Renewable Natural Gas
Outreach and Education

EPA Technology Transfer Workshop
Renewable Natural Gas – Driving Value for Natural Gas and Biogas Sectors

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Market Development Manager
Markets and Organizations
Markets and Organizations

**Landfills:** ~35 facilities within SoCalGas’ service territory

**Drivers to Produce RNG**
- Largest source of biogas
- Many are flaring due to recent air quality regulations, which lowered emission levels for stationary engines
- High value of RNG when used for transportation

**Challenges to Produce RNG**
- High nitrogen content can make cleanup technically/economically challenging
- Landfills are often located in remote sites with limited pipeline infrastructure

**WWTPs:** ~50 facilities within SoCalGas’ service territory

**Drivers to Produce RNG**
- Many are flaring due to recent air quality regulations, which lowered emission levels for stationary engines
- High value of RNG when used for transportation

**Challenges to Produce RNG**
- Majority of WWTP’s do not produce large volumes of biogas and economics are difficult for pipeline injection
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**Dairies:** ~ 1 million dairy cows within SoCalGas’ service territory

**Drivers to Produce RNG**
- Can provide significant reduction in methane emissions
- Lowest carbon intensity of all LCFS pathways
- High value of RNG when used for transportation

**Challenges to Produce RNG**
- Single dairy projects are typically not large enough for economics to work for pipeline injection
- Dairy cluster projects require significant capital (need to build digesters unlike WWTPs and landfills)

**Organics Diversion:** ~ 9 million tons per year of food and green waste sent to landfills within SoCalGas’ service territory

**Drivers to Produce RNG**
- State diversion goals for organics
- Negative carbon intensity LCFS pathway
- High value of RNG when used for transportation

**Challenges to Produce RNG**
- Projects require significant capital (need to build digesters and processing facilities unlike WWTPs and landfills)
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Other Entities Where Education is Provided Include:

1. Local and State Agencies
2. Cities and Counties
3. Air Quality Districts
4. Engineering and Consulting Firms
5. SoCalGas Internal Organizations
Examples of High Level Information Provided When Meeting with Customers or Presenting at Industry Events
Differences Between Biogas & Renewable Natural Gas (RNG)

<table>
<thead>
<tr>
<th>Illustration for Landfill Diverted Waste</th>
<th>Biogas</th>
<th>“Conditioned” 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>
Market Drivers to Produce RNG

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

   **CARB 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
Natural Gas and RNG both have carbon intensities below the current target, and therefore both generate LCFS credits.

<table>
<thead>
<tr>
<th>LCFS Pathway</th>
<th>Carbon Intensity Value (gCO2e/MJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline</td>
<td>98.47</td>
</tr>
<tr>
<td>Diesel</td>
<td>101.01</td>
</tr>
<tr>
<td>Traditional Natural Gas</td>
<td>79.46</td>
</tr>
<tr>
<td>Landfill RNG</td>
<td>~30-60</td>
</tr>
<tr>
<td>Wastewater Treatment RNG</td>
<td>~7 or 30</td>
</tr>
<tr>
<td>Landfill diverted organic waste RNG</td>
<td>~-23</td>
</tr>
<tr>
<td>CalBio Dairy Prospective RNG</td>
<td>~-276</td>
</tr>
</tbody>
</table>
Market Drivers to Produce RNG

(Estimated Value of RNG From WWTP Biogas When Used as a Transportation Fuel in CA)

A + B + C

Renewable Fuel Standard
RIN Price = ~$3.03RIN*
~$39.35/MMBtu

Low Carbon Fuel Standard
LCFS Price = ~$93/ton CO2
~$6.48/MMBtu**

Commodity Price of Natural Gas
$2.96/MMBtu***

Total Value
~$48.79/MMBtu

Prices as of 09/15/17
* 2017 Vintage D3 RIN’s
** Assumes carbon intensity for WWTP of 30 gCO2/MJ
*** Approximate Henry Hub Natural Gas Future Price – Oct 2017
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>Minimum Renewable Fuel Blending</th>
<th>Application Year</th>
<th>% Renewable Fuel Required</th>
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<tbody>
<tr>
<td></td>
<td>2016</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>2017</td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td>2018</td>
<td>25%</td>
</tr>
<tr>
<td></td>
<td>2019</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td>2020</td>
<td>100%</td>
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</tbody>
</table>
## 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>Incentive of 50% of eligible costs with</strong></td>
<td><strong>Incentive of 50% of eligible costs with</strong></td>
</tr>
<tr>
<td><strong>$5 Million Cap</strong></td>
<td><strong>$3 Million Cap</strong></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>
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SoCalGas, A Sempra Energy utility
Estimated Breakdown of Lifecycle Costs to Produce and Inject RNG into the Pipeline
{based on 1.5 million scfd of biogas for 15 years}

