Exploring the Best Use of Biogas

92nd Annual MWEA Conference
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Presentation Agenda

- Biogas Use Drivers and Opportunities
- Conditioning Needs
- Case Study: City of Raleigh Bioenergy Recovery Program
Drivers for Successful Biogas Use

Best Use of Biogas?

- Cost of electricity
- Cost of natural gas
- Green energy incentives
- Availability of vehicle fleet for CNG
- Offtake agreements for RNG
- Volume of gas available
- Seen to be green
- Local utility requirements & rates
- Biosolids management costs
Typical Uses of Biogas

Of the 1,238 AD facilities responding, 85% beneficially use biogas

Source: WEF/NEBRA Biogas Data Collection Project, 2011
Biogas Augmentation Can Improve Viability

COD conversion = methane

Two Approaches:

1. Improve COD conversion
   (i.e. advanced digestion such as thermal hydrolysis)

2. Bring in additional high COD material
   (e.g. FOG or High Strength Waste)
Use as Electricity

Combined Heat and Power
Combined Heat and Power

BIOGAS

PROCESS HEAT

CHP SYSTEM

AUXILIARY FUEL

ELECTRICITY
Of the ~300 CHP Facilities, the Vast Majority Use IC Engines

- **Microturbine**: 12%
- **Turbine**: 7%
- **Fuel Cell**: 5%
- **Engine**: 76%

Source: WEF/NEBRA Biogas Data Collection Project, 2011
Typical System Configuration

- Gas storage
- Gas cleaning and compression
- Power generator
- Waste heat system
- Emissions control
Note: This was a quick evaluation based on key assumptions.

EPA Opportunities for Combined Heat and Power at Wastewater Treatment Facilities, October 2011 provides an excellent overview of the economics of CHP on wastewater facilities.
How is Payback Affected if CHP also Provides Backup Power?
Considerations for CHP Applications

- Available gas quantity/quality
  - Co-digestion?
- Onsite power requirements
- Onsite heat needs
- CHP as backup power
- Funding and incentives

5 MW Turbine at DC Water (15 MW total)
Use as Renewable Natural Gas
Renewable Natural Gas (RNG)

- Two primary utilization options
  - Pipeline injection
  - Vehicle Fuel
General System Configuration – Pipeline Injection

- Gas cleaning and compression
General System Configuration – Vehicle Fuel

- Gas storage
- Gas cleaning and compression
- Mother/Daughter Stations
Considerations for RNG Applications

• General
  • Gas quality requirements
  • Funding incentives

• Pipeline injection
  • Availability of local transmission main for pipeline injection
  • Direct sale to utility or sale to third party

• Vehicle Fuel
  • Availability & location of vehicle fleet for CNG
  • Existing or new vehicles?
Conditioning Needs
Gas Cleaning Needs are Dependent on the Use

- Moisture
- H2S
- Siloxanes
- CO2
H2S Removal Technologies

Iron Sponge, Iron Oxide Granular Media

Ferric Addition

Biological Scrubber

Chemical Scrubber

Activated Carbon
Siloxane Removal Technologies

Activated Carbon Adsorption

Temperature Swing Adsorption (TSA)

Deep Chilling
Case Study

City of Raleigh Bioenergy Recovery Program
Background

- New project to replace existing aerobic digestion system with:
  - Thermal Hydrolysis
  - Anaerobic digestion
  - Gas utilization
  - Sidestream treatment
  - Other associated facilities

- Capacity:
  - WWTP: 90 mgd (ultimate)
  - Gas Production: 1,442 scfm
  - Gas Energy: 14,038 KW or 48 mmBTU/h
Options Evaluated

1. Base Option: Steam boiler only
2. Engine driven blower
3. CHP with engine generators
4. Vehicle Fuel (buses)
5. Vehicle Fuel (garbage trucks)
6. Vehicle Fuel (both)
7. 1 MW CHP and RNG to buses
8. 2 MW CHP and RNG to buses
Results – Biogas Usage

- Steam Gen. Only
- Engine Driven Blower
- CHP with Engine Generators
- CNG to Buses
- CNG to Garbage Trucks
- CNG to Buses and Garbage Trucks
- CNG to Garbage Trucks
- 2 MW CHP + CNG to Buses
- 1 MW CHP + CNG to Buses

Legend:
- Red: To flare
- Purple: Methane loss through PSA
- Green: To CNG
- Blue: To engine (CHP or blower)
- Gray: To boiler
Results – Net Present Value Comparison

- Boiler Only
- Engine Driven Blowers
- CHP w/IC Engines
- RNG to Garbage Trucks
- 2 MW CHP and RNG to Buses
- RNG to Buses
- RNG to Buses and Garbage Trucks
- 1 MW CHP and RNG to Buses
City Buses – Cost Sensitivity to Incentives

- **Base Case**: Federal funding covers 80% of the incremental cost of bus purchase.
- **RINS average**: $2 per RIN.
- **Alt fuel tax credit in place**: at $0.5 per GGE.
- **Federal funding + RINS + fuel tax credit**.
Pipeline Injection Alternative

• Considerations
  • City bus fleet conversion likely > 5 yrs away
  • New PSNC regional gas pipeline on NRRRF Site

• New options
  • Direct sale to PSNC
  • Third party offtake agreement with private buyer

• Phased RNG Alternative
  • 1: RNG to pipeline (direct sale or third party offtake)
  • 2: RNG to City via third party offtake
Results – Net Present Value Comparison

- **Boiler Only**
- **Engine Driven Blowers**
- **CHP w/IC Engines**
- **RNG to Garbage Trucks**
- **2 MW CHP and RNG to Buses**
- **RNG to Buses**
- **1 MW CHP and RNG to Buses**
- **RNG to Buses and Garbage Trucks**
- **RNG Pipeline**
Conclusions

• Significant opportunities for biogas utilization exist

• Assessment should use integrated market driven approach

• Power generation, vehicle fuel and pipeline injection are viable options

• Biogas use viability is highly dependent on site/project/utility specific criteria
BUILDING A WORLD OF DIFFERENCE

• Contact Info A

• Contact Info B