Renewable Natural Gas and Interconnecting to the SoCalGas Pipeline

PR1118.1 Working Group Meeting
October 24, 2017
Jim Lucas
Market Development Manager
Discussion Topics

1. SoCalGas Overview
2. Differences Between Biogas and Renewable Natural Gas (RNG)
3. Market Drivers and Challenges to Produce RNG
4. Interconnection: Overview of Components
5. Biomethane Interconnection Incentive
6. Breakdown of Costs to Produce and Inject RNG into Pipeline
7. Biogas Conditioning and Upgrading Projects
8. Interconnection Tools and Process Improvements
9. Overview of SoCalGas’ Biogas Conditioning and Upgrading Services (BCS) Tariff
Southern California Gas Company (SoCalGas) has been delivering clean, safe and reliable natural gas to its customers for 150 years.

A regulated public utility that provides gas service to 21.6 million consumers.

Nation’s largest natural gas distribution utility with 5.9 million meters.
Differences Between Biogas & Renewable Natural Gas (RNG)

<table>
<thead>
<tr>
<th>Illustration for Landfill Diverted Waste</th>
<th>Biogas</th>
<th>“Condition” Biogas</th>
<th>RNG</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gas Composition and Heating Value</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CH4</td>
<td>62.0%</td>
<td>62.0%</td>
<td>98.5%</td>
</tr>
<tr>
<td>CO2</td>
<td>37.6%</td>
<td>37.6%</td>
<td>0.8%</td>
</tr>
<tr>
<td>O2, H2, N2, Others</td>
<td>0.4%</td>
<td>0.4%</td>
<td>0.7%</td>
</tr>
<tr>
<td>Heating Value (btu/scf)</td>
<td>625</td>
<td>625</td>
<td>991</td>
</tr>
<tr>
<td><strong>Two of the Key Trace Constituents</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H2S</td>
<td>300 ppm</td>
<td>1 ppm</td>
<td>1 ppm</td>
</tr>
<tr>
<td>Siloxanes</td>
<td>4,000 ppb</td>
<td>70 ppb</td>
<td>1 ppb</td>
</tr>
</tbody>
</table>
1) **Utilize as a Transportation Fuel** - When RNG is used as a transportation fuel from a qualified feedstock, **credits can be generated and sold** which increases the market value of RNG

- **California Air Resources Board Low Carbon Fuel Standard (LCFS)** – program to reduce the carbon intensity of California’s transportation fuels by **at least 10 percent by 2020**

- **EPA Renewable Fuel Standard (RFS)** – federal program that requires petroleum refiners and importers of gasoline to **demonstrate that a portion of the fuel they sell is renewable**. Fuel volume requirements currently go through 2022

Source: [https://www.arb.ca.gov/fuels/lcfs/fuelpathways/pathwaytable.htm](https://www.arb.ca.gov/fuels/lcfs/fuelpathways/pathwaytable.htm)
What are the Market Drivers to Produce RNG?

(Estimated Total Value of RNG When Used as a Transportation Fuel in CA)

For WWTP Biogas

A + B + C

Total Value
$46.77/MMBtu

Renewable Fuel Standard
RIN Price = ~$2.86RIN*
~$37.14/MMBtu

Low Carbon Fuel Standard
LCFS Price = ~$92.65/ton CO2
~$6.45/MMBtu**

Commodity Price of Natural Gas
$3.18/MMBtu***

Prices as of 10/06/17
* 2017 Vintage D3 RIN's
** Assumes carbon intensity for WWTP of 30 gCO2/MJ
*** Approximate Henry Hub Natural Gas Future Price – Jan 2018
What are the Market Drivers to Produce RNG?

(Estimated Total Value of RNG When Used as a Transportation Fuel in CA)

For Dairy Biogas

A + B + C

Total Value
$76.68/MMBtu

C

Renewable Fuel Standard
RIN Price = ~$2.86RIN*
~$37.14/MMBtu

B

Low Carbon Fuel Standard
LCFS Price = ~$92.65/ton CO2
~$36.36/MMBtu**

A

Commodity Price of Natural Gas
$3.18/MMBtu***

Prices as of 10/06/17
* 2017 Vintage D3 RIN’s
** Assumes carbon intensity for Dairy Biogas of -276 gCO2/MJ
*** Approximate Henry Hub Natural Gas Future Price – Jan 2018
What are the Market Drivers to Produce RNG?

