Waste Utilization: Production of biogas, bio-fertilizers

K. M. Mahdiuzzaman Sayed
Lecturer
Nutrition & Food Engineering
Daffodil International University

What is biogas?

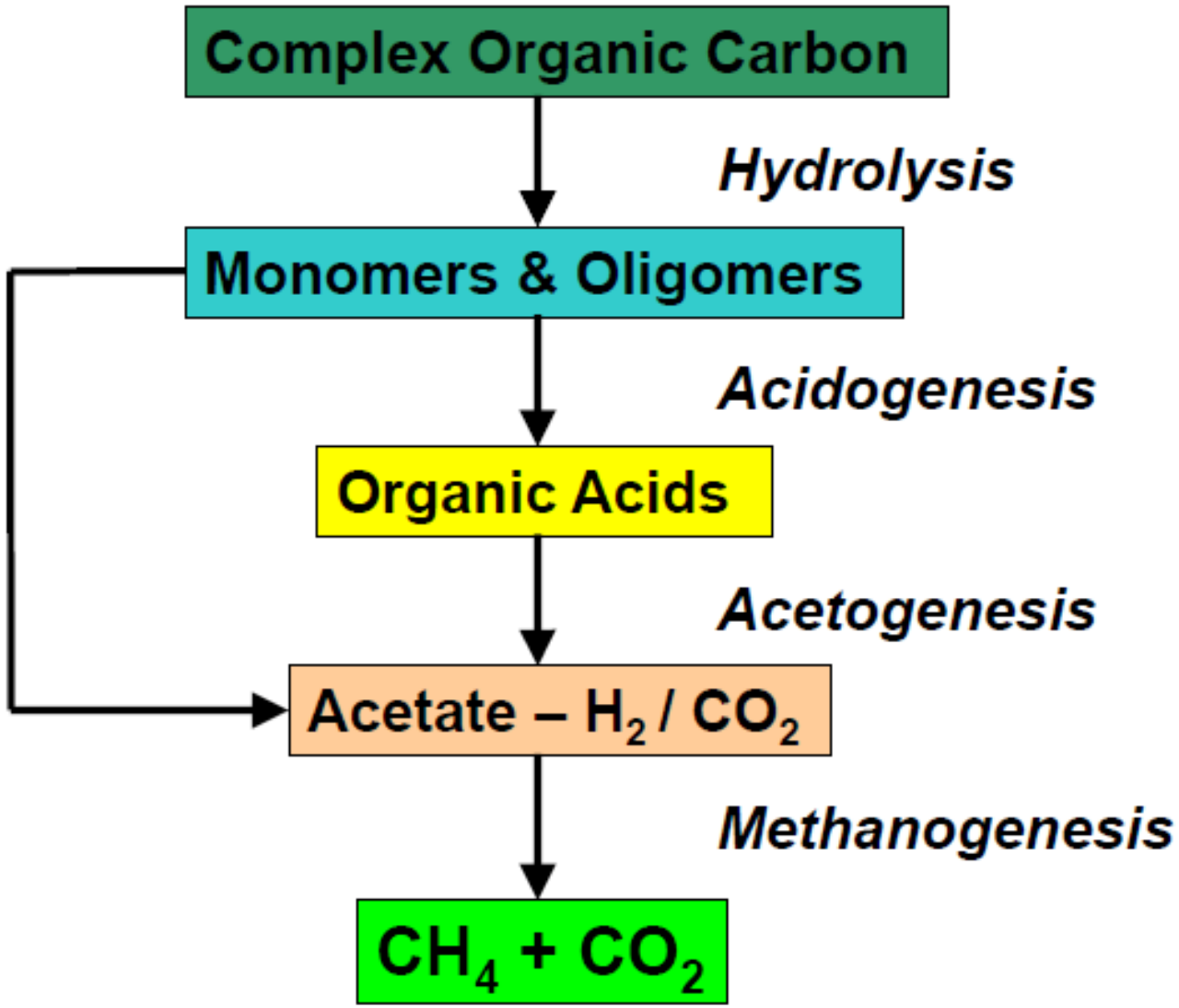
Gas produced by the anaerobic digestion or fermentation of organic matter under anaerobic conditions.

