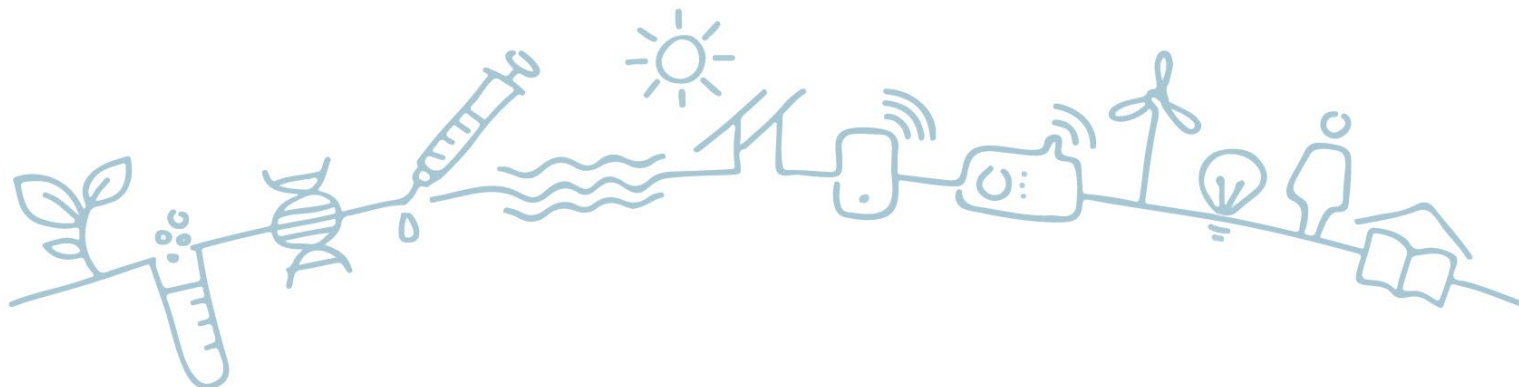


# Technology Assessment of Biogas Systems: Components and Considerations

Roger Sathre

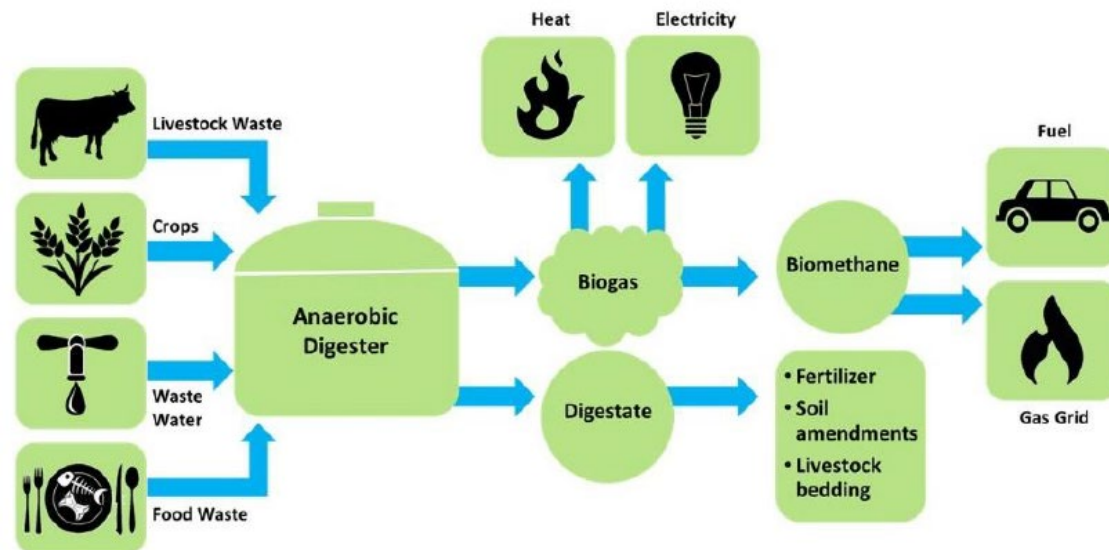
9 May 2023

UNCTAD-DSI Regional Workshop on Technology Assessment



# What is Biogas?

- Produced from anaerobic decomposition of organic matter
- Contains about 60% methane, 40% carbon dioxide, and other trace gases
- Can be used for cooking, electricity, heating, etc.
- Leftover material (digestate) can be used as fertilizer
- Produced worldwide; most common in China



