Iowa Farm Bureau

Economics of Biogas

Methane (Biogas) from Anaerobic Digesters

- Methane is a gas that contains molecules of methane with one atom of carbon and four atoms of hydrogen (CH_4).
- It is the major component of the "natural" gas used in many homes for cooking and heating.
- It is odorless, colorless, and yields about 1,000 British Thermal Units (Btu) of heat energy per cubic foot when burned.
- Natural gas is a fossil fuel that was created eons ago by the anaerobic decomposition of organic materials. It is often found in association with oil and coal.

Biogas Heating Potential

- Biogas produced in anaerobic digesters consists of methane (50%-80%), carbon dioxide (20%-50%), and trace levels of other gases such as hydrogen, carbon monoxide, nitrogen, oxygen, and hydrogen sulfide.
- The relative percentage of these gases in biogas depends on the feed material and management of the process.
- When burned, a cubic foot of biogas yields about 10 Btu of heat energy per percentage of methane composition.
- For example, biogas composed of 65% methane yields 650 Btu per cubic foot.

Digester 101- Digester Basics

- Anaerobic digesters are made out of concrete, steel, brick, or plastic.
- They are shaped like silos, troughs, basins or ponds, and may be placed underground or on the surface.
- All designs incorporate the same basic components: a pre-mixing area or tank, a digester vessel(s), a system for using the biogas, and a system for distributing or spreading the effluent (the remaining digested material).

Digester 101-Types of Digesters

- Two basic types of digesters: **batch and continuous.**
- Batch-type digesters are the simplest to build. Their operation consists of loading the digester with organic materials and allowing it to digest.
- In a continuous digester, organic material is constantly or regularly fed into the digester. The material moves through the digester either mechanically or by the force of the new feed pushing out digested material.
- Unlike batch-type digesters, continuous digesters produce biogas without the interruption of loading material and unloading effluent.
- Many livestock operations store the manure they produce in waste lagoons, or ponds. A growing number of these operations are placing floating covers on their lagoons to capture the biogas. They use it to run an engine/generator to produce electricity.

Digesters 101- Factors Affecting Digestion

- **Temperature.** Anaerobic bacteria communities can endure temperatures ranging from below freezing to above 135° Fahrenheit (F)
  - but they thrive best at temperatures of about 98°F (36.7°C) (mesophilic)
  - and 130°F (54.4°C) (thermophilic).
  - Bacteria activity, and thus biogas production, falls off significantly between about 103° and 125°F
  - and gradually from 95° to 32°F (35° to 0°C).
  - decomposition and biogas production occur more rapidly in the thermophilic range than in the mesophilic range.
  - However, the process is highly sensitive to disturbances such as changes in feed materials or temperature.
  - all anaerobic digesters reduce the viability of weed seeds and disease-producing (pathogenic) organisms, but thermophilic digestion results in more complete destruction.
  - Digesters operated in the mesophilic range must be larger (to accommodate a longer period of decomposition within the tank, but the process is less sensitive to upset or change in operating regimen.

Digesters 101 – Other Factors

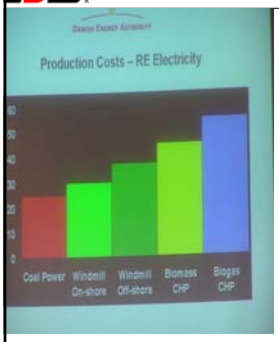
- pH
- water/solids ratio
- carbon/nitrogen ratio
- mixing of the digesting material
- particle size of the material being digested
- retention time.

Danish Thermophilic System

Danish thermophilic system

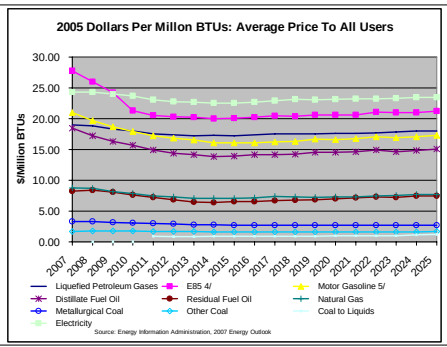
Danish Thermophilic system

Danish Energy Costs

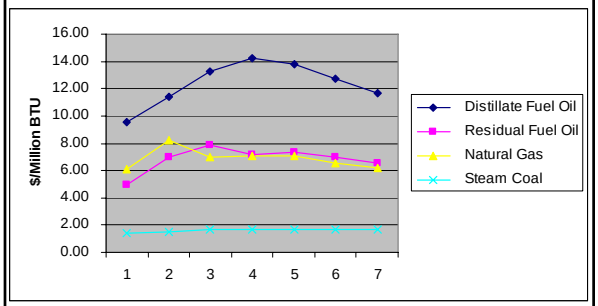


- Biogas is nearly twice as expensive as coal
- More expensive than wind.
- Divide by 7 to get to US dollars per million Btu

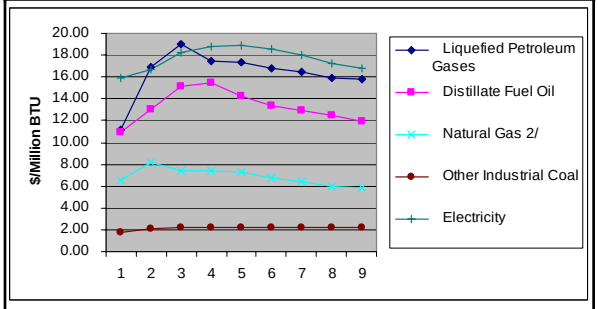
Relative Energy Values



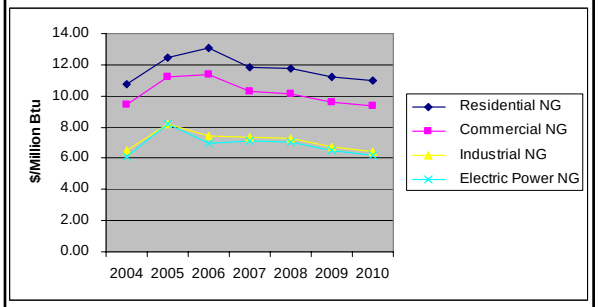
Energy Costs for Electrical Generation



Energy Costs – Industrial Use



Natural Gas Costs by Application



Iowa Section 476C Incentive

- "Energy production capacity equivalent" means the amount of energy in a standard cubic foot of hydrogen gas or the number of Btus that are equal to the energy in a kwh of electricity.
- For the purposes of this chapter, one kwh shall be deemed equivalent to 3,333 Btus of heat for commercial purposes or 10.45 of standard cubic feet of hydrogen gas.
- "Heat for a commercial purpose" means the heat in Btu equivalents from methane or other biogas produced in this state sold to a purchaser of renewable energy for use for a commercial purpose.

Section 476C Tax Credit

- A purchaser of renewable energy may receive renewable energy tax credits under this chapter in an amount equal to:
  - 1.5 cents per kwh of electricity, or
  - $4.50 per million Btu of heat for a commercial purpose, or
  - $1.44 per one thousand standard cubic feet of hydrogen fuel generated by and purchased from an eligible renewable energy facility.

Section 476C Tax Credit

- Need 1 qualified owner for every 2.5 MW of nameplate capacity
- 20 MW set-aside for non-wind facilities
- Must put unit into service by Jan 1, 2011
- Credits must be claimed by Dec 31, 2020
- Credit may be transferred one time.