

Anaerobic Digesters for Renewable Natural Gas



One way farmers can participate in the shift towards more renewable energy is by building an anaerobic digester on their farm or supplying feedstock for a nearby digester.

What is a digester?

An anaerobic digester is a “big artificial stomach” that digests feedstock to produce biogas. A digester needs to be kept warm, free of oxygen (that’s why we use the word “anaerobic”), and moist. On-farm digesters in the United States are usually quite large, and while smaller digesters can be successful, the economics tend to be tougher to justify.

Feedstocks for digesters



Dairy Manure – The most common feedstock in Pennsylvania and many regions of the United States due to its high volume, digestibility, and stability in the digester.



Poultry Manure – Tends to have high ammonia levels that can inhibit methane production. However, dry poultry manure has been used successfully in digesters designed for that purpose.



Swine Manure – Gaining popularity as a feedstock for anaerobic digestion, and shows good promise for future growth.



Grasses – Can be added to a manure digester to increase overall biogas production, however methane yield varies depending on the digestibility of species.



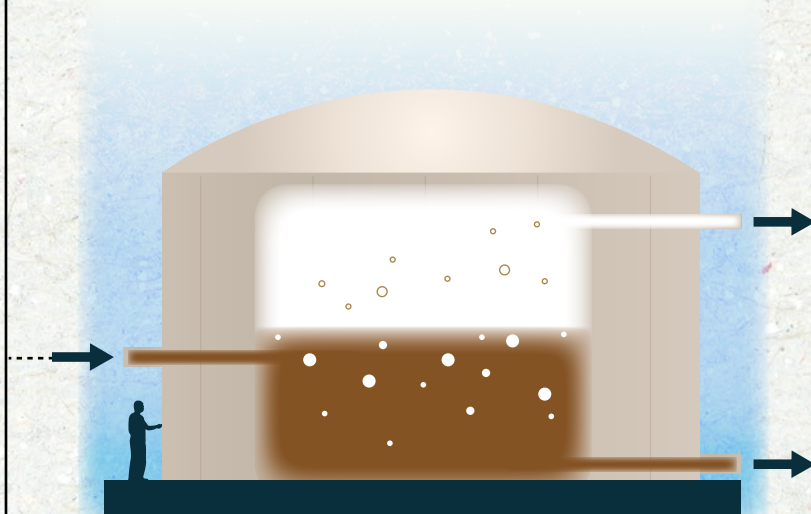
Food Waste – Very digestible materials from local processing plants, restaurants, or retailers who pay a “tipping fee” to divert the material from a landfill.

How do on-farm digesters work?

The most popular type operates at “body temperature” (about 100°F) and uses the naturally occurring microbes that are found in an animal’s gut to break down feedstocks to produce biogas. While complex biochemical reactions occur, the bottom line is if the microbes are kept happy, the system will produce biogas. The most important things to do to keep the microbes happy: **keep the temperature and pH in the right range and exclude oxygen from the digester.**



Biogas is the raw gas produced by anaerobic digestion. The biogas can be cleaned and purified to become renewable natural gas (RNG), which is 98% methane and can be injected into gas distribution pipelines.



Feedstock enters from the left and biogas exits from the top right with effluent leaving from the bottom right. Feedstocks can sit for 3 weeks or more as digestion takes place to form biogas.

What are the main parts of an anaerobic digestion system?



1. Feedstock collection

Examples include a manure slurry tank or silage bunker.



2. Infeed mixing tank

Used to hold the next day's supply of feedstock and mix in any additional materials before adding it to the digester.



3. Digester tank

Can be below or above ground, fully sealed and insulated (especially when located in a cold climate).



4. Biogas treatment

Depending on biogas end use, a system may need no treatment, sulfur removal only, or a sophisticated CO₂ separation system to upgrade to pipeline quality.



5. Biogas end use

Most common uses:

- Run it in a generator to generate electricity and heat on site
- Inject it into a pipeline to sell



6. Digestate treatment

Most of the feedstock mass remains after digestion – solids usually separated at this point.



7. Solids storage

If solids are separated from the digestate effluent, they will need to be stored in a covered location.



8. Liquid effluent storage

Large lagoon where digestate is kept until conditions are suitable for land application.



9. Flare

Biogas without a dedicated use should be converted to CO₂ by flaring before release into the atmosphere.

Why do farmers install anaerobic digesters?

- Provide a new income stream for the farm.
- Provide bedding from digestate separated solids.
- Liquid digestate retains nutrients and can be used as fertilizer.
- Generate biogas on site to make the farm more independent and renewable.
- Dramatically reduce livestock odors - nice for farmers and neighbors alike.
- Owning and running a digester can actually be kind of fun!

NOTE: There are a variety of digester types and configurations on the market, so this description is for a "typical system" that could be found on a farm with a digester.

Penn State Extension renewable energy programs: <http://energy.extension.psu.edu>

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