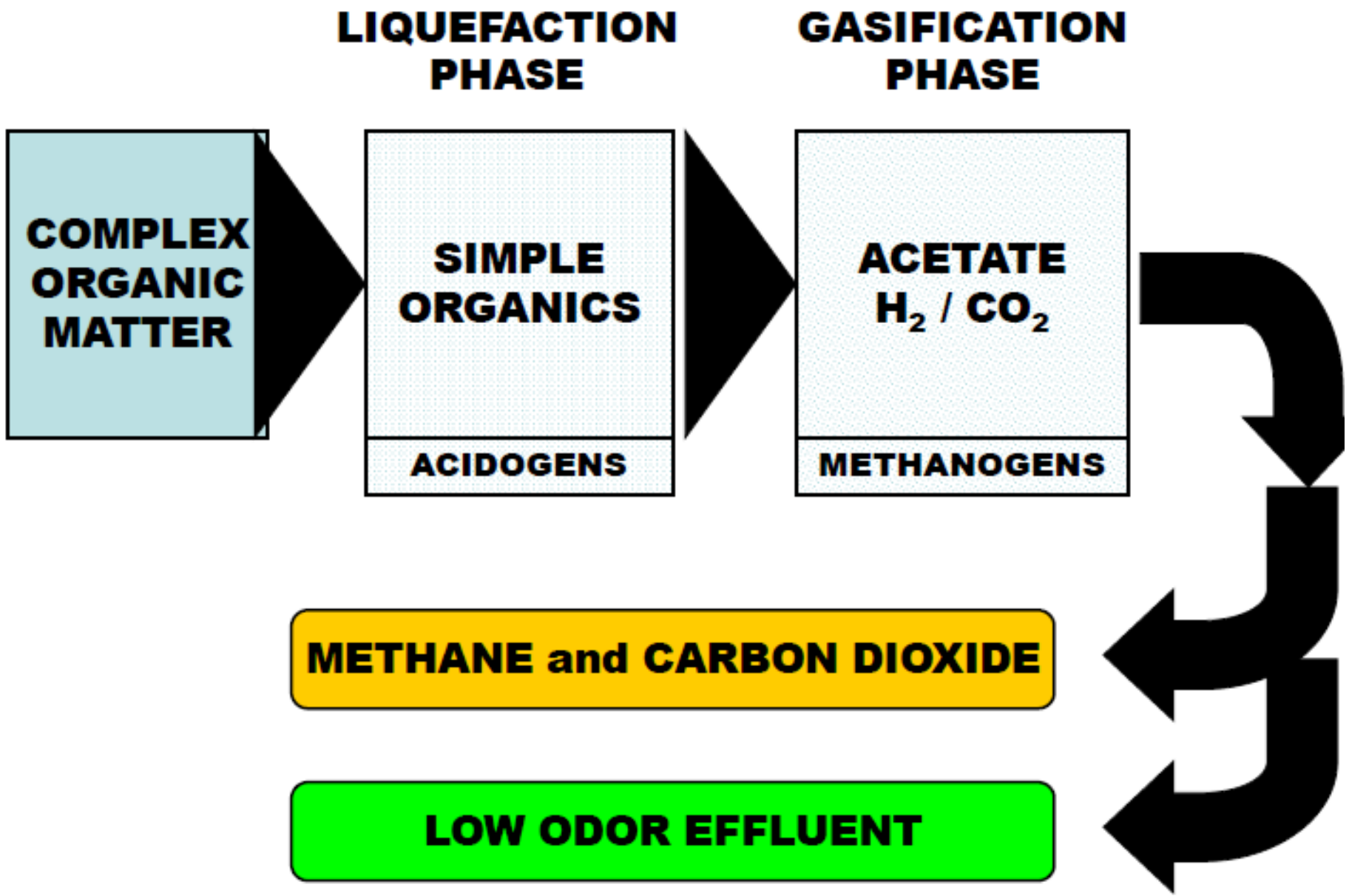
Biogas = $CH_4 + CO_2 + H_2S + N_2 + H_2$ etc

