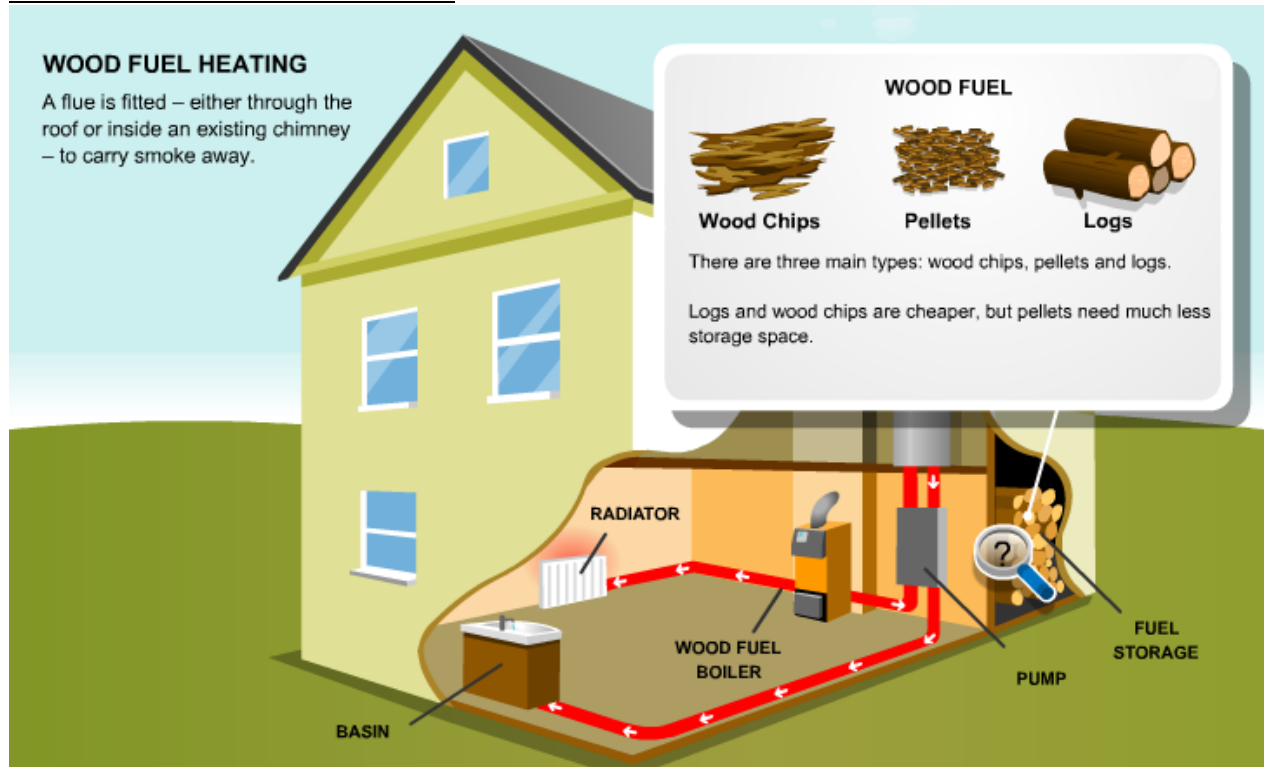


## How a home biomass boiler works



[http://www.proenviro.com/UK/images/services/biomass\\_diagram2.png](http://www.proenviro.com/UK/images/services/biomass_diagram2.png)

A residential biomass system operates by using the combustion of the wood fuel in the boiler which produces heat that can be transferred directly through the radiator in the house for heating, or can be connected to a heat medium such as water to be used for hot water heating.

