

Biogas Energy Systems



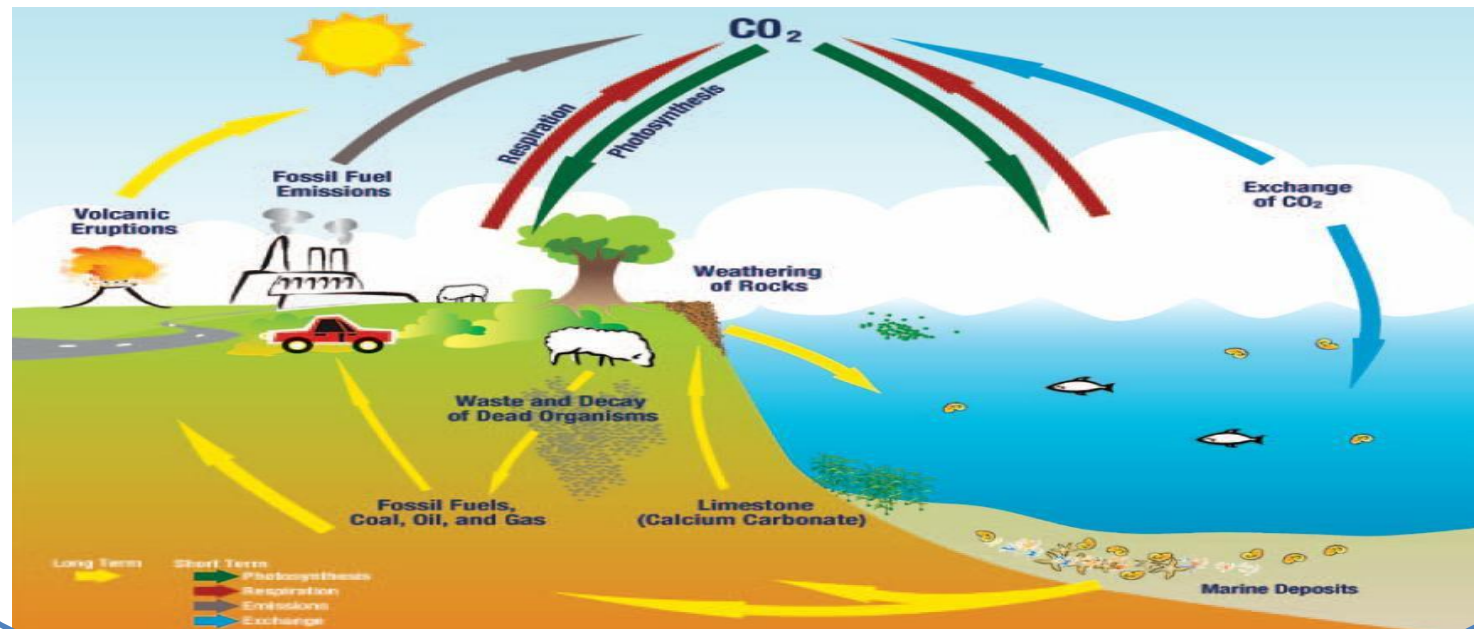
Biogas

- Biogas originates from bacteria in the process of bio-degradation of organic material under anaerobic (without air) conditions.
- The natural generation of biogas is an important part of the biogeochemical carbon cycle.
- Methanogens (methane producing bacteria) are the last link in a chain of micro-organisms which degrade organic material and return the decomposition products to the environment.
- In this process biogas is generated, a source of renewable energy.



Biogas and the Global Carbon Cycle

- Each year some 590-880 million tons of methane are released worldwide into the atmosphere through microbial activity.
- About 90% of the emitted methane derives from biogenic sources, i.e. from the decomposition of biomass.
- The remainder is of fossil origin (e.g. petrochemical processes)



Substrate and Material Balance

- In principle, all organic materials can ferment or be digested.
- However, only homogenous and liquid substrates can be considered for simple biogas plants: Dung and urine from cattle and possibly from poultry and the wastewater from toilets.
- When the plant is filled, the excrement has to be diluted with about the same quantity of liquid, if possible, the urine should be used.