## Scale of Biogas Systems

- Gas production, feedstock demand, capital cost and operational complexity will all vary with scale



*Small-scale: single family household*

*Medium-scale: village or school*

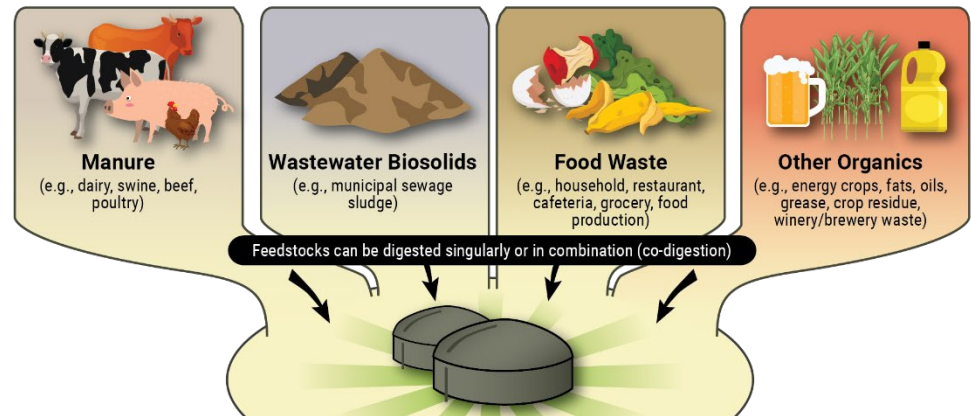


*Large-scale: municipality or commercial dairy farm*



# Feedstock for Biogas Production

- Needs a continuous supply of biomass feedstock
- Feedstock can be:
  - Crop residue
  - Food waste
  - Livestock manure
  - Human manure
  - Other organic residues



- Opportunity cost of using feedstock for biogas production: What else could it have been used for?
- Labor/cost of collecting and loading feedstock into digester

## Products from Biogas Systems

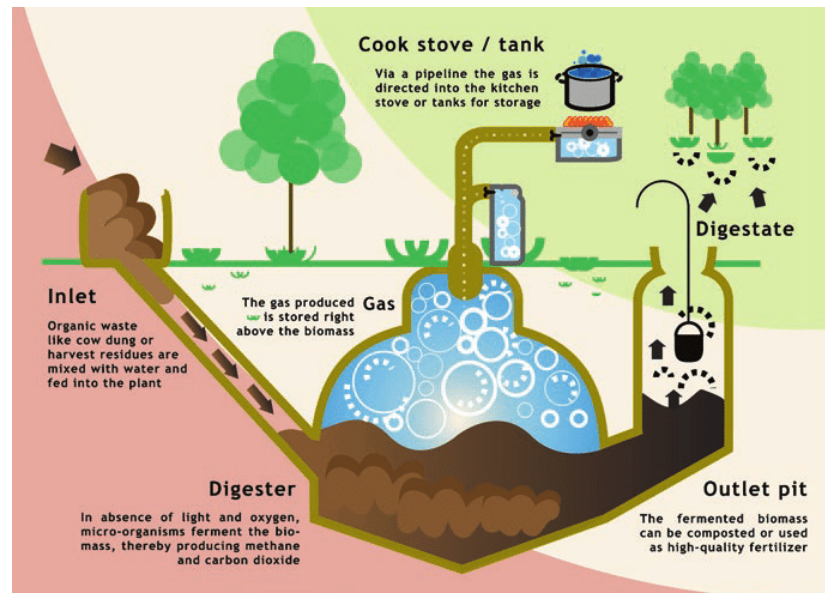
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- Raw biogas can be burned for clean cooking and heating
- Distribution of gas from digester to users:
  - Plastic pipes
  - Low-pressure bags
  - High-pressure cylinders (?)
- Biogas can power a generator to make electricity (with efficiency loss)
- Raw biogas can be upgraded to “renewable natural gas”
- Digestate can be used as crop fertilizer