### How much biomass would I need to heat my house?

The typical house in New York uses around 700,000 BTU per day in the winter time  
Assuming that you had a 70% efficient system:

#### Wood:

200 lbs. per day (wet), 120 lbs. per day (dry)

#### Corn Stover

190 lbs. per day (wet), 130 lbs. per day (dry)

#### Straw/Switchgrass

180 lbs. per day (wet), 150 lbs. per day (dry)

#### Wood Pellets

120 lbs. per day

How much would it cost to heat my house for the winter (4 month)?

Assuming within a 20 mile transport distance:

Wood

200 lbs/ day x 120 days= 24000 lbs or 12 tons (wet)

120 lbs/day x 120 days= 14400 lbs. or 7.2 tons (dry)

Wood Fuel Cost@\$20/ton = \$240 (wet), \$144 (dry)

Transportation Costs@\$15/ton = \$180 (wet), \$108 (dry)

Total Costs= \$420 (wet), \$252 (dry)

Corn Stover

190 lbs/day x 120 days= 22800 lbs or 11.4 tons (wet)

130 lbs/day x 120 days= 15600 lbs or 7.8 tons (dry)

Corn Fuel Cost@\$71/ton= \$809.40(wet), \$553.80 (dry)

Transportation Costs@\$15/ton= \$171 (wet), \$117 (dry)

Total Costs = \$980.40 (wet), \$670.80 (dry)

Straw/ Switchgrass

180 lbs/day x 120 days= 21600 lbs or 10.8 tons (wet)

150 lbs/day x 120 days= 18000 lbs or 9.0 tons (dry)

Switchgrass Fuel Cost@\$75/ton= \$810(wet), \$675 (dry)

Transportation Costs@\$15/ton= \$162 (wet), \$135 (dry)

Total Costs = \$972 (wet), \$810 (dry)

Wood Pellets

120 lbs/day x 120 days= 14400 lbs or 7.2 tons

Pellet Fuel Cost@\$200/ton= \$1440

Transportation Costs@\$15/ton= \$108

Total Costs = \$1548

#2 Fuel Oil

115,000BTU/gal

Fuel Costs@\$4/gal= \$2921.74

Natural Gas

Fuel Cost@\$12.38/ 1000ft<sup>3</sup> = \$1039.92

Keep in mind that the capital cost for a high efficiency boiler around \$4000-10,000

What fuel type is right for you

| Fuel Type    | Pros  | Cons  |
|--------------|---|---|
| Wood, Logs   | Very Low Fuel cost, easily available, easy to store,  | Frequent stoking required (every 2-8 hrs), more emissions and odor                              |
| Wood Chips   | Low fuel costs, automated stoking possible, easy handling, generally for systems about 50 KW                | Careful handling and storage required , high capital cost, chipper required for self-production |
| Wood Pellets | Low user input required, reduced storage space and transport distance, suitable for applications up to 50KW | Higher fuel costs, medium capital costs   |

Electricity generation from biomass

A 2-3 bedroom house would require about a 30-50KW system.

