Alternative Energy – Biogas Utilization as RNG

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What to **Expect**

- Why RNG?
- Case Studies
- Recap/Advantages
Why RNG?
Traditional Uses for Digester Gas

- **Flare**: Lost Opportunity
- **Boiler**: Process/Building Heat
- **Engine Generator Microturbine**: Combined Heat/Power (Cogeneration)
More Recent Biogas Uses

Renewable Fuel Standard (RFS)

- Produce vehicle fuel
- Produce pipeline quality natural gas
The RFS program was created to:
- Reduce greenhouse gas emissions
- Expand nation’s renewable fuels sector

In 2007, program was significantly expanded:
- Defining what qualified as a renewable fuel
- Extending volume requirements to 2022
- Increasing 2022 renewable fuel goal to 36 Bgal
RFS Program Basics

Obligated parties:
Refiners/importers of gasoline and diesel fuel

Compliance achieved by:
Blending renewable fuel into transportation fuel
Obtaining credits (RINs – Renewable Identification Numbers)

Renewable fuel producers generate RINs

RIN credits are the currency of the program
Renewable fuel producers generate RINs

Market participants trade RINs

Obligated parties obtain and ultimately retire RINs for compliance

Renewable identification numbers (RINs)
RIN Example Life Cycle

* RVO = Renewable Volume Obligation
Source: U.S. EPA
Biogas from POTWs qualify for D3 RINs.
Renewable Fuel Volume Targets (RVO)

36 Billion Gallons of Renewable Fuel by 2022

Source: U.S. EPA
Biogas Value Based on Utilization

<table>
<thead>
<tr>
<th>Process/Building Heat</th>
<th>Combined Heat &amp; Power</th>
<th>D5 Transportation Fuel</th>
<th>D3 Transportation Fuel</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$3.50</td>
<td>$3.00</td>
</tr>
<tr>
<td>$15.00</td>
<td>$12.00</td>
<td>$45.00</td>
<td>$40.00</td>
</tr>
<tr>
<td>$20.00</td>
<td>$25.00</td>
<td>$50.00</td>
<td>$45.00</td>
</tr>
<tr>
<td>$25.00</td>
<td>$30.00</td>
<td>$60.00</td>
<td>$50.00</td>
</tr>
<tr>
<td>$30.00</td>
<td>$35.00</td>
<td>$70.00</td>
<td>$60.00</td>
</tr>
<tr>
<td>$35.00</td>
<td>$40.00</td>
<td>$80.00</td>
<td>$70.00</td>
</tr>
<tr>
<td>$40.00</td>
<td>$45.00</td>
<td>$90.00</td>
<td>$80.00</td>
</tr>
</tbody>
</table>

Gas Value (per MMBTU)
RIN Market Value

Weekly D3, D4, D5 and D6 RINs Prices

Transfer Date by Week, FUEL (D Code)

Last updated date: Sep, 18, 2019 (Updated monthly)
Case Studies
A municipality in Colorado wanted to reduce plant operating costs by converting digester gas to RNG (using BioCNG™ conditioning skids).
Persigo Gas System Upgrade

Overview

- Municipal WWTP
- 500 GGE/day produced (200 cfm)
- Piped 6 miles to existing CNG fueling station
- Fuel powers a fleet of buses + municipal vehicles

<table>
<thead>
<tr>
<th>Equipment</th>
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<tbody>
<tr>
<td>H₂S Vessels</td>
</tr>
<tr>
<td>Gas Conditioning Skid</td>
</tr>
<tr>
<td>Gas Control Skid with Chiller</td>
</tr>
<tr>
<td>New Flare</td>
</tr>
<tr>
<td>Six Miles of Pipeline</td>
</tr>
</tbody>
</table>
Persigo Gas System Upgrade

Solution

In conjunction with the municipality, Symbiont built a system to transport CNG from the local WWTP to a preexisting fueling station.

- CNG fuel sold to a public transportation agency as a source of revenue
- CNG fuel also powers city refuse trucks, street sweepers, and general utility pickups
Upgrade Cost

- Equipment: $1,550,000
- Construction: $1,300,000

Total: $2,850,000
St. Landry Parish Vehicle Fuel System

Challenge

A regional waste disposal district wanted to increase gas production and construct a renewable natural gas system to produce vehicle fuel.
St. Landry Parish Vehicle Fuel System

Overview

- Municipal solid waste
- 50 scfm biogas treated
- 210 GGE/day produced
- Fuel sold to power 10 CNG refuse trucks

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<td>H₂S Vessels</td>
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<td>Gas Conditioning Skid</td>
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<tr>
<td>Gas Control Skid with Chiller</td>
</tr>
<tr>
<td>CNG Fueling Station</td>
</tr>
<tr>
<td>Medium and High-Pressure Storage Tanks</td>
</tr>
</tbody>
</table>
St. Landry Parish Vehicle Fuel System

Solution

In conjunction with the municipality, Symbiont managed:

- Construction
- Scheduling
- Regulatory Approvals
- Commissioning for the installation of the BioCNG™ system

CNG fuel sold to power fleet of 10 CNG refuse trucks
Upgrade Cost

- Bio CNG Equipment: $1,550,000
- ANG Equipment: $885,000
- Construction: $475,000

Total: $2,910,000
Recap/Advantages
<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Compared to Gasoline</th>
<th>Compared to Diesel</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOx</td>
<td>66% (g/mile basis)</td>
<td>N/A</td>
</tr>
<tr>
<td>NMHC</td>
<td>85% (g/mile basis)</td>
<td>N/A</td>
</tr>
<tr>
<td>CO</td>
<td>50% (normal driving)</td>
<td>N/A</td>
</tr>
<tr>
<td>Air Toxics</td>
<td>85%</td>
<td>N/A</td>
</tr>
<tr>
<td>SO₂</td>
<td>90%</td>
<td>90%</td>
</tr>
<tr>
<td>Global Warming Gases</td>
<td>20%</td>
<td>50%</td>
</tr>
<tr>
<td>Particulate Matter</td>
<td>NA</td>
<td>50-75%</td>
</tr>
</tbody>
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Critical Considerations Affecting Feasibility

- Purchaser of Gas
- Value of RIN
- Value of Sale of Gas
- Potential for Additional Feedstock
- Capital and O&M Cost Estimates
Simple Payback Analysis

- Capital Cost
- Operating Cost
- Annual Gross Revenue
- Annual Net Revenue
- Simple Payback
Want to Know more?

Visit Symbiont at Booth 218

Contact Us

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Low Carbon Fuel Standard (LCFS) Credits

- Program designed to reduce greenhouse gas (GHG) emissions
- Applies to fuels used for transportation
- $6.85/MMBTU CNG
- $610,000/year