2) **Utilize for Electric Generation** - RNG can be used as the fuel source to produce renewable energy (utility scale and distributed generation)

- **Renewables Portfolio Standard (RPS)** – RNG can be used to help achieve California RPS goals, 50% by 2030

- **Self Generation Incentive Program (SGIP)** - California Public Utilities Commission mandated program providing incentives to support existing, new and emerging distributed energy resources

<table>
<thead>
<tr>
<th>Application Year</th>
<th>% Renewable Fuel Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>0%</td>
</tr>
<tr>
<td>2017</td>
<td>10%</td>
</tr>
<tr>
<td>2018</td>
<td>25%</td>
</tr>
<tr>
<td>2019</td>
<td>50%</td>
</tr>
<tr>
<td>2020</td>
<td>100%</td>
</tr>
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</table>
Challenges to Produce RNG

1) Market Price of RNG
   • Entities not willing to enter into long term contracts to purchase LCFS and Renewable Fuel Standard (RFS2) due to future uncertainty of these markets

2) Project Scale
   • Minimum threshold is approximately 1.0 to 1.5 million standard cubic feet per day for favorable economics (including interconnection costs). Higher volumes generally needed for landfills
   • Small to medium scale biogas production facilities have historically not been economical. But with biomethane interconnection incentive and high credit prices things are changing

3) Incentives/Subsidies - Need incentive programs specific to RNG projects to bring down the costs
Interconnection: Overview of Components

Two Primary Components of the Term “Interconnection”

“Interconnection” = “Point of Receipt” + “Pipeline Extension”
The Point of Receipt

1. **Monitors gas quality** to ensure it meets SoCalGas Rule 30 Gas Quality Specifications (e.g. CO₂, O₂, total inerts, heating value, H₂S)

2. **Prevents non-compliant gas** from entering the utility pipeline network should the monitored Rule 30 parameters not be met

3. **Meters and odorizes** the volume of RNG put into the utility pipeline network
“Pipeline Extension” Component of the Interconnection

» **Pipeline extension** is the pipe installed from the outlet of the Point of Receipt to the nearest utility pipeline having the capacity to accept the interconnector volume of RNG.

» Majority of the pipelines in streets are **distribution lines with limited takeaway capability to accept interconnector gas** during summer months (particularly in the early a.m. hours)
  - May result in high pipeline extension costs because the nearest pipeline having the capacity is miles away.

**Illustration**

Nearest SoCalGas pipeline to Point of Receipt (e.g. 500 feet away) but doesn’t have the capacity.

Nearest SoCalGas pipeline that has the takeaway capacity to accept supply (e.g. ~ 1.5 miles away).

Point of Receipt

Pipeline Extension
Pipeline Extension Cost Considerations

Illustration 1 (curb and gutter):
- Cost to install pipe is much more expensive when:
  - Asphalt/concrete is cut
  - Traffic control is required
  - Night work is required

Illustration 2 (no curb and gutter):
- Cost to install pipe is much less expensive when:
  - No need to cut asphalt/concrete
  - Minimal traffic control
  - No work hour restrictions
### Biomethane Interconnection Incentive

**Statewide Program Cap of $40 million, Ending on 12/31/21**

<table>
<thead>
<tr>
<th>Interconnection project with 3 or more dairies in close proximity</th>
<th>All other interconnection projects (e.g. landfill, wastewater, landfill diverted organics, 1-2 dairies)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>$5 Million Cap</strong></td>
<td><strong>$3 Million Cap</strong></td>
</tr>
<tr>
<td>Incentive of 50% of eligible costs with</td>
<td>Incentive of 50% of eligible costs with</td>
</tr>
<tr>
<td><strong>Eligible costs include</strong></td>
<td><strong>Eligible costs include</strong></td>
</tr>
<tr>
<td>Biogas collection lines</td>
<td>Compression equipment for product gas</td>
</tr>
<tr>
<td>Compression equipment for product gas</td>
<td>Utility Point of Receipt</td>
</tr>
<tr>
<td>Utility Point of Receipt</td>
<td>Utility Pipeline Extension</td>
</tr>
<tr>
<td>Utility Pipeline Extension</td>
<td></td>
</tr>
</tbody>
</table>
1) Pipeline Extension costs are based on installing pipeline in roads with curb/gutters.