Typical biogas composition:

Methane, CH_4	:	**55-70%**
Carbon dioxide, CO_2	:	**25-40%**
Nitrogen, N_2	:	**0-2 %**
Hydrogen Sulphide, H_2S	:	**0-3 %**
Hydrogen, H_2	:	**0-2 %**
Oxygen, O_2	:	**0-2 %**

Anaerobic Digestion




LIQUEFACTION PHASE
GASIFICATION PHASE
COMPLEX ORGANIC MATTER
SIMPLE ORGANICS
ACIDOGENS
ACETATE
H_2 / CO_2
METHANOGENS
METHANE and CARBON DIOXIDE
LOW ODOR EFFLUENT

WHERE DOES BIOGAS COME FROM?

- ***Vegetation - When vegetation decomposes, it gives off methane gas***
- ***Farm and ranch animals - cattle, chickens, pigs***
- ***Sewage – The treatment of human waste in anaerobic digesters produces methane***
- ***Landfills***
- ***Garbage produces methane as it decomposes***

Biogas Cycle

Solar energy

Photosynthesis

Biomethane production

Animal husbandry

Crop harvesting

Industrial processing

Human consumption

CO_2

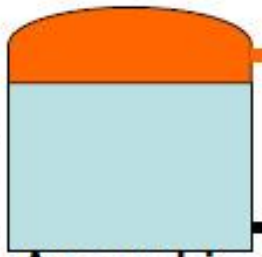
H_2O

Energy crops

Biofertilizer

Electrical and/or thermal energy

Organic wastes



Anaerobic digestion

Biogas

Natural gas pipeline

Energy crops

CO_2

Cleaning & Upgrading

Potential wastes that can be used for biogas power generation

- Leather Industry Wastes
- Abattoir Industry Wastes
- Fruit/Food Processing Wastes
- Pulp & Paper Industry Wastewater
- Municipal Wastewater/Sewage
- Vegetable Market Yard Wastes
- Animal/Agro Residue

Possible Biogas Plant In Bangladesh

1. Fixed dome type
2. Floating drum type
3. Bag type


BIO GAS SYSTEM

Flexible balloon biogas plant

"BIOGAS TO POWER".....WHY?

- villages and household are non electrified- Power is in big deficit.
- Rural, decentralized and renewable power -**A Priority**.
- Enactment of Electricity Act 2003 and Renewable policy 2005 in place.
- Process industries need **high quality** and **uninterrupted** power.
- Any expansion /New downstream projects will require additional, **quality** power.
- Power generation/Cogeneration is becoming an important revenue stream.

"BIOGAS TO POWER".....WHY?

- **Successful reference plants** available –reduced risk.
- **Elemental Sulphur as a high value biproduct** from Bioskrubber process , an added advantage.
- **CDM benefits** – Generate **more power**, get **more benefit**
- Therefore generating **additional power** from biogas now makes **good business sense**.

***CDM: Clean Development Mechanism**

Biogas application from " Heat to Power " A High Value Shift

- Current utilization of biogas - mostly as **heat** value.
- Biogas fired Gas Engines - for **high value shift**.
- **1 m^3** of gas fired in engine can give **2 units** of power .

