Cost-Effective Utilization of Biogas

Alan Zelenka
Kennedy/Jenks Energy Services Leader

AAEES Workshop – Energy Management for Water and Resource Recovery Facilities
May 8, 2017
Energy Efficiency First!

- Energy Audits
  Lower Your Operating Costs

- Most Cost-Effective
  Energy Services Option

“Didn’t ya hear? To save energy we have to keep the thermostat at 1,100 degrees instead of 1,200 degrees!”
Why Do an Energy Recovery Project
Go Green with Renewables!
Divert Food Waste From Landfills
Energy Independence
Utilize Surplus Digester Gas
Benefits of Energy Recovery Project

- Lower Operating Costs
- Utilization of Surplus Digester Capacity
- Diverts Food Waste From Landfill
- Reduces GHG Emissions
- Increases Energy Independence
- Local Renewable Energy Project
Energy Recovery Alternatives

1. Flaring (do nothing)
2. Heating
3. Electricity
4. CNG (vehicles)
5. RNG (pipeline)
Flaring and Heating

- Excess gas is flared
- Boiler for heating
- No gas treatment
Energy Recovery Projects

K/J Has Investigated 34 Projects
Electricity
Food Waste Load for Processing
Food Waste Load
Food Waste Load
FOG & Food Waste Facility
Food Waste System Schematic
Digestion - Anaerobic Digesters
Gas Treatment

West Lafayette, IN
Electricity Generation
Microturbines
Electricity Incentives

- NJ Combined Heat & Power (CHP) Program
  - FCFS, $49M budget, $5.5M left
  - $/KW depending on size, capped at 30% of project costs, no project size limit
  - 30/50/20 Incentive Payment Structure
- Net Metering
  - Retail rate
  - Project size limited to on-site use
- RECs
BioCNG™ Vehicle Fueling System

Process Flow Diagram

Digester or Landfill → BioCNG™ Gas Conditioning System → CNG Vehicle Fueling Station → CNG Vehicles

Potential Energy Produced
Vehicle Fuel
Electricity
Heat

Boilers
IC Engines
Microturbines
BioCNG™ System

Main Components
- BioCNG™ Compression, Moisture, Siloxane/VOC, & CO₂ Removal
- H₂S Removal
- Heat Trace & Insulation
- Electrical Distribution Panel
- Glycol Chiller
- Electrical Control Panel
- Skid Mounted Glycol Chiller & Electrical Control Panel
- Interconnection Kit
- Skid Enclosure

Options
San Mateo Gas Treatment Equipment
San Mateo Vehicle Fuel Equipment
San Mateo Vehicle Fueling Station
CNG Vehicles

2015 Chevrolet Impala – dual fuel
CNG Storage
CNG/RNG Incentives

- RECs
- RINs
- Some states Low Carbon Fuel Standard or Clean Fuel Standard Credits
RIN Basic Information

- A Renewable Identification Number (or RIN)
- Assigned serial number for gallon of renewable fuel to track its production, use, and trading
- Federal Renewable Fuel Standard (RFS) until 2022
- Must be used as transportation fuel
- RIN agents or brokers
Federally Mandated RIN Volumes

The Renewable Fuel Standard Consumption Mandate

Source: National Academy of Sciences

- Conventional biofuels
- Biomass-based diesel
- Advanced biofuels
- Cellulosic biofuels

D5 RIN
D3 RIN
Carbon Intensity for Fuels and Renewable Substitute (gCO2/MJ)
RIN Basics

- RIN value inversely related to price of gasoline and therefore constantly changing
- Current D3 RIN price: ~$1.80/RIN
- One GGE of RNG is worth 1.48RINs or $2.66
- 1 GGE = 126scf of NG or 250scf of Biogas
- CNG price ~$2.00-$2.50
- Applicable LCFS credits are in addition to RIN
Oregon Clean Fuels Credits

- Reduces the Carbon Intensity (CI) of transportation fuels by 10% by 2025
- Credits for amount below CFS
- Clean Fuels Credit ~$50-$60/MTCO$_2$
Energy Recovery Options

**Electricity from IC Engines**
- Medium ROR
- High Maintenance and O&M Attention
- Complex Controls, Prefer Constant Gas Supply
- Challenge To Meet Latest Air Emission Standards
- GHG Reductions

**Electricity from Microturbines**
- Medium ROR
- O&M Easy (contract)
- Easy to Use Electricity
- GHG Reductions
Energy Recovery Options

Vehicle Fuel-Used by Owner
CNG

• Owner production and use
• Gas Treatment, Storage, and Fueling Station
• Need CNG vehicles
• High ROR
• Highest value on RIN credits (up to $2/GGE), need Broker
• GHG Reductions
• Clean Fuels Credit (if applicable)

Vehicle Fuel-Used by Others
RNG

• Add RNG to pipeline
• Sell RNG to others, need contracts to wheel
• Gas Treatment
• High ROR
• High value of RIN credits (up to $1.50/GGE), need Broker
• GHG Reductions
• Clean Fuels Credit (if applicable)
WTE Model

<table>
<thead>
<tr>
<th>Gas Production</th>
<th>Waste Receiving Equipment Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generation Equipment Cost</td>
<td>Generation Equipment Database</td>
</tr>
<tr>
<td>Incentives</td>
<td>Incentives Database</td>
</tr>
<tr>
<td>Cost-Effectiveness Analysis</td>
<td>Inputs &amp; Outputs</td>
</tr>
</tbody>
</table>
## Energy Recovery Comparison

<table>
<thead>
<tr>
<th></th>
<th>Electricity</th>
<th>CNG</th>
<th>RNG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complexity</td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>O&amp;M Burden</td>
<td>High</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>End Use</td>
<td>Easy</td>
<td>Medium</td>
<td>Easy</td>
</tr>
<tr>
<td>GHG Reductions</td>
<td>Med to High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>ROR</td>
<td>Medium</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>
## Financial Comparison of Options

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Project Cost</th>
<th>Annual Benefit</th>
<th>Annual O&amp;M Costs</th>
<th>Net Annual Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cogen IC</td>
<td>$7.13</td>
<td>$0.76</td>
<td>$0.70</td>
<td>$0.06</td>
</tr>
<tr>
<td>Cogen MT</td>
<td>$10.0</td>
<td>$0.75</td>
<td>$0.66</td>
<td>$0.09</td>
</tr>
<tr>
<td>RNG to CNG</td>
<td>$9.8</td>
<td>$1.92</td>
<td>$0.68</td>
<td>$1.24</td>
</tr>
<tr>
<td>RNG-Pipe Inj.</td>
<td>$6.9</td>
<td>$1.20</td>
<td>$0.57</td>
<td>$0.63</td>
</tr>
<tr>
<td>Heat/Flare</td>
<td>$0.58</td>
<td>$0.24</td>
<td>$0.15</td>
<td>$0.10</td>
</tr>
</tbody>
</table>

Millions of $
Cost-Effective Utilization of Biogas

Thanks for your time!

Alan Zelenka
Kennedy/Jenks - Energy Services Leader
Princeton New Jersey Office
(541) 228-6331 cell
AlanZelenka@KennedyJenks.com