

# Biogas to Vehicle Fuel “Lessons Learned”

**Rodefeld Landfill  
Dane County, Wisconsin**

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# Overview of Lessons Learned Developing BioCNG Projects

- Project History
- Biogas to BioCNG Operations
- Fuel Quality
- CNG Vehicle Availability
- Vehicle Performance
- BioCNG Economics

# History of Rodefeld Landfill Biogas Vehicle Fuel Project

- Dane County, WI Rodefeld Landfill
- Developed with private, municipal and educational entities
- Purpose is to use biogas as a vehicle fuel on a small scale (20 scfm biogas, 100 gge/d)
- System installation - December 23, 2010
- Being upgraded to 50 SCFM/ 250 gge/day in 2012



**System Delivery December 23, 2010**



**Fueling Station, Fast Fill 60-GGE capacity,  
Built in early 1980's**



**First Vehicle Fueled March 18, 2011**



**August 2011, Operating System**

# BioCNG System Operations

## Lessons Learned

- System installation and startup 1-Week
- Need to consider permitting requirements
  - Air, Solid Waste, Waste Water
  - NFPA / Fire Department / Fueling Stations
- BioCNG production sized to match CNG fueling station and fuel use
- Operated at -10 F to 95 F, need to consider ambient temperature extremes
  - Chiller Replacement required
  - Need for heat tracing and heating

# BioCNG System Operations

## Lessons Learned

- Consider natural gas as a backup or supplemental fuel
  - Blended BioCNG / Natural Gas Fuel
  - Backup fuel if Biogas source is interrupted
- System operating efficiency can be modified depending on biogas quality (65% to 80 %)
  - Depends on biogas quality
  - Desire to produce more BioCNG or higher Btu BioCNG (and continue to meet vehicle fuel specifications)

# BioCNG and CNG Fueling Station Considerations

- Biogas and BioCNG produced 24 hours/day, may not match vehicle fuel use
- CNG storage is expensive, consider time and fast fill station, natural gas blending / backup fuel
- Sizing of systems: present use of CNG or future use of CNG, how many vehicles?
- BioCNG for sale as a potential source of revenue?
- Additional quality control and liability concerns

# Biogas to BioCNG Fuel Quality Lessons Learned

- Biogas quality makes a difference
  - High Methane, low O<sub>2</sub> and low N<sub>2</sub>
  - Voc's, H<sub>2</sub>S, Siloxanes Impact operating costs not fuel quality
- Ideally suited for small or excess biogas quantities
  - Waste Water Digesters
  - Food Waste Digesters
  - Ag waste digesters
  - Landfills

# Rodefeld Landfill / BioCNG Gas Constituents

<b>Constituent</b>	<b>Units</b>	<b>Inlet LFG (1)</b>	<b>BioCNG (1)</b>	<b>BioCNG Range (2)</b>
CH <sub>4</sub>	vol. %	55.0	90.0	80 - 95
CO <sub>2</sub>	vol. %	39.5	0.3	0.0 - 0.5
O <sub>2</sub>	vol. %	0.5	0.1	0.1 - 0.5
N <sub>2</sub>	vol. %	5.0	9.6	5 -15
H <sub>2</sub> S	ppmv	250	ND	ND

## Notes:

- (1) Data is compiled from field and laboratory analysis of samples collected on January 4, 2011.
- (2) Based on periodic field measurements during system operations.

# CNG Vehicle Operations / Purchase

## Lessons Learned

- CNG vehicles to use BioCNG is a factor in project success
- Demand for CNG vehicles is growing as CNG stations are established
- Buyer beware. 2001 Ford F150 Bi-fuel purchased by Cornerstone (Parts for old CNG vehicles may not be available)
- 17 Bi-fuel vehicles ordered by Dane Co. in Nov 2010 not delivered until 2012. (CNG vehicles more available than Bi-fuel)
- Total CNG Vehicle Fleet for Dane County by early 2012 to be 19 vehicles



Ford 2011 F350 CNG / Gasoline Pickup Truck  
Delivered to Dane County January, 2012

# CNG Vehicle Performance

## Lessons Learned

- Drivers of pickup trucks and cars did not notice a difference when using gasoline, CNG or BioCNG
- CNG Vehicles operate on fuel with lower Btu's than Nat Gas
- Vehicle dynamometer testing, December 2011
  - 0-60 mph, 1/8 mile lap, peak torque, towing 2,500 lb, towing 6,000 lb
  - Noticeably lower emissions from CNG and BioCNG
- Test results indicate that CNG or BioCNG vehicle performance will be similar to gasoline



2002 Chevy 2500 Bi-fuel pickup truck being tested on a Dynamometer



2011 Ford Fusion Bi-fuel car being tested on a Dynamometer

# BioCNG Economics Lessons Learned

- Producing 100 GGE of BioCNG from 20 scfm of biogas has marginal payback, (50 to 200 scfm preferred)
- BioCNG can be cost competitive with other vehicle fuels ( Gasoline, Diesel and CNG)
- BioCNG production \$0.60 to \$0.98 / GGE depending on biogas quality and quantity, financing charges not included
- **Approximate BioCNG 50 System Cost**
  - \$450,000 for gas conditioning skid installed and permitted
  - \$150,000 to \$200,000 for CNG fueling Station
  - Produces approximately 250 GGE/day
- **Potential for Vehicle Fuel Credits**
  - RINs (Renewable Fuel Credits) \$0.89/gal credit (actual Contract price)
  - RIN is short for Renewable Identification Number and is a renewable fuel credit. RIN credits were created by the EPA as part of the Renewable Fuel Standard (RFS) to track progress toward reaching the energy independence goals established by the U.S. Congress. RIN credits are the currency used by obligated parties to certify compliance they are meeting mandated renewable fuel volumes.

# Using Biogas as a Vehicle Fuel

- Digesters and WWTP are ideally suited to produce BioCNG to meet fuel specifications
- Nitrogen in landfill gas can limit potential (5% MAX)
- CNG vehicles are likely to limit potential
- Job creation / training and education programs are needed, vehicle mechanics / system operators?

# Opportunities and Other Projects

- **Other projects being developed and starting up in 2012**
  - **St Landry Parish, Louisiana**
    - **Startup scheduled for February 2012**
  - **Janesville, Wisconsin, Waste Water Treatment Plant**
    - **Startup scheduled for January 2012**
  - **Approximately 80 other facilities are considering BioCNG use**
- **Cost Effective Vehicles / Conversions are needed**
  - **USEPA regulates conversions for air emissions**
- **Public Awareness of CNG and BioCNG is growing**

# Contact Information

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