Ways to produce power from biogas…

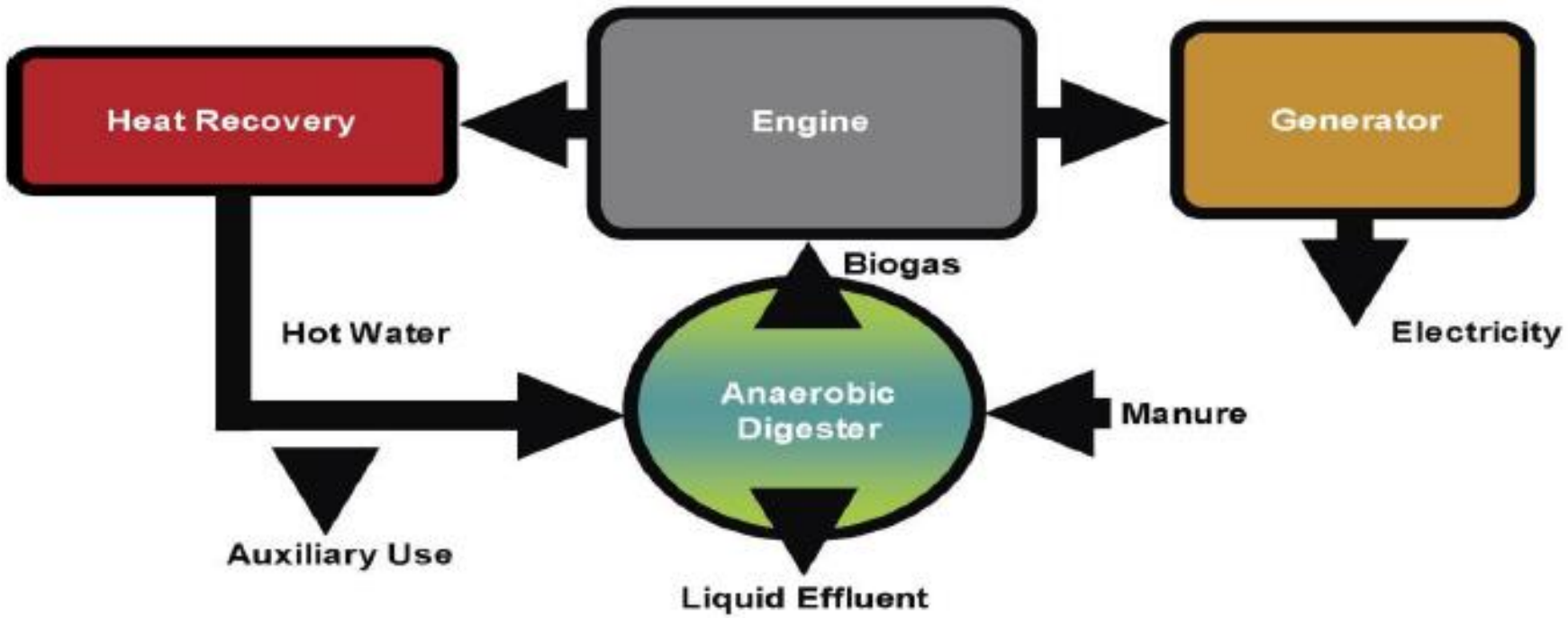
1. Biogas used in duel fuel engine with 75% - 80 % replacement of diesel
2. Through 100% biogas engines
3. Through fuel cells – direct conversion of biogas into electricity.
4. Through burning biogas in boiler → steam → turbine → electricity

Facts need to keep in mind….

- Biogas can be burned and used as a heat source (produce hot air, hot water or steam).
- Biogas can be used to operate an engine generator set that produces electricity and if the waste heat is captured and used, (Combined Heat & Power-CHP), plant efficiency improves.
- The monetary benefit occurs when the electricity generated is used to replace electricity that's normally bought at retail.
- A Combined Heat & Power (CHP) unit increases the cost of an anaerobic digester system.
- You can store gas – but can't store electricity.

