Digester Biogas to CNG Opportunities

Presentation to NACWA Climate & Energy Committee
Chris Voell, Eastern Sales Manager
BioCNG, LLC
The CNG Revolution has begun!

- CNG (compressed natural gas)
- 15,000,000 NGVs running worldwide
- Fleets (especially refuse) are converting to CNG for cost savings and environmental sustainability.
  - Vehicle emissions contribute to air pollution, climate change, and health concerns.
- Citizens want energy security and independence.
- Vast majority of CNG to date has come from fossil sources.
A new opportunity is before us – biogas to CNG!
Why Biogas-CNG?

• “…renewable natural gas and fossil gas are the only vehicle fuels that can displace significant amounts of oil while safeguarding U.S. national security and strengthening the economy.”

• “The U.S. economy is sapped of almost $845 million a day that is sent abroad to buy 45% of the oil to meet our needs. Some $110 million of this goes daily for the oil needed in diesel production.”
  – Fluctuating price destabilizes U.S. economy and upsets local community budgets

• “The 10 million trucks and buses on U.S. roadways provide essential services to every American community, and they transport goods worth nearly 70% of the GDP.”
  – Buses and trucks make up just 4% of all vehicles, but they use 23% of all highway fuel – almost entirely high-carbon diesel from foreign oil.

*Renewable Natural Gas (RNG) - The Solution to a Major Transportation Challenge A Clean, Secure, Commercially Viable Replacement for Diesel Fuel Today*” (Energy Vision, 2012)
Biogas-CNG Benefits

• Significant **savings** over gasoline and diesel
  – 50-75% savings over current gas/diesel cost
  – Cost-competitive to fossil-based CNG

• Local, **green**, renewable fuel source
  – Up to 90% GHG reductions v. gas and diesel
  – Renewable fuel and GHG credits

• **Control** your future!
  – Cost locked in for 15-20 years
  – Hedge against rising NG prices
Successful Projects

Biogas Source

Vehicle Fuel Demand

Project Enabler/Developer
The Biogas Resource
(Energy Vision 2012)

Figure 2. The Pathway from Organic Waste to RNG

- **Wastes**: All organic wastes contain energy.
  - Anaerobic digestion of wastes at landfills or in digester plants produces energy-rich biogas.

- **Biogas**: Biogas upgrading removes carbon dioxide & impurities to make *renewable natural gas* (RNG).

- **RNG Fuel**: RNG goes to on-site fueling stations, or by truck or pipeline to off-site pumps.

- **Fuel Stations**: RNG works just like regular natural gas to power vehicles.

- **Vehicles**:
Trucks & Buses Shifting To CNG: Cleaner, Quieter & Cheaper Fuel
Fleets, Communities & Drivers Love Them
Primary Targets for CNG Vehicles

• Trash, recycling, cement and other vocational work trucks
• Transit buses/shuttle buses/school buses
• Major metro fleet management and public works departments
• Heavy-duty freight trucks
• Medium-duty delivery and commercial service trucks
• Taxis and light-duty service vehicles

The more fuel used – the quicker the payback
Why BioCNG?

• Use otherwise wasted biogas
• Opens up opportunities where they didn’t exist before
  – WWTP, manure and organics digesters, smaller landfills
  – Excess biogas at larger sites
• Incentives for renewable electricity are disappearing in many places
• Growing desire for local and national energy independence and control

It’s affordable now!
BioCNG Benefits

- Local, green energy source - less air pollution.
- Cost competitive to NG-CNG at today’s prices.
- Renewable fuel credits available (RINs).
- Hedge against potentially rising NG costs.
- Book fuel cost for 15-20 years.
- GHG reductions – up to 90%.
BioCNG Market Potential

• Current Nationwide Biogas Sources
  – 2,000 WWTP digesters (unused biogas)
    • Excess digester capacity as well
  – 195 manure/organics-based digesters
    • At least 8,000 opportunities (new source of biogas)
  – 600 operating LFG energy projects (excess biogas)
    – electric contracts expiring
  – 500+ landfills flaring gas

• Hundreds of billions of cubic feet of biogas wasted every year.
“Utility of the Future”

• Triple Bottom Line of BioCNG
  – Social: enhance energy independence by reducing reliance on petroleum
  – Environmental: 90% reduction in GHGs v. diesel
  – Economic: vehicle fuel at 25-50% the cost of gas/diesel

• Upgraded biogas can provide a versatile energy source:
  – Vehicle fuel – replacing gasoline and diesel for POTW and other fleets
  – Electricity production – lower CapX and O&M costs
  – Thermal energy – offsetting NG and propane needs
  – Long-term hedge on energy costs
Upgrade and Fueling System

BioCNG Conditioned System

CNG Fueling Station

Biogas Source (Landfills, Digesters)

Product BioCNG (CH₄)

Waste Gas: CO₂, VOCs, H₂O, H₂S, CH₄

Optional Natural Gas Blending

CNG Vehicles
St. Landry Parish Landfill, Louisiana
(*currently a BioCNG50 – plans to add BioCNG 200)
### Janesville, WI