Capital costs usually range from \$2,000-2600/KW for electricity generation



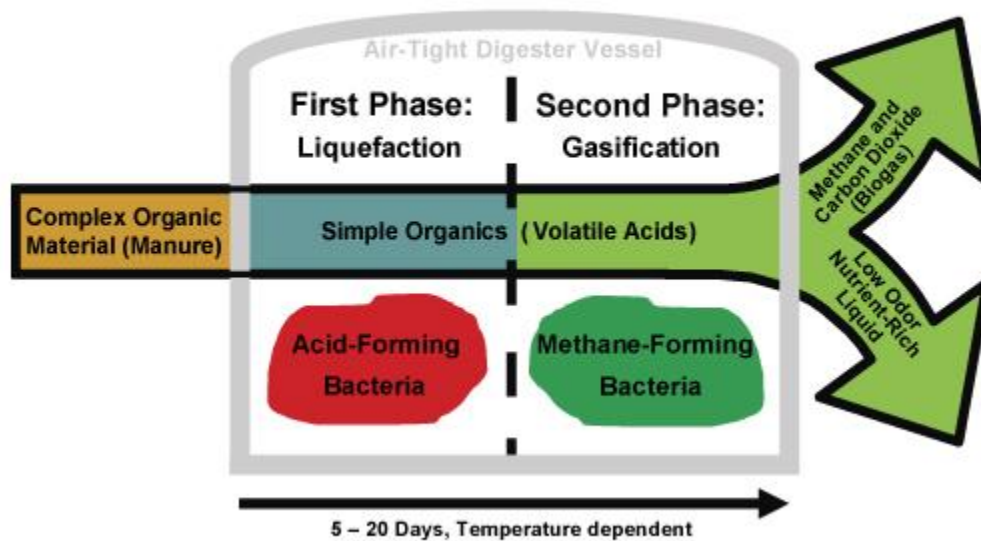
Euro 30 KW log boiler

## Anaerobic Digesters

Anaerobic Digestion is essentially the decomposition of organic matter in this case animal manure using heat, and bacteria in an oxygen free vessel for the production of biogas.

This biogas can be used for heating purposes as a substitute for natural gas, but can also be used for electricity generation via combustion. Cogeneration systems are also popular in which the biogas is combusted to produce both heat and electricity.

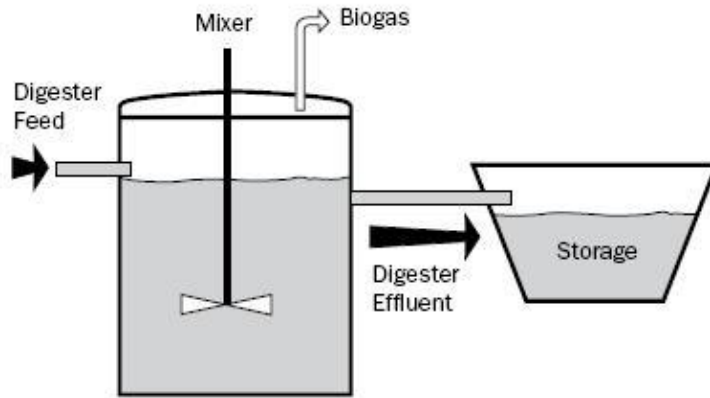
### How it works...



<http://revmodo.com/2012/06/11/anaerobic-digester-power-system-comes-online-at-maine-farm/>

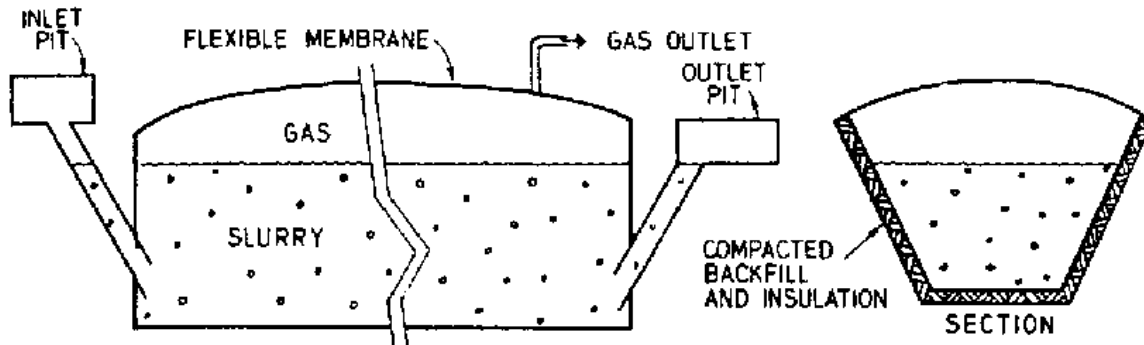
### 3 System Types:

1. **Completely Mixed-** this system uses a large where fresh material is mixed with partially digested material. The most common fuel types are animal manure, and agricultural wastes.