2) Estimated costs assume testing for all 17 biogas constituents and includes the cost of the tests and associated labor.
Biogas Conditioning and Upgrading Projects
SoCalGas Biogas Upgrading Demonstration Project at the Hale Avenue Resource Recovery Facility (HARRF)

HARRF Information

» Wastewater treatment facility located in Escondido, CA

» Average Daily Flow ~ 15.6 MGD

» Biogas was being flared prior to start of demonstration project

» Biogas Production ~ 95 million cubic feet per year

» Biogas contains enough energy to supply ~1,200 homes

Demonstration project occurred in 2011 and 2012

Typical Weekly Operating Data
- Avg Feed Flow - 158 scfm
- Avg Product Flow (biomethane) – 85 scfm
- Avg Product Quality – 99.2% methane
- Avg Methane Recovery – 90%
- Avg Product H2S – 0.12 ppm
  - Rule 30 limit is < 4.0 ppm
- Siloxane range – 0.005 to .04 mg Si/m3
  - Rule 30 lower action level = 0.1 mg Si/m3

The demonstration project validated biogas can be safely and efficiently upgraded to SoCalGas Rule 30 pipeline quality specifications
Point Loma Wastewater Treatment Plant treats approximately 175 million gallons of wastewater per day generated by ~2.2 million area residents.

Prior to the project, the plant was flaring more than 1.3 million cubic feet per day of digester gas.

The plant partnered with BioFuels Energy, LLC, to condition/upgrade wastewater digester gas and feed it into the natural gas pipeline system.

Since 2012, the RNG is injected into the utility pipeline and used to power a 2.8 MW fuel cell at UC San Diego and a 1.4 MW fuel cell at South Bay Water Reclamation Plant in San Diego.

Total project cost of $45 million, 75% was subsidized through incentives and tax credits.

Data and Photo Sources
CR&R Waste and Recycling Services is a recycling and waste collection company, serving more than 2.5 million people and 5,000 businesses throughout Orange, Los Angeles, San Bernardino, Imperial, and Riverside counties.

- **Project Details**: 
  - Two of the four phases are complete with each phase capable of handling ~83K tons/year of organic waste.
  - Each phase is expected to produce ~1,000,000 diesel gallon equivalent (DGE) of vehicle fuel per year, enough to fuel ~80 of CR&R’s CNG waste trucks.
  - Each phase is capable of producing 10 million gallons/year of liquids (fertilizer) and 35,000 tons/year of solids (soil product).
  - Equipment Vendors: Eisenman (anaerobic digestion) and Greenlane Biogas (biogas upgrading).
  - Cost: Over $100 million at full buildout.
  - Construction began in 2014 and RNG expected to flow into SoCalGas pipeline in Q4 of 2017.

- The CR&R project will be the first RNG-to-pipeline project in SoCalGas’ service territory.

*Sources of Information:
  - [Biomass Magazine](http://biomassmagazine.com/articles/10641/crr-breaks-ground-on-california-ad-facility)
  - [Paul Relis](http://www.paulrelis.com/california-msw-organics-digester-prepares-to-launch/)
  - [Biocycle](https://www.biocycle.net/2017/05/01/high-solids-digester-services-california-municipalities/)
CR&R Renewable Gas Project Overview

Overview of Pipeline Extension – CR&R Perris

Overview

• Installation of ~1.4 miles of 8” high pressure steel pipe (directional bore method)
• Majority of the street where pipe was installed does not have curb and gutter (minimized the need to cut asphalt/concrete)
• Pipeline crossed the San Jacinto Canal
Overview of SB 1383

SB 1383 directs CARB to implement regulations to reduce emissions of Short Lived Climate Pollutants (SLCPs). By 2030, requires a reduction of the following compared to 2013 levels:

- 40 percent reduction in methane
- 40 percent reduction hydrofluorocarbon (f-gases)
- 50 percent reduction in black carbon (such as diesel)