Composition and properties of biogas

- Biogas is a mixture of gases that is composed chiefly of:

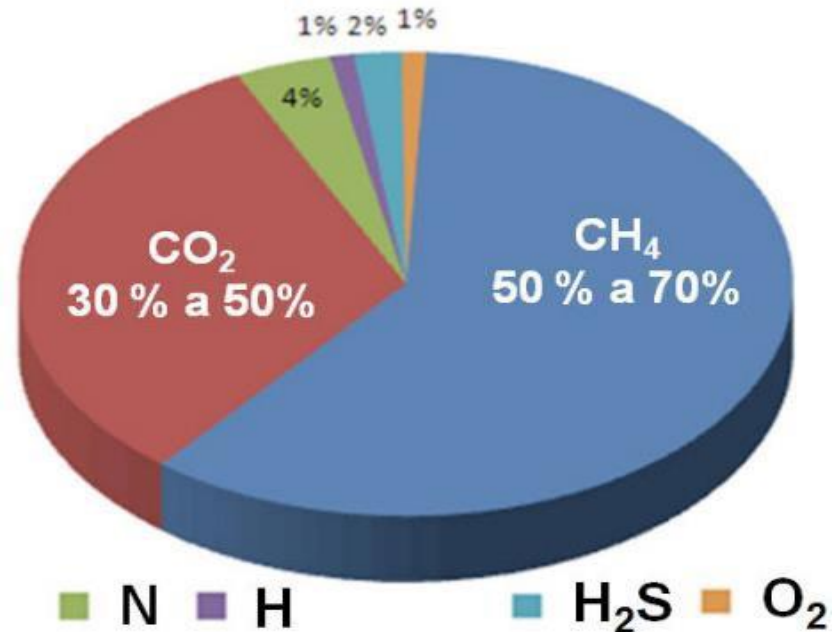
Methane (CH_4): 40-70 vol.%

Carbon dioxide (CO_2): 30-60 vol.%

Other gases: 1-5 vol.% including

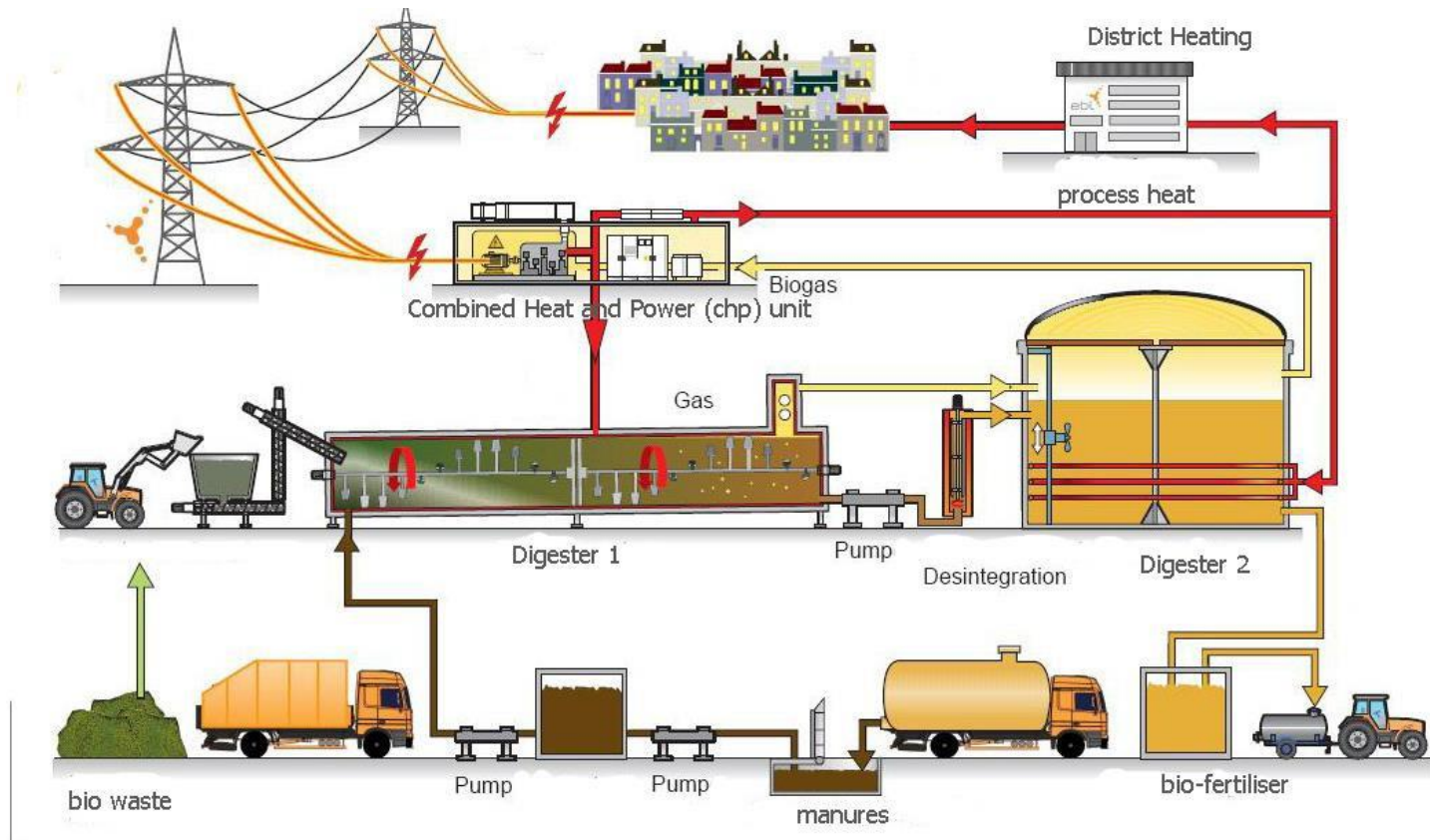
hydrogen (H_2): 0-1 vol.%

hydrogen sulfide (H_2S): 0-3 vol.%



Utilization of Biogas

- Well-functioning biogas systems can yield a whole range of benefits for their users, the society and the environment in general:
- Production of energy (heat, light, electricity) ;