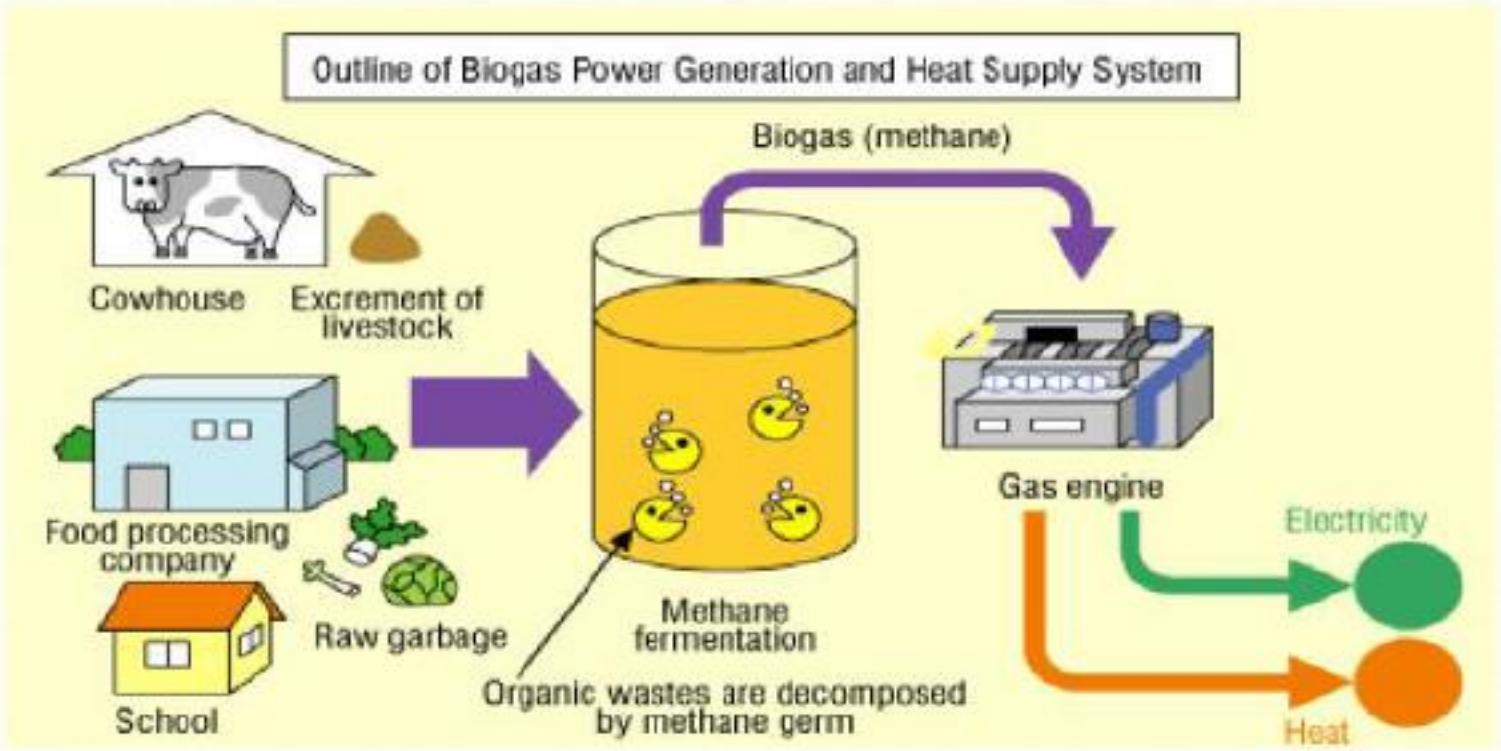
Biogas into Electricity conversion through Engines

How it's used...