# Operation of Biogas Systems

- Knowledgeable operator needed to maintain system
  - Feedstock mixing and loading
  - Digestate removal and spreading
  - Gas distribution pipe cleaning
- Without dedicated operator, system will fail and be abandoned



## Cost of Biogas Systems

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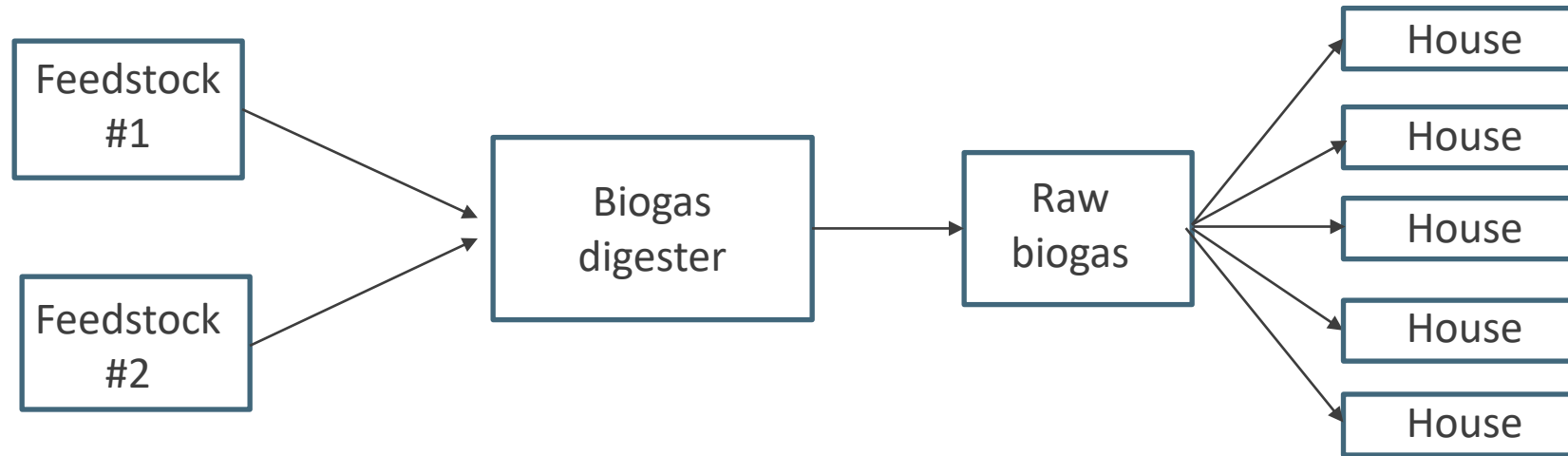
- Capital cost for biogas systems is relatively high (compared to other cooking systems like firewood, charcoal, LPG)
- Capital cost varies with construction type (pop-up, pre-fabricated, site-built, etc.) and scale



- Operational cost for biogas production is low (depending on labor and feedstock cost)

# Technoeconomic Assessment of Biogas Systems

- Determine conversion efficiencies of all processes
- Based on desired end product, determine amount of intermediate products and feedstocks needed



- Example: If we want to produce cooking gas for 5 households, then:
  - How much biogas do we need per day?
  - What size of biogas digester is required?
  - How much feedstock is required daily?
  - How much digestate is produced daily?
  - What labor is needed to operate the system?



## Summary

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- Biogas systems can convert low-value organic waste into high-value energy resource
- Operates continuously, so adequate feedstock supply must be ensured
- Requires trained labor for reliable operation and maintenance
- Capital cost of installation is significant, but operating cost of gas production is low
- Made with common construction materials– no exotic materials needed
- Abandoned biogas systems are result of lack of planning and foresight



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