- Transformation of organic waste into high quality fertilizer;



Utilization of Biogas

- Improvement of hygienic conditions through reduction of pathogens (anything that can produce disease), worm eggs and flies;
- Reduction of workload, mainly for women, in firewood collection and cooking.

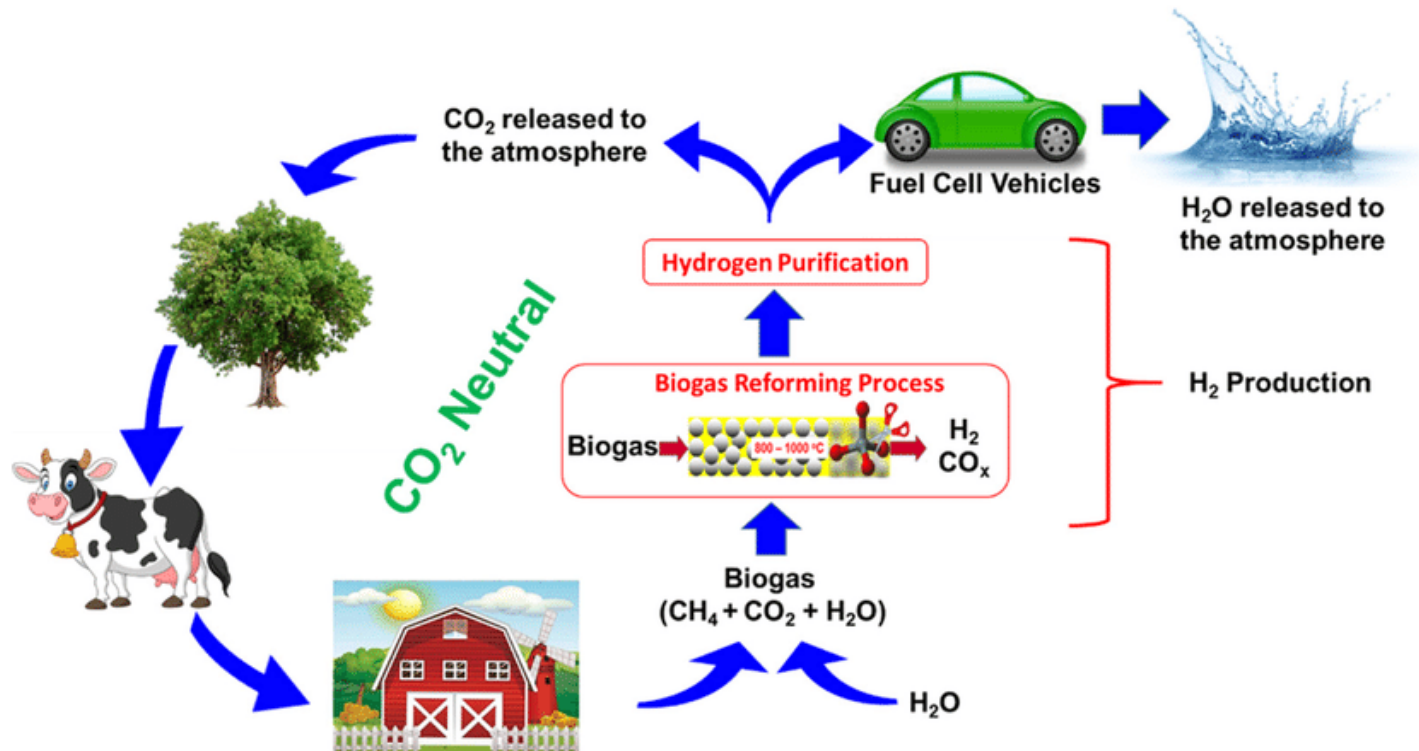


Utilization of Biogas

- Environmental advantages through protection of soil, water, air and woody vegetation;
- Micro-economical benefits through energy and fertilizer substitution.