Breakdown includes interconnection subsidy of 50%, maximum of $3.0 million per project.
Additional Delivery Channels
Renewable energy is increasingly important part of California’s clean energy future. You’ve probably heard of renewable energy sources like solar and wind, but you may not have heard of renewable natural gas (RNG). This section provides information and resources to help you understand how renewable natural gas is generated and delivered to customers.

What is Renewable Natural Gas?
See how Renewable Natural Gas is derived from organic waste materials.

Biogas and Renewable Natural Gas
Your business may be able to save energy and money with renewable biogas and biomethane.

Biogas Conditioning/Upgrading Services
See how SoCalGas® can help biogas producers plan, design, procure, construct, own, operate and maintain biogas conditioning and upgrading equipment.

Launched renewable gas section on socalgas.com in mid-2017
Includes six subsections:
- What is Renewable Natural Gas?
- Biogas and Renewable Natural Gas
- Biogas Conditioning/Upgrading Services
- New or Expanded RNG Interconnection Receipt Points
- Biomethane Monetary Incentive Program
- Additional Information and Resources

Additional subsections will be added in the future
Renewable Natural Gas (RNG) Toolkit

(as available for download at socalgas.com/rng)

RNG is biogas that is produced from organic waste and upgraded to pipeline quality. RNG can be utilized in the natural gas pipeline system to support the integration of renewable energy sources. RNG has many benefits, including:

- **Emission Reductions**: RNG has a lower carbon footprint compared to traditional natural gas, helping to reduce greenhouse gas emissions.
- **Energy Security**: RNG helps to diversify energy sources and reduce dependence on imported natural gas.
- **Economic Benefits**: RNG can create jobs in the biogas and RNG production sectors.
- **Infrastructure Utilization**: RNG can be used to upgrade existing natural gas pipeline infrastructure.

**RNG Project Development Process**

1. **Feasibility Study**: Conduct a comprehensive study to determine the feasibility of a RNG project.
2. **Permitting**: Obtain necessary permits and approvals from regulatory agencies.
3. **Construction**: Build the RNG facility to process organic waste into biogas.
4. **Pipeline Interconnection**: Connect the RNG facility to the natural gas pipeline system.
5. **Regulatory Compliance**: Ensure compliance with all relevant regulations and standards.
6. **Operation and Maintenance**: Maintain the RNG facility to ensure safe and reliable operation.

**RNG Project Benefits**

- **Renewable Energy Source**: RNG provides a renewable energy source that can be used to meet natural gas demand.
- **Job Creation**: RNG projects create jobs in the biogas and RNG production sectors.
- **Economic Growth**: RNG can stimulate economic growth in rural and agricultural communities.
- **Environmental Stewardship**: RNG helps to manage organic waste and reduce greenhouse gas emissions.

**RNG Project Challenges**

- **Regulatory Complexity**: RNG projects are subject to complex regulations and permitting processes.
- **Economic Viability**: The economic viability of RNG projects can be impacted by varying feedstock availability and project costs.
- **Technology Requirements**: RNG projects require advanced technology to ensure safe and reliable operation.
- **Market Access**: Access to natural gas markets is necessary to monetize RNG.

**RNG Project Examples**

- **Biogas Upgrading**: Upgrading biogas to pipeline quality using advanced technologies.
- **Pipeline Interconnection**: Interconnecting RNG facilities to the natural gas pipeline system.
- **Regulatory Compliance**: Ensuring compliance with all relevant regulations and standards.
- **Economic Evaluation**: Evaluating the economic feasibility of RNG projects.

**RNG Project Outcomes**

- **Increased Renewable Energy**: RNG projects increase the use of renewable energy in the natural gas pipeline system.
- **Emission Reductions**: RNG projects reduce greenhouse gas emissions.
- **Energy Security**: RNG projects improve energy security by diversifying energy sources.
- **Economic Benefits**: RNG projects provide economic benefits to communities.

