Biogas Uses

- Majority using IC engine/generator sets (size range 100kW to 775 kW)
- Some have tried microturbines
- Biogas-fired boilers (heat digester & meet other thermal loads)
- New technologies
  - Sterling Engine
  - Fuel cells
  - Produce hydrogen
  - Pipeline quality gas
  - Compressed gas
Biogas Uses

Challenges with electricity generation

- Electricity sales (often low)
- Cost of purchased electricity (low?)
- Cost of generating equipment
- Increased maintenance demand
- Utility interconnection issues
- Inefficiencies in conversion to electricity
Alternative Biogas Uses

- Thermodynamic efficiencies for heating applications (beyond digester heating– create value-added products)
- Gas cleanup and sale to utilities
- Gas cleanup, bottle and sell as a CNG, fleet fuel
- Gas cleanup and add to NG pipeline
Figure 4.2  Average Daily Methane Content in Raw Biogas at DDI  
(July - November 2003)
Figure 4.5  Average Daily BTU in Raw Biogas at DDI
(July - November 2003)
Figure 4.8  Average H$_2$S Concentrations at 5 NY State Dairies
**Biomass Processing & Methane Production**

- Anaerobic Fermentation of Manure in a Plug Flow Biodigester

**Fuel Cell Cogeneration**

- Biogas (Methane)

**Energy Utilization**

- Heat
- Electricity
- Nutrient Rich Stream
- Compost or Dry Bedding

- Heat/Cogen

- Biogas
- H2S scrubber

- CO2 scrubber

**Factors and Other Enterprises (e.g., Greenhouses, Pastuerization, Aquaculture, etc.)**

- H2S

- Heat/Cogen

- Nutrient Rich Stream

- Electricity

- CO2 Supply

- Home Heating/Air Conditioning

- Electrical Supply
Table 4.5
Present Worth of Biogas Sales Over a Ten-Year Period
For NG Pipeline (3000 cows)

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital Cost</td>
<td>$991,200</td>
</tr>
<tr>
<td>Interest Rate</td>
<td>5%</td>
</tr>
<tr>
<td>Inflation Rate</td>
<td>3%</td>
</tr>
<tr>
<td>Present Worth (PW) of O &amp; M Costs over 10 Years</td>
<td>$579,130</td>
</tr>
<tr>
<td>PW of Income for the Sales of Upgraded Biogas</td>
<td>$1,369,759</td>
</tr>
<tr>
<td>PW of Upgraded Biogas Sales</td>
<td>-$200,572</td>
</tr>
</tbody>
</table>
Table 4.7
Present Worth of Biogas Sales Over a Ten-Year Period For NG Pipeline (10,000 cows)

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital Cost</td>
<td>$2,054,950</td>
</tr>
<tr>
<td>Interest Rate</td>
<td>5%</td>
</tr>
<tr>
<td>Inflation Rate</td>
<td>3%</td>
</tr>
<tr>
<td>Present Worth (PW) of O &amp; M Costs over 10 Years</td>
<td>$1,501,105</td>
</tr>
<tr>
<td>PW of Income for the Sales of Upgraded Biogas</td>
<td>$4,565,862</td>
</tr>
<tr>
<td>PW of Upgraded Biogas Sales</td>
<td>$1,009,807</td>
</tr>
</tbody>
</table>