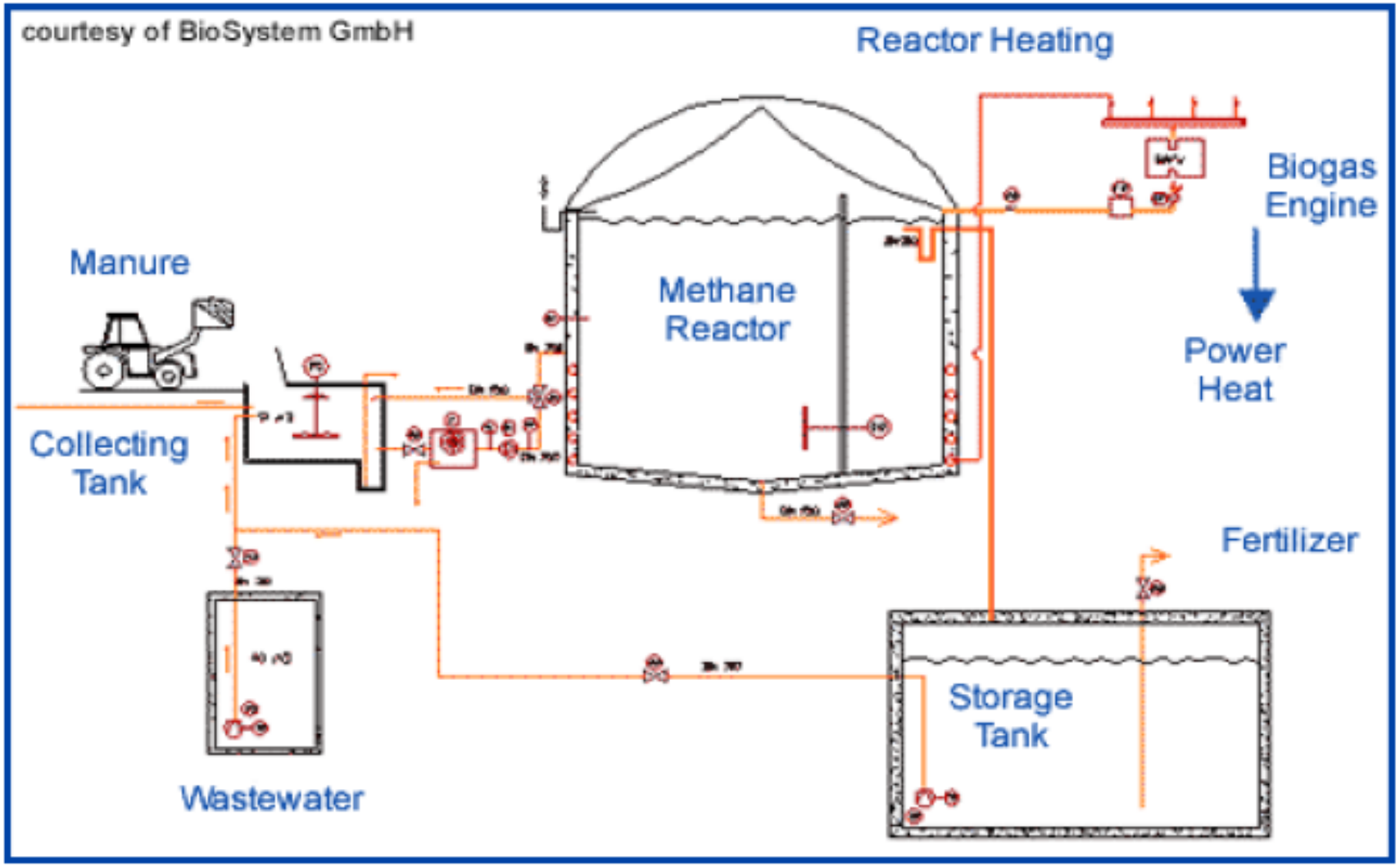


Power generation from biogas…..

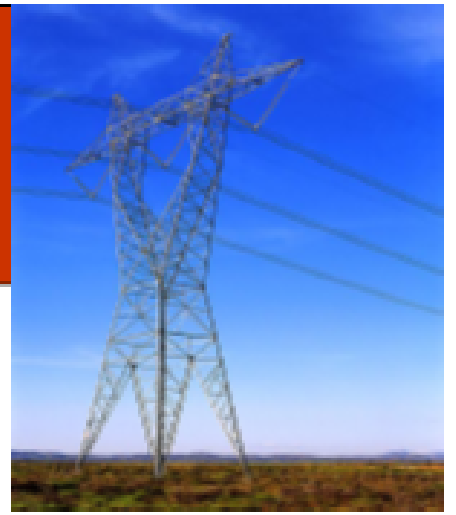
Bio Gas Power



General Process flow diagram….