**RNG Toolkit Resources**

- **Guidance Documents**: Detailed guidance on RNG project development and operation.
- **Case Studies**: Real-world examples of RNG projects that have been successfully developed.
- **Technical Resources**: Technical information on RNG technology and upgrading processes.
- **Regulatory Information**: Information on regulatory requirements for RNG projects.

**Contact Information**

SoCalGas

1-866-550-2727

For more information about RNG, visit socalgas.com/rng.

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**Utility Interconnection**

**RNG Pipeline Network**

**Biogas Upgrading**

**Regulatory Compliance**

**Economic Evaluation**

**Technology Development**

**Market Access**

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STEP 1
INTERCONNECTION CAPACITY STUDY
The process starts with an Interconnection Capacity Study, which determines the utility's downstream capacity to take the renewable natural gas away from the interconnection point and the associated utility facility enhancement cost. The Capacity Study step also provides interconnectors with the option to request a deviation from the gas quality specifications defined in SoCalGas' Rule 30, Paragraph 1.3. Interconnectors are responsible for the actual costs needed to perform the Interconnection Capacity Study. These costs typically range from $5,000 to $10,000 and requires six weeks to complete.

STEP 2
PRELIMINARY ENGINEERING STUDY
The Preliminary Engineering Study develops the preliminary cost estimates for land acquisition, site development, right-of-way, metering, gas quality, permitting, regulatory, environmental, unusual construction, operating and maintenance costs. Interconnectors are responsible for the actual costs needed to perform the Preliminary Engineering Study. These costs typically range from $50,000 to $60,000 and requires four to five months to complete.

STEP 3
DETAILED ENGINEERING STUDY
There are three elements in the Detailed Engineering Study, including:
1. Description of all costs of construction
2. Development of complete engineering construction drawings
3. Preparation of all construction and environmental permit applications and right-of-way acquisition requirements
Interconnectors are responsible for the actual costs needed to perform the Detailed Engineering Study. These costs typically range from $145,000 to $225,000 and four to six months to complete.

GAS CONSTITUENT MONITORING AND MEASUREMENT
Siloxanes, one of the constituents of concern, can be found in a variety of consumer products. Siloxanes are usually present in biogas created at landfills and waste water treatment plants, and can sometimes be found in diverted food and green waste biogas. Siloxanes can create problems in end user equipment because during combustion, they can coat equipment with a fine layer of silica and silicates. This is especially problematic for sensitive end-user equipment found in Southern California. For example, siloxanes can cause expensive catalysts to fail. These catalysts perform an important service reducing emissions to keep our air clean, and are found in all fuel cells, natural gas vehicles, and the majority of electric power generators. The local aerospace industry and other manufacturers have also expressed concerns with siloxanes potentially entering their sensitive facilities through the fuel supply.

CLEANING BIOGAS TO PIPELINE QUALITY STANDARDS
Several methods and technologies are available to condition and upgrade biogas into renewable natural gas (RNG) and remove constituents of concern. Technology selection can be based on many criteria, including the makeup of the biogas as well as site and operating conditions. Some examples of technologies used in biogas conditioning and upgrading are:
- High-selectivity membranes
- Pressure swing adsorption systems
- Water scrubbing systems
- Solid scavenging media
- Regenerative or non-regenerative adsorbent media
- Catalytic O2 removal

It is common to find a combination of these technologies working together to meet a set of specifications.

FIND OUT MORE
For more information, please visit:
socalgas.com/rg
or contact us at:
gasstudyrequests@semprautilities.com

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For more information, please visit:
socalgas.com/rg
Or contact our Low Carbon Fuels Market Development Team at:
marketdevelopment@semprautilities.com
Annual RNG Workshop

» First RNG Workshop held in Southern California in October of 2016 and co-hosted with Energy Vision

» Very successful event attended by more than 180 people

» Panel sessions cover:
  - Policy
  - Biogas Upgrading Technologies
  - Case Studies
  - Utility Interconnection
  - RNG end-uses

» 2017 RNG Workshop will take place in Sacramento on October 5th and co-hosted with Energy Vision and PG&E
Thank You

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