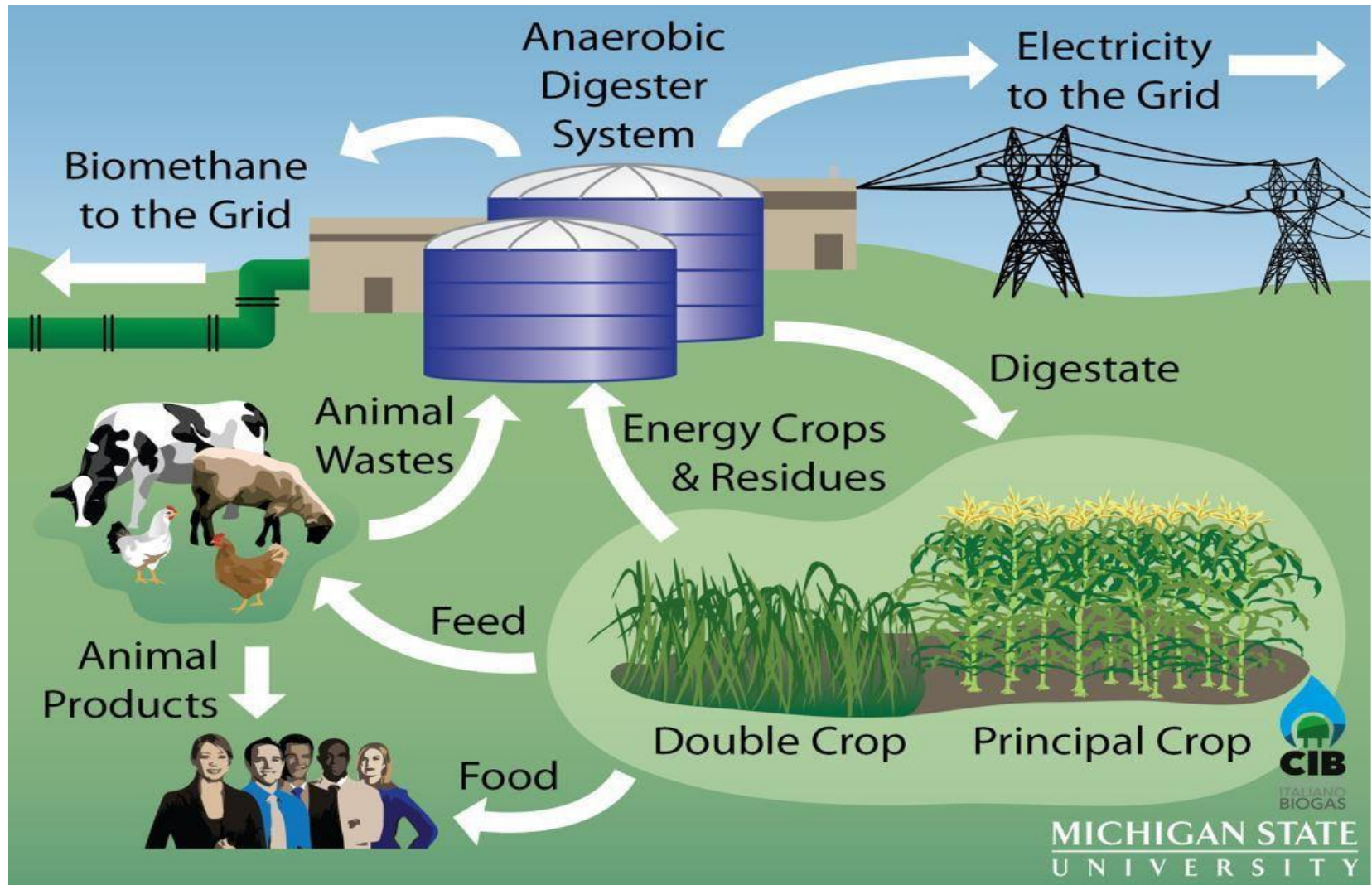


Biogas Generation



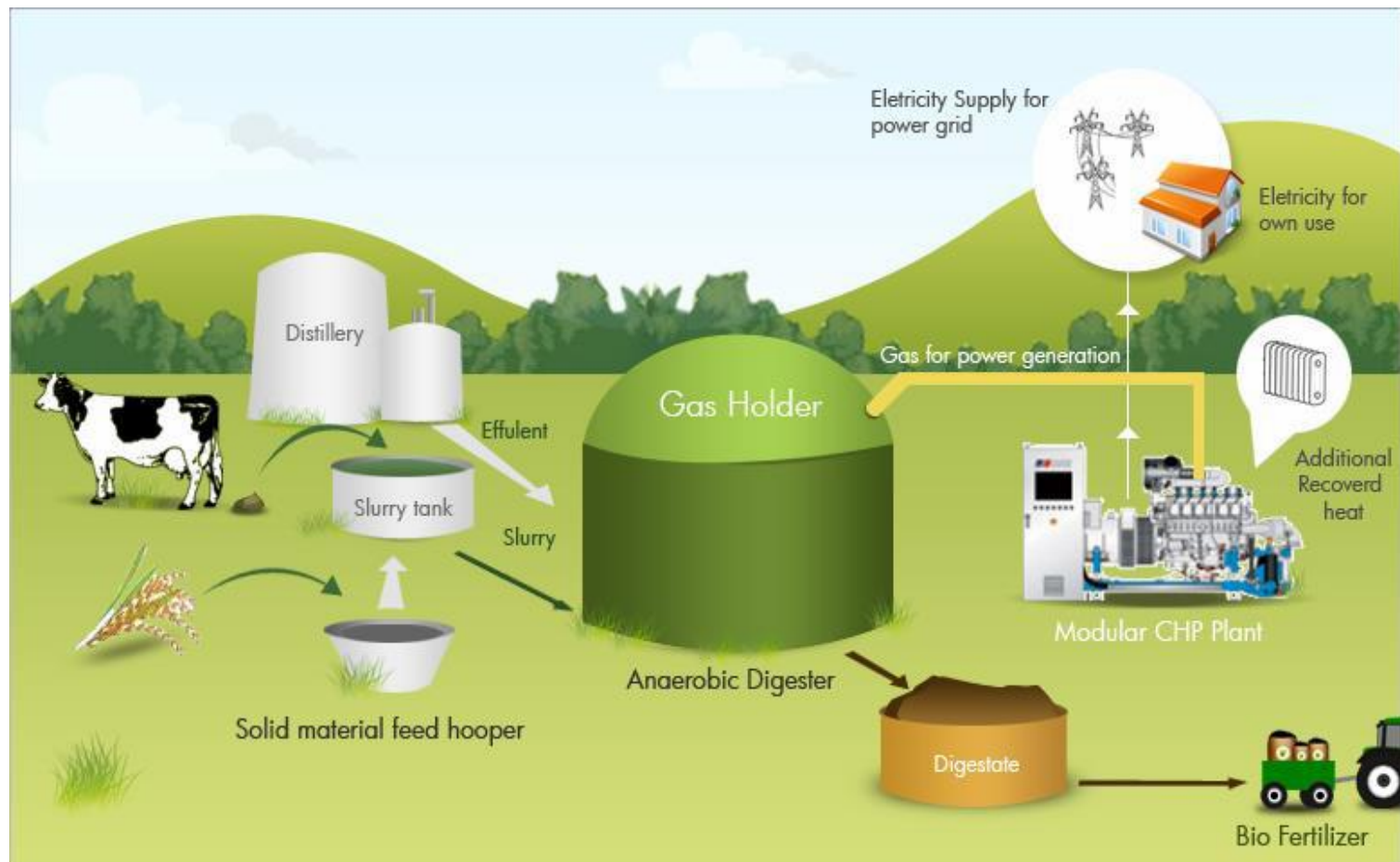
Biogas Plant

- The biogas plant cycle



Biogas Plant

- Raw material for biogas (Dung, biomass etc) is mixed with water and sent to Anaerobic digester.
- Gas and sludge both are very useful bi-products