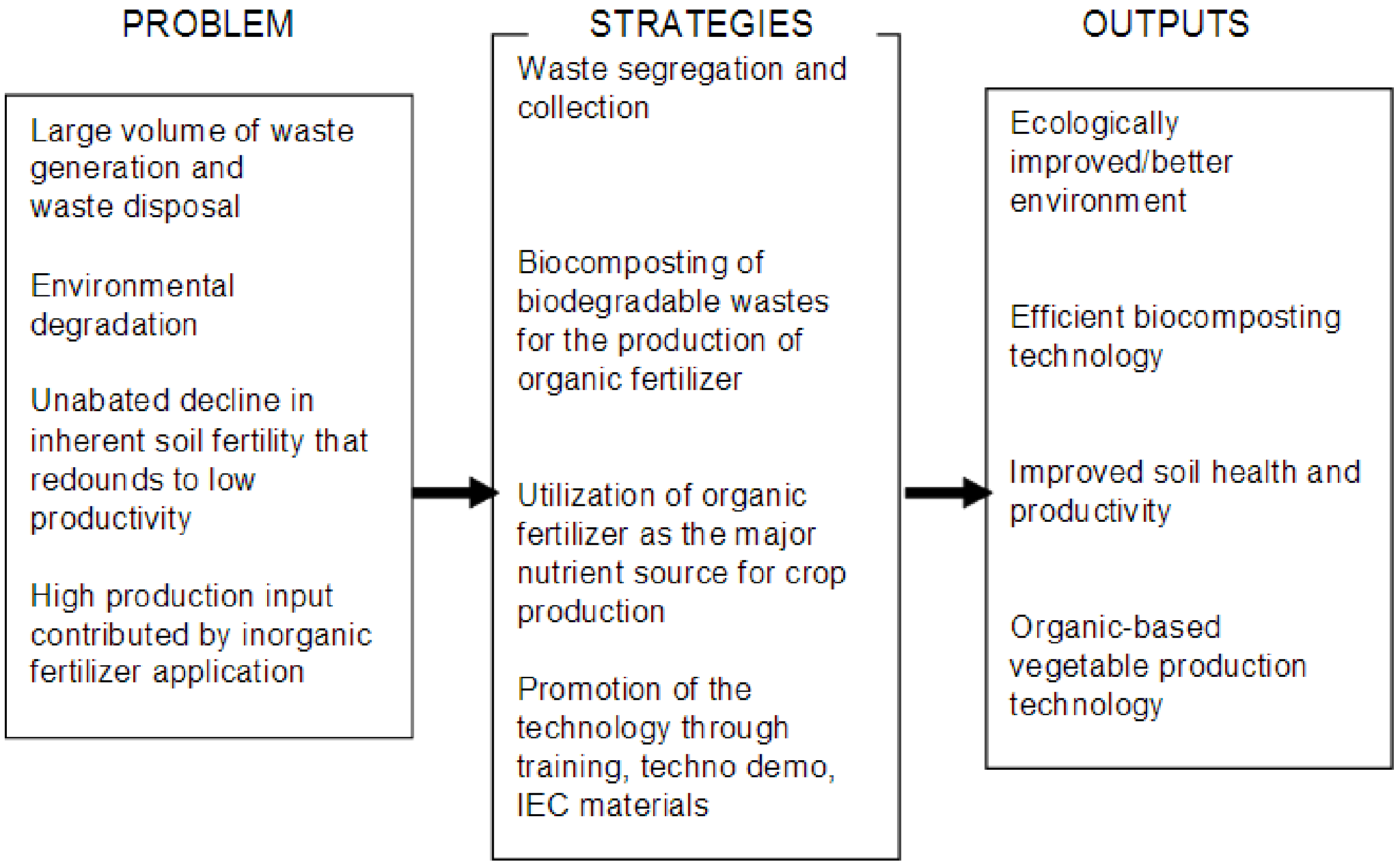
Advantages of biogas based power generation



- *Usable fuel*
- *Useful by-products from the biogas process*
- *Reduces Greenhouse Gas emissions*
- *Sustainable Resource as long as we have wastes*
- *Could fulfill the gap in the peak electricity demand and supply*
- *Highly possible in community and institutional biogas plants*

