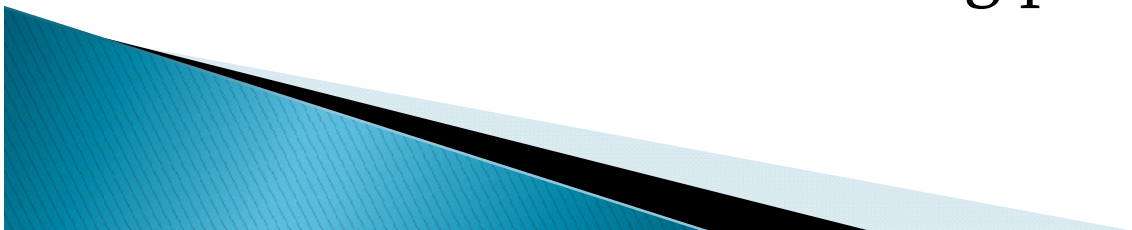
100 goats' and 15 people's (about 1.2 kg per person) waste can produce 10 m³ of biogas

1 kW generator can run on 5.64 m³ of biogas for 12 hours per day

6 kW generator: 33.84 m³ for 12 hours/day

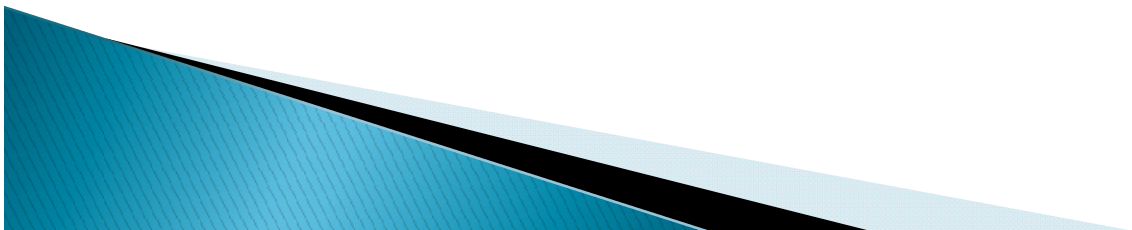
Cow can have dung of 42 kg per day

Horse have a manure of 15 kg per day



Limitations of Biogas Plant

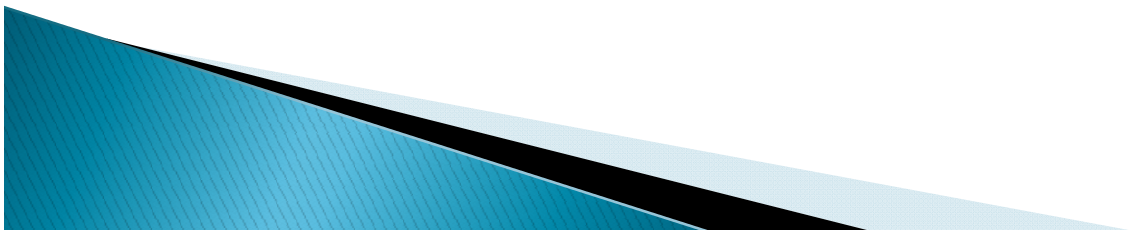
- Installation cost is not cheap.
- Maintenance and repair problems in our country.
- It is very difficult to keep biogas plant clean after one complete process in our country.
- Capacity determined by availability of dung. Not suitable for varying loads.
- Not feasible to locate at all the locations.



Potential of Biomass Energy in Pakistan

Major potential Areas of Biomass Energy in Pakistan are:

- ▶ Animal Dung
- ▶ Crops residue (Sugarcane, Rice and wheat)
- ▶ City Waste
- ▶ POULTRY LITTER
- ▶ Bio diesel Crops



ZONES OF BIOMASS POTENTIAL

Zone	Code	District Clusters	Industrial Cluster	Biomass Potential (M. Ton)	Electric Generation Potential MW
Cotton	C-1	R.Y.Khan	Industrial Estate R.Y.Khan	0.602	72
	C-2	Bahawalpur & Bahawalnagar	Ahmadpur East Road & Hasilpur	1.321	157
	C-3	Lodhran & Multan	Multan Industrial Estate	0.982	117
	C-4	Vehari & Khanewal	Mian Channu	1.328	158
	C-5	Muzaffargarh, D.G.Khan & Rajanpur	Jampur Road D.G Khan	0.911	108
Rice	R-1	Sialkot & Narowal	Sialkot	0.510	61
	R-2	M.B.Din & Hafizabad	Hafizabad	0.476	57
	R-3	Sheikhupura, Nankana Sahib & Lahore	Lahore Sheikhupura Road	0.488	58
	R-4	Gujranwala & Gujrat	Gujranwala	0.946	112

BIOMASS POTENTIAL OF ZONES

Zone	Code	District Clusters	Industrial Cluster	Biomass Potential (M. Ton)	Electric Generation Potential MW
Mix Cropping	M-1	Okara & Kasur	Okara Depalpur Road	0.953	113
	M-2	Sahiwal & Pakpattan	Sahiwal	0.873	104
	M-3	Faisalabad & T.T.Singh	Khurrianwala, Shahkot	0.417	50
	M-4	Chiniot, Jhang, Khushab & Sargodha	Sargodha Industrial Estate	0.536	63
	M-5	Bhakkar, Layyah & Mianwali	Sikindarabad Mianwali	0.400	47



BIOMASS POWER GENERATION

- Generation of at least 300 MW from this source
- Stand alone biomass or biomass-coal mix plants
- Proposed plant sizes is 5 MW to 30 MW across the crop zones ideally in industrial clusters
- Detailed survey of agriculture waste resource resource