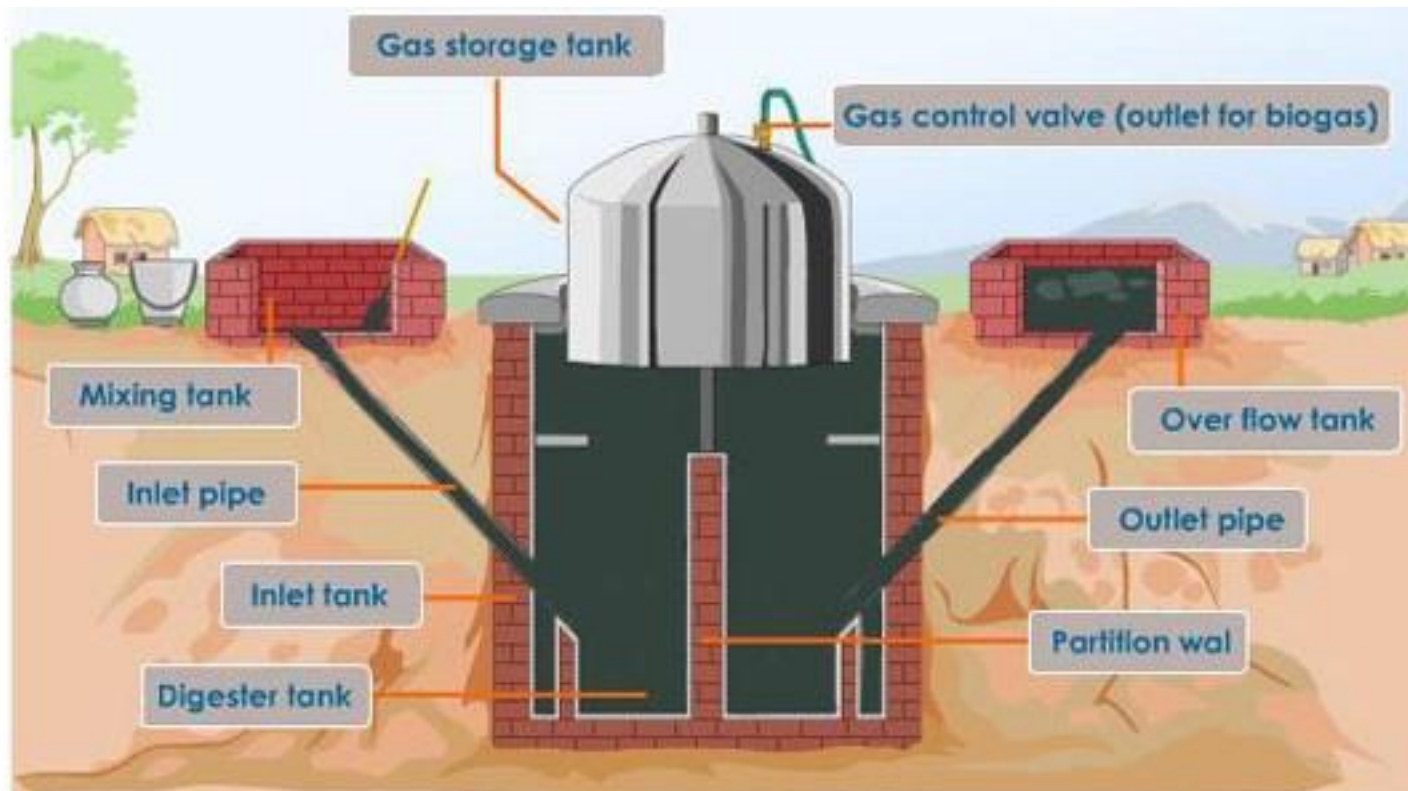


Biogas Plants – Developing Countries



Floating Drum Plants

- In the past, floating-drum plants were mainly built in India.
- A floating-drum plant consists of a cylindrical or dome shaped digester and a moving, floating gas-holder, or drum.
- The gas-holder floats either directly in the fermenting slurry or in a separate water jacket.



Floating Drum Plants

- The drum in which the biogas collects has an internal and/or external guide frame that provides stability and keeps the drum upright.
- If biogas is produced, the drum moves up, if gas is consumed, the gasholder sinks back.



Floating Drum Plants

- Floating-drum plants are used chiefly for digesting animal and human feces on a continuous feed mode of operation, i.e. with daily input.
- They are used most frequently by small- to middle-sized farms (digester size: 5-15m³) or in institutions and larger agro-industrial estates (digester size: 20-100m³).



Floating Drum Plants

- **Advantages:**

- Floating-drum plants are easy to understand and operate.
- They provide gas at a constant pressure, and the stored gas-volume is immediately recognizable by the position of the drum.
- Gas-tightness is no problem, provided the gasholder is derusted and painted regularly.