Guidelines for organic fertilizer production from solid waste

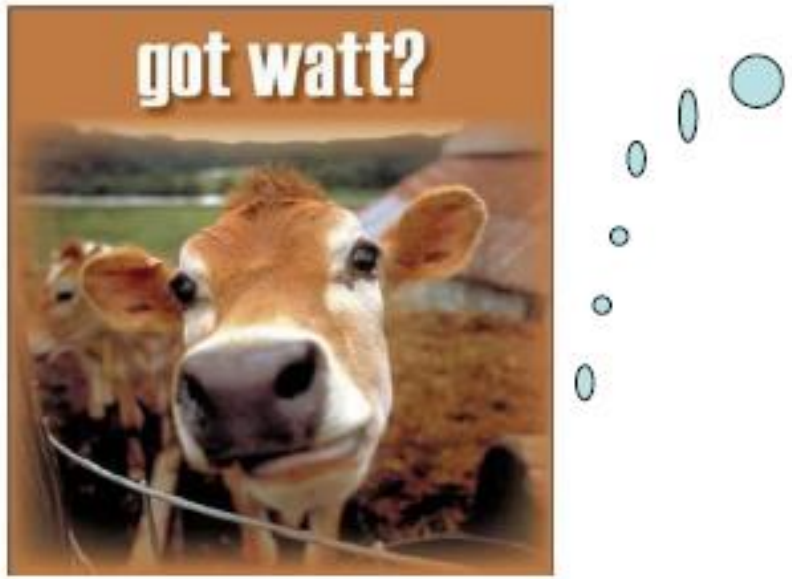
1. Collect raw materials (leaf litter, farm waste, household and market waste, buffalo or goat manure, carbonized rice hull).
2. Mix the materials at a ratio of 2:1:1 (2 solid waste [household, farm, market]: 1 buffalo, chicken or goat manure:1 carbonized rice hull).
3. Moisten the mixed materials and shred to reduce the size and to enhance the decomposition process.
4. Pile the shredded materials at the height of 100-150 cm under shed and cover with plastic to increase the temperature, maintain moisture and minimize escape of gases to the atmosphere.
5. Monitor the temperature of the pile weekly. Maintain 60% moisture in the pile. If the compost pile becomes dry, moisten it using compost leachate or manure tea.
6. After two weeks, open and turn the pile thoroughly to facilitate uniform decomposition.
7. Incubate for another two weeks or more depending on the type of compost material. If most of the compost material is composed of leaf litter and/or rice straw, decomposition is prolonged from 30 days to 60 to 75 days.
8. After another two weeks, the compost is already mature. Matured compost material is compost that does not generating heat, has no smell of decomposing material and looks like soil. Harvest the composted material and spread on a flat floor in the drying area for at least a week or to a moisture level of 30%. Avoid sun drying the harvested composted material.
9. Shred and sieve using a 2-cm mesh prior to bagging.
10. Pack the composted material using polyethylene plastic bags in a sack (50 kg/bag) and store in a cool dry place.


PROBLEM
Large volume of waste generation and waste disposal
Environmental degradation
Unabated decline in inherent soil fertility that redounds to low productivity
High production input contributed by inorganic fertilizer application
STRATEGIES
Waste segregation and collection
Biocomposting of biodegradable wastes for the production of organic fertilizer
Utilization of organic fertilizer as the major nutrient source for crop production
Promotion of the technology through training, techno demo, IEC materials
OUTPUTS
Ecologically improved/better environment
Efficient biocomposting technology
Improved soil health and productivity
Organic-based vegetable production technology

Conclusion

Biogas plants provide a fully sustainable and integrated system for resource and environmental management that offer governments a multipurpose technology option for fulfilling a cluster of policy needs. For example, biogas can be used to displace fossil fuels otherwise used for heating, electricity and transport. In addition, digestate is an easy to use biofertilizer that can be used to replace fossil fuels that otherwise would be used for fertiliser manufacture and its transport around the world. Production of good quality digestate for use as biofertilizer is the result of careful control of all aspects of the process, from feedstock to field. Feedstock selection, adherence to strict standards (government and/or farmer determined) and compliance with codes of good agricultural practice are all key issues.

"DON'T WASTE THE WASTE"



The Three Rs of Recycling Plus One!