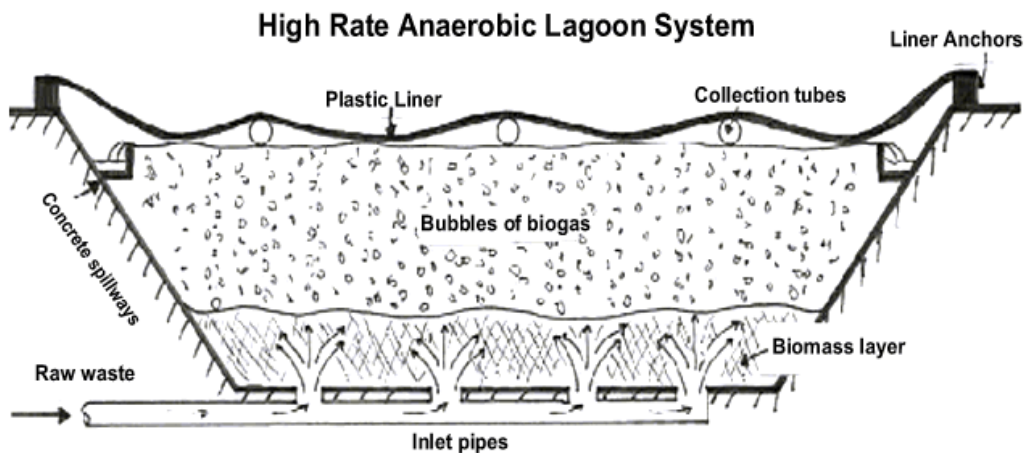
<http://climatetechwiki.org/sites/climatetechwiki.org/files/images/extra/mixed%20reactor.jpg>

2. Plug Flow- typically employs long channels where liquid manure is moved into a large digester using gravity to move the manure.



<http://www.fao.org/docrep/T0541E/T0541E0H.GIF>

3. Covered Lagoon- is a large anaerobic lagoon with a long retention time that uses a flush manure system that dispenses manure at .5 to 2% solids. They are not heated and have a 30-45 day retention period.



[http://www.wioa.org.au/conference\\_papers/00/paper2.htm](http://www.wioa.org.au/conference_papers/00/paper2.htm)

How much do these systems cost?

-In this case the amounts are intended for dairy farmers using 2003-2009 cost estimates

| Digester Type  | Capital Cost (\$)                            |
|----------------|--|
| Complete Mix   | 563 x the number of dairy cows<br>+ 320, 864 |
| Plug Flow      | 617 x the number of dairy cows<br>+ 566,006  |
| Covered Lagoon | 400 x the number of dairy cows<br>+ 599,556  |

[http://www.epa.gov/agstar/documents/digester\\_cost\\_fs.pdf](http://www.epa.gov/agstar/documents/digester_cost_fs.pdf)

It is also believed that 1 KW of electricity can be produced from the manure of 5-7 cows.

Is a way to increase our energy independence and is an excellent option for farmers especially those who want to live off grid.

Compiled by: Greg Gronski, Alternative Energy Research Assistant

Information gathered from:

<http://www.biogas.psu.edu/coveredlagoon.html>

[http://www.biomassenergycentre.org.uk/pls/portal/docs/PAGE/BEC\\_TECHNICAL/BEST%20PRACTICE/38215\\_FOR\\_BIOMASS\\_3\\_LR.PDF](http://www.biomassenergycentre.org.uk/pls/portal/docs/PAGE/BEC_TECHNICAL/BEST%20PRACTICE/38215_FOR_BIOMASS_3_LR.PDF)

[http://www.epa.gov/chp/documents/biomass\\_chp\\_catalog\\_part7.pdf](http://www.epa.gov/chp/documents/biomass_chp_catalog_part7.pdf)

[http://www.duke-energy.com/pdfs/BTUpperYr\\_Central\\_Nov.pdf](http://www.duke-energy.com/pdfs/BTUpperYr_Central_Nov.pdf)