Proposed Biogas Solution

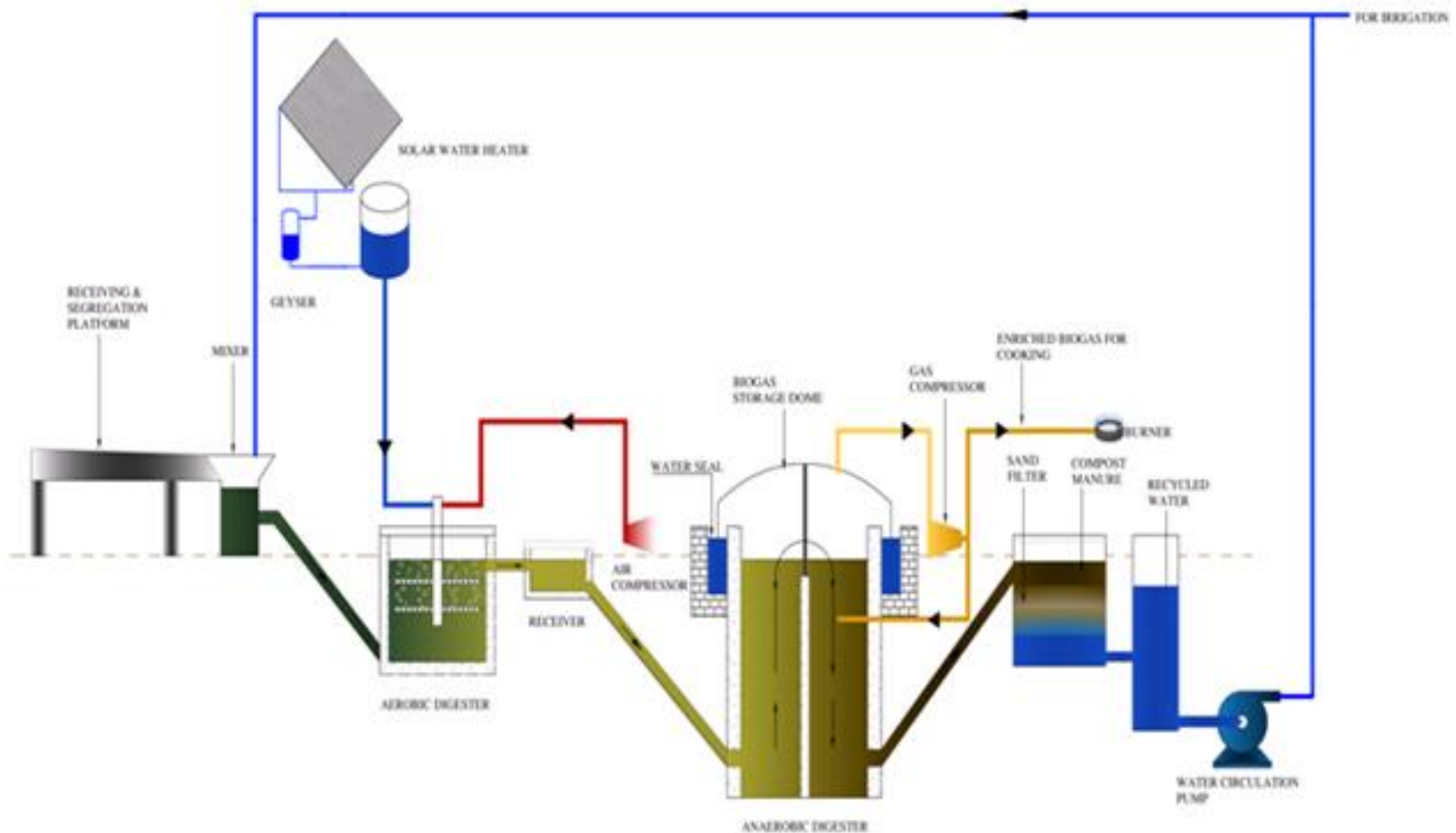


Proposal parameters:

Process Characteristics

Feedstock Load	:	<10,000 kg/day*
Assumed Operating Temperature	:	37 ° C
Biogas Generation Variation	:	± 10%
Totally expected Biogas Production	:	380-400 m ³ /day*
Methane Content	:	Min. 55%*
Operating days	:	340 days/year

Process Flow Diagram of Biogas plant



Large Scale Biogas Plant

- The following slides show few examples of Biogas plants in industrialized countries