**BioCNG Vehicle Fuel Project Fact Sheet**

<table>
<thead>
<tr>
<th><strong>Biogas Source</strong></th>
<th>WWTP digester</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Size (MGD)</strong></td>
<td>18 MGD</td>
</tr>
<tr>
<td><strong>Gas Collected (entire site)</strong></td>
<td>200 scfm</td>
</tr>
<tr>
<td><strong>Gas Quality</strong></td>
<td>Methane (CH₄) - 62%</td>
</tr>
<tr>
<td><strong>Flare</strong></td>
<td>Available</td>
</tr>
<tr>
<td><strong>Other Gas Use</strong></td>
<td>Combined heat and power with micro turbines</td>
</tr>
<tr>
<td><strong>Available Gas for CNG</strong></td>
<td>50 scfm</td>
</tr>
<tr>
<td><strong>Size of BioCNG Unit</strong></td>
<td>BioCNG 50</td>
</tr>
<tr>
<td><strong>Components</strong></td>
<td>H₂S removal, chilling, VOC/Siloxane removal, CO₂ removal; (4) 48” inflatable gas storage spheres</td>
</tr>
<tr>
<td><strong>Fueling Unit</strong></td>
<td>ANGI fast fueling station</td>
</tr>
<tr>
<td><strong>Start-up Date</strong></td>
<td>February 2011</td>
</tr>
<tr>
<td><strong>Fuel Production (GGE)</strong></td>
<td>Up to 275 GGE/day</td>
</tr>
<tr>
<td><strong>Waste Gases</strong></td>
<td>Routed to turbines for destruction</td>
</tr>
<tr>
<td><strong>Back Up For CNG Fueling</strong></td>
<td>NG backup through the use of a manual three-way valve</td>
</tr>
<tr>
<td><strong>Fleet Size/Type</strong></td>
<td>Vehicles on order</td>
</tr>
<tr>
<td><strong>Outside Users</strong></td>
<td>None at this time</td>
</tr>
<tr>
<td><strong>Performance Issues</strong></td>
<td>None</td>
</tr>
</tbody>
</table>
**BioCNG System Sizing**

- Pre-engineered, skid-mounted
- Multiple modules
- Customization for larger systems

<table>
<thead>
<tr>
<th>System Size</th>
<th>Biogas Inlet Flow (scfm)</th>
<th>Fuel Production (GGE/day)</th>
<th>Fleet Size Per Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Light duty</td>
</tr>
<tr>
<td>BioCNG 50</td>
<td>50</td>
<td>200-275</td>
<td>20-27</td>
</tr>
<tr>
<td>BioCNG 100</td>
<td>100</td>
<td>375-550</td>
<td>38-55</td>
</tr>
<tr>
<td>BioCNG 200</td>
<td>200</td>
<td>775-1110</td>
<td>77-110</td>
</tr>
</tbody>
</table>
Sample - BioCNG 200 cfm

- **$0.66 DGE**
  - Includes RINs of $0.76 DGE
- **200 cfm digester gas (65% methane)**
- **BioCNG Production**
  - ~1,100 diesel gallon equivalents (DGEs)/day (359,000 DGE/yr)
  - Enough fuel for 20-30 HDVs or 100-150 LDVs
- **Total system CapX - ~$2,100,000**
  - Includes BioCNG upgrade and fueling station engineering, permitting, installation, start up and training
  - 10 years, 3% interest

- **Fuel Savings**
  - Assuming savings of $2 gallon on gasoline/diesel costs
  - ~$720,000 in annual fuel savings

- **Renewable Fuel Credits**
  - Assuming $0.76 per DGE
  - ~$270,000 per year

**Additional Costs**
- New Vehicle Premium or Conversion
- Maintenance Facility Upgrade
Project Structures

• Produce CNG on site:
  – Facility owner vehicles (heavy duty, medium, passenger)
  – Site users (biosolids haulers, organics haulers)
  – Soon - transfer trailers, over the road tractors, inter-modal
  – Public

• Produce upgraded biogas:
  – Fuel off site station (‘mother-daughter station’)
  – Sell upgraded biogas to end user
  – Fuel for CHP applications
  – Offset NG or propane use
  – Power advanced treatment, nutrient recovery
BioCNG™ Projects

• Dane County Landfill (WI)
  – Replaced BioCNG 25 with BioCNG 50
  – Currently fuel service vehicles and pick ups; plans to fuel packers and transfer trailers
• City of Janesville WWTP (WI) – BioCNG 50
• St. Landry Parish Landfill (LA)
  – Budgeting to add BioCNG 200 to existing BioCNG 50
• Sacramento Organics Digester (CA)
  – Currently installing BioCNG 100 (plans for expansion)
  – Will fuel collection fleet
• City of Riverview Landfill (MI)
  – BioCNG 100 in fabrication
Environmental Benefit

Direct Greenhouse Gas Emissions (gCO2e/MJ):
Diesel and Alternative Fuels

Derived from C.A. Resources Board LCFS, 2009.
Bio-CNG v. Diesel Emission Reductions

10 garbage trucks converted from diesel to Bio-CNG – reduce 1,000+ tons CO2e annually

Diesel

Bio-CNG

Regional Freight Truck

Transit Buses

Garbage Truck

Municipal Sweeper

CO2e Emissions (tons)

Miles Driven (x1000)
Local Control of Fuel Cost

• If you could go back 20 years and lock down your fuel costs, wouldn’t you?
  – 1992 - $1.25 gallon gasoline
  – August 2012 - $3.73 gallon gasoline

• Why not control the next 20!

Gasoline Prices – 1992-2011
Biogas-CNG Lessons Learned

• Trucks are quieter and cleaner – great customer service
• Smaller, modular systems allow for growth as:
  – Biogas increases; capital becomes available; fuel demand rises
• Fuel complies with CNG engine warranties
• Bio-CNG vehicle performance comparable to gasoline/diesel
• Biogas quality
  – Higher methane – more fuel
  – Biogas contaminants impact on operating costs - not fuel quality
Bio-CNG Summary

• Proven technology
• Lowest cost fuel and fixed long term
• Complies w/engine manufacturers warrants
• Greenest fuel
• Can be feasible at small scale
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