Some Dairy Related Sub-Parts of SB 1383

- Directs CARB to adopt regulations to reduce methane emissions from livestock manure management operations and dairy manure management operations by up to 40 percent below 2013 levels by 2030
  - Approximately 45% of all methane emissions in CA come from dairies, 25% from manure and 20% from enteric fermentation

- No later than January 1, 2018, CPUC to direct gas corporations to implement not less than 5 dairy RNG injection pilot projects. Reasonable pipeline infrastructure costs are recoverable in rates
SB 1383 - Dairy RNG to Pipeline Pilot
Representative renewable gas operating model

1. Digester at Each Dairy
   - Digester #1 (X,000 cows)
   - Digester #2 (X,000 cows)
   - Digester #3 (X,000 cows)
   - (Sequence of processing, monitor/metering, and compression equipment may differ)

2. Biogas Conditioning Facilities and Collection Lines
   - Monitor and Meter Biogas
   - Remove H2S and H2O
   - Biogas Compression

3. Biogas Conditioning and Upgrading Facility
   - RNG Piping
   - Point of Receipt

4. Interconnection (Point of Receipt)
   - RNG Piping

5. Interconnection (Pipeline Extension)
   - Pipeline Extension

6. Existing Pipeline Network
   - NGV Fueling Station or Other End-use
Nitrogen and Oxygen Levels in Landfill Gas Can Significantly Impact Costs and Project Economics

» The removal of nitrogen (N2) and oxygen (O2) from biogas to meet pipeline quality specifications is expensive.

» High levels of nitrogen and oxygen exist in landfill gas because there has been little need to minimize air intrusion for a landfill gas collection system, as engines/turbines can handle these high levels.

<table>
<thead>
<tr>
<th>Typical Biogas Compositions by Source</th>
<th>Methane (CH4)</th>
<th>Carbon Dioxide (CO2)</th>
<th>Nitrogen (N2)</th>
<th>Oxygen (O2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy, wastewater treatment, and landfill diverted food/green waste</td>
<td>~60 to 65%</td>
<td>~30 to 35%</td>
<td>&lt;1%</td>
<td>&lt;0.2%</td>
</tr>
<tr>
<td>Landfill</td>
<td>~35 to 60%</td>
<td>~30 to 40%</td>
<td>~10 to 30%</td>
<td>~1 to 3%</td>
</tr>
</tbody>
</table>

» In 2015, SoCalGas commissioned Black & Veatch to perform a evaluation of current biogas upgrading technologies. Included in the report is a high-level impact assessment for removing nitrogen and oxygen.

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Scenario</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen and oxygen removal</td>
<td>Eliminate the need for nitrogen removal equipment</td>
<td>Lowers cost by 20 to 25% for large scale cases</td>
</tr>
<tr>
<td>Pipeline Interconnection Costs</td>
<td>Reduce (post Biomethane Interconnection Incentive) interconnection cost by 50%</td>
<td>3 to 10% reduction in biomethane costs. Greater impact on smaller cases</td>
</tr>
</tbody>
</table>
Interconnection Tools and Process Improvements
1. **Modify the Existing Rule 30 Gas Quality Deviation Process**
   - Approval of Advice Letter 5128 effective on 5/28/17 allows interconnectors to request a gas quality deviation during the Capacity Study (previously only available starting with the Preliminary Engineering Study)

2. **Gas Quality Outreach and Education**
   - Developed **Information Sheets** to educate the industry on gas quality standards and monitoring
   - **Example**: We frequently hear siloxanes are continuously monitored at our interconnection facilities. Fact is siloxanes are monitored and tested by taking periodic gas samples and sent to a laboratory for testing

3. **Created a Renewable Gas (RG) Section on socalgas.com**
   - Provides information on a variety of RNG topics. **Additional Information and Resources** page provides links to useful reports and websites

4. **Developed a downloadable RNG Toolkit**
   - Available on socalgas.com and topics include: overview of biogas and RNG, interconnection procedure, gas quality standards, interconnection monetary incentive program, and tools/tips for biogas to pipeline projects

5. **Streamline the Interconnection Process**
   - Reviewed the existing interconnection process to improve/enhance the experience for the interconnector and company personnel
SoCalGas recently **completed comprehensive testing** to determine the effects of accepting gas with a lower minimum heating value (existing minimum heating value is 990 btu/scf)

- The testing was done to determine if a lower minimum heating value was interchangeable with our historical gas supplies

Based on the results of the study, gas **as low as 974 Btu/scf** did not show increase safety or reliability concerns

- 974 BTU/scf gas can be interchangeable with gas supplies meeting Rule 30 limits
- All other gas quality constituent levels still need to be met (e.g. – inerts, CO2, O2, Wobbe Number, etc.)