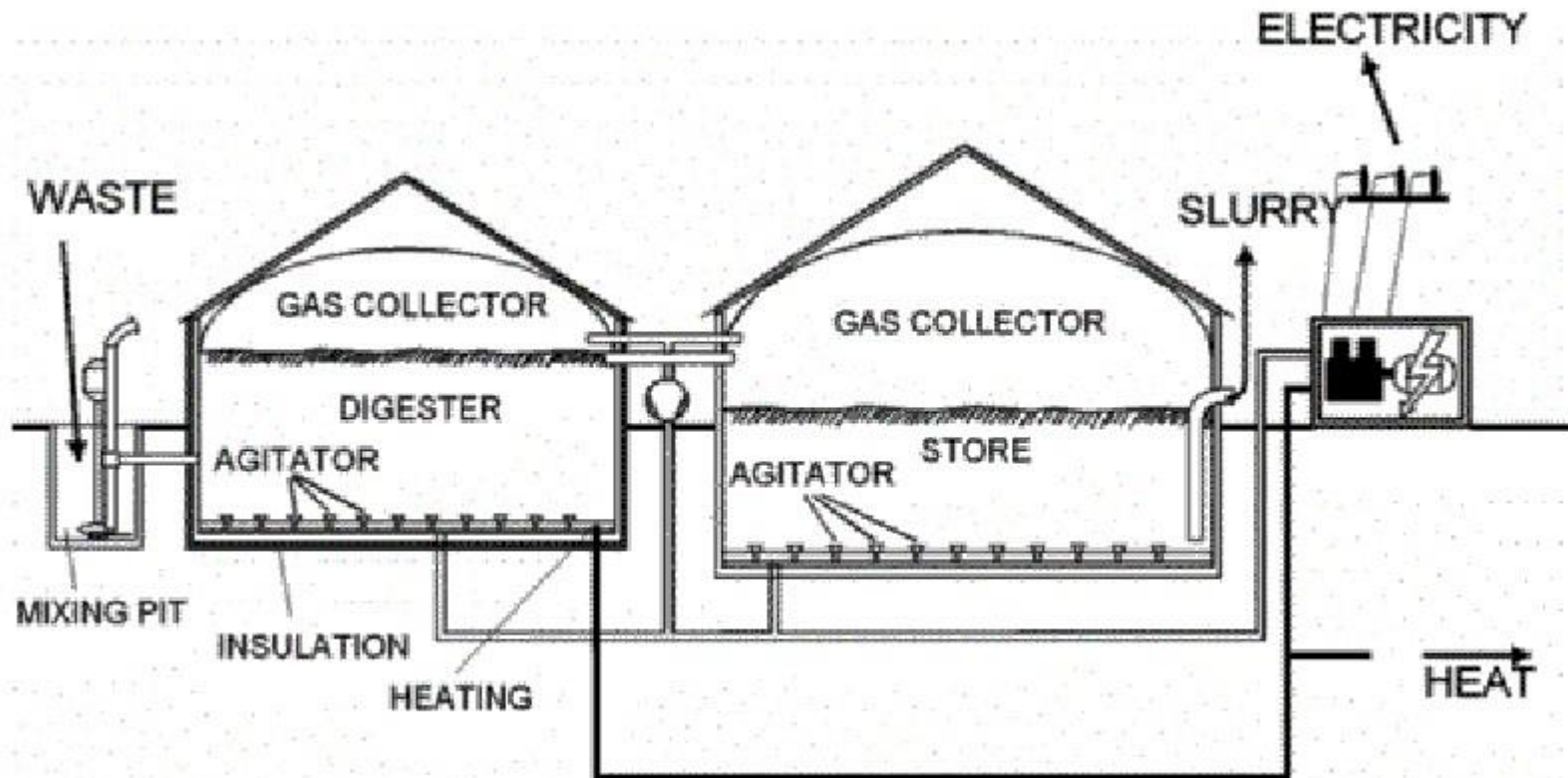


Figure 13: Concrete digester with integrated plastic gas-holder

Photo: TBW

Large Scale Biogas Plant

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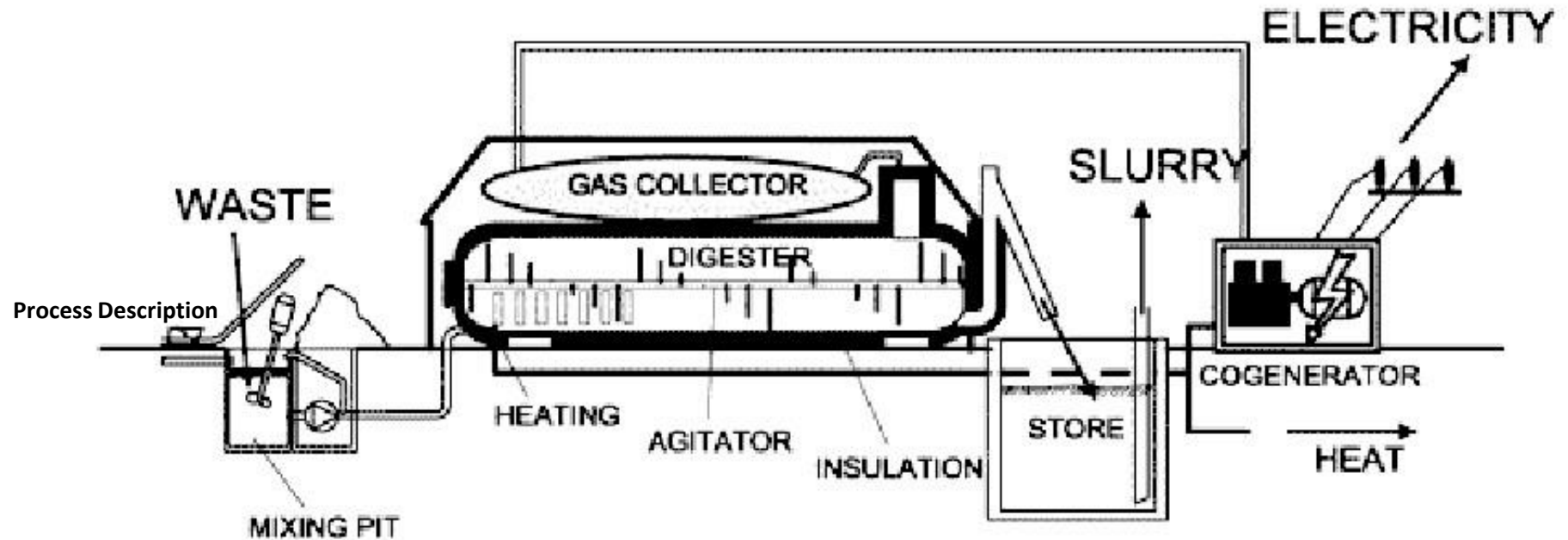


Figure 14: Steelvessel fermenter with sepearte ballon gas-holder

Photo: TBW



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