SoCalGas’ Rule 30, Section I.5 offers the ability to request **a gas quality deviation** for those constituents identified in Rule 30, Section I.3 (one of these is minimum heating value)

A gas quality deviation can be requested during the Capacity Study phase or the Preliminary Engineering Study phase

- Gas quality deviation requests are **fully collectible** and paid for by the potential interconnector
- If deviation has no negative impact, then SoCalGas to file an Advice Letter that **must be approved by CPUC**
<table>
<thead>
<tr>
<th>Component (Rule 30 Max)</th>
<th>mol%</th>
<th>96</th>
<th>96</th>
<th>96</th>
<th>96.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methane</td>
<td>mol%</td>
<td>3</td>
<td>1.4</td>
<td>0.5</td>
<td>2.97</td>
</tr>
<tr>
<td>Carbon Dioxide (3.0%)</td>
<td>mol%</td>
<td>0.15</td>
<td>0.2</td>
<td>0</td>
<td>0.18</td>
</tr>
<tr>
<td>Oxygen (0.2%)</td>
<td>mol%</td>
<td>0.85</td>
<td>2.4</td>
<td>3.5</td>
<td>0.55</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>mol%</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3.7</td>
</tr>
<tr>
<td>Total Inerts (4.0%)</td>
<td>mol%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Calculated Values</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>High Heating value</td>
<td>Btu/cf</td>
<td>974</td>
<td>974</td>
<td>974</td>
</tr>
<tr>
<td>Wobbe (Rule 30 Min = 1279)</td>
<td></td>
<td>1270</td>
<td>1279</td>
<td>1285</td>
</tr>
</tbody>
</table>

Does not meet minimum Wobbe No of 1279 even though heating value is equal to or greater than 974 btu/scf
» **Summary:** The BCS Tariff is a utility tariff that allows SoCalGas to design, install, own, operate & maintain biogas conditioning/upgrading equipment on or adjacent to the customers premise

» **Optional:** The BCS Tariff is an optional tariff service and not tied to any other tariff or non-tariff services the customer may receive
  - The BCS Tariff is promoted on a competitively neutral basis with periodic reporting to the Commission

» **Price:** The BCS Tariff rate charged to the customer covers the full cost to provide the service (both CapEx and O&M costs)
  - **SoCalGas ratepayers do not bear the risk** of under collections related to the BCS Tariff

» **Commonly Asked Questions About BCS Tariff**

<table>
<thead>
<tr>
<th>Who is responsible for the upfront investment of upgrading facility?</th>
<th>Who is responsible for on-going maintenance of the upgrading facility?</th>
<th>Who is responsible for the parasitic load (utility costs to run the facility)?</th>
<th>Who owns the biogas and RNG?</th>
<th>Who determines the contract term?</th>
<th>Who is responsible for the interconnection with the utility?</th>
</tr>
</thead>
<tbody>
<tr>
<td>SoCalGas</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BCS Tariff Customer</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
BCS Tariff Illustration

Customer Owned Biogas

Biogas Conditioning/Upgrading Services Facility (SoCalGas Owned and Operated)

Customer pays SoCalGas a monthly BCS tariff fee for a turnkey solution

What is included in SoCalGas’ turnkey solution?
• 100% of the upfront capital
• Biogas conditioning/upgrading facilities design
• Equipment and construction RFP
• Vendor selection and management
• Project/construction management
• Facility operation and ongoing maintenance
• Contract management

What is not included?
• Customer pays for utility costs (e.g. – kWh to operate the upgrading facility)

Customer Owned Conditioned/Upgraded Biogas

Customer decides how to use conditioned/upgraded biogas

Onsite Use – CNG or Generation

Interconnection for Pipeline Injection (Responsibility of Customer)
Thank You

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