Getting the Facts on Renewable Natural Gas

Making California’s future renewable

2nd Annual AGA-EPA Natural Gas STAR/Methane Challenge
Renewable Natural Gas Workshop & Exhibit
Presented by Deanna Haines, Director of Energy & Environmental Policy
SoCalGas/SDG&E
Ft. Worth Omni Hotel | October 23, 2018
Both Utilities in service for over 135 years

**SoCalGas**
- Largest natural gas distribution utility in the US
- Serve 12 counties (over 500 communities) and more than 21 million people
- Over 5.8 million gas meters

**SDG&E**
- Provides electricity and natural gas to 3.4 million people from Orange County to the Mexican border.
California leads the nation in setting climate goals and policy

<table>
<thead>
<tr>
<th>Governing Law – SB100</th>
<th>Governing Law – SB1383</th>
<th>Executive Order B-55-18</th>
</tr>
</thead>
<tbody>
<tr>
<td>By 2030, obtain 60% of electricity from renewable sources</td>
<td>By 2030, reduce methane emissions 40% below 2013 levels</td>
<td>By 2045, economy-wide, become Carbon Neutral</td>
</tr>
</tbody>
</table>
We need scalable, affordable solutions to solve these issues.

Solar, wind and hydro alone are not enough.

We need to use ALL the tools in our toolbox – including Renewable Natural Gas.
Like electricity, natural gas can come from renewable sources
Why is this important?
CA’s biggest sources of methane come from our waste streams

- Dairies & Livestock: 55%
- Landfills & Waste Water: 25%
- Pipelines & Storage: 10%
- Oil & Gas Extraction: 5%
- Agriculture: 3%
- Industrial & Misc.: 2%

Source: California Air Resources Board, 2018 Greenhouse Gases Emissions Inventory, 2016 Methane Emissions
RNG is critical to California’s overarching GHG reduction plan

Short Lived Climate Pollutant Plan

- Methane
  - 62%
- ~35%

- Cap & Trade
- Energy Efficiency
- Mobile Sources
- Biofuels (Low Carbon Fuel Standard)
- 50% Renewable Portfolio Standard

Source: Percentages reflect reductions proposed in California Air Resources Board, AB 32 Updated Scoping Plan (2017)
Context

RNG Basics

The Case for RNG
Let’s take a closer look.
The basics of Renewable Natural Gas

Capture waste from dairies, farms and landfills

Convert into biogas using anaerobic digestion

Process the biogas to make it pipeline-ready (biomethane)

Inject the biomethane into the pipeline for future use

CH₄
<table>
<thead>
<tr>
<th>Key terms defined</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Renewable Natural Gas</strong></td>
</tr>
<tr>
<td>methane produced from renewable sources like digested organic waste and gasified biomass</td>
</tr>
<tr>
<td><strong>Renewable Gas</strong></td>
</tr>
<tr>
<td>can be renewable natural gas or hydrogen gas produced from Power-to-Gas.</td>
</tr>
<tr>
<td><strong>Biogas</strong></td>
</tr>
<tr>
<td>a biofuel that is naturally produced from the decomposition of organic waste during anaerobic digestion. Until biogas is processed to state pipeline standards, it is not considered renewable gas.</td>
</tr>
<tr>
<td><strong>Biomethane</strong></td>
</tr>
<tr>
<td>biogas that has been cleaned to state standards and converted to biomethane, which is renewable gas.</td>
</tr>
</tbody>
</table>
Context

RNG Basics

The Case for RNG
Renewable Natural Gas beats building electrification

Achieve 30% emissions reductions in the building sector by switching to

~5% RNG

Achieve the same GHG reductions as overhauling 100% of CA’s buildings to all electricity with

~16% RNG

When used as a transportation fuel, RNG from food and Green waste has a negative carbon intensity

Navigant Consulting, “Gas Strategies for a Low-Carbon California Future,” 2018
Increasing renewable energy in any form will increase costs, but it is a worthwhile investment. We all agree on that. Now what we need is a practical plan.
Renewable Natural Gas is also more cost effective

Likely RNG supply mix over 3x more cost effective than any electrification scenario.

Source: Navigant Consulting, "Gas Strategies for a Low-Carbon California Future," 2018
With RNG, we can achieve our goals with less disruption

In addition to unnecessary costs, electrification would put a heavy burden on consumers.

It would mean:

• Switching out appliances
• Upgrading electric panels
• Rewiring home electric systems

Sources: Navigant Consulting, “Gas Strategies for a Low-Carbon California Future,” 2018
True or False?

There is enough RNG available to meet CA’s 2030 goals.
There is a growing supply of RNG in California and the broader U.S.
The RNG supply is available:
in-state estimates

94 BCF
UC Davis/ARB Study:
based on current federal and LCFS incentives

100-200 BCF
ICF Assessment:
CA with current regulation / incentives;
100 BCF conservative estimate

300 BCF
UC Davis/CEC Study

Sources: The Feasibility of Renewable Natural Gas as a Large-Scale, Low Carbon Substitute, Prepared for the California Air Resources Board and the California Environmental Protection Agency by Amy Jaffe, Principal Investigator. STEPS Program, Institute of Transportation Studies, UC Davis
The RNG supply is available: out-of-state resources

1 TCF RNG
Available in the US today (and growing)

1.7 TCF
Projected CA natural gas throughput by 2030

16% = 272
RNG rate BCF in 2030

But is it feasible?
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

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 Renewable Gas Project Overview

CR&R is turning GHG-laden organic waste into Carbon-neutral renewable natural gas

Near-zero natural gas engines reduce NOx emissions up to 90% and GHG emissions up to 80%.

CR&R's RNG is fueling 400 waste trucks. That's the equivalent of taking 130,000 cars off the road.
We’re developing a renewable natural gas market to capture emissions and meet CA climate goals.

Up to $110 million in grants from the California Department of Food and Agriculture to support new dairy biogas projects.
Thinking globally, we can have a greater impact.

In California, agriculture is responsible for 9% of our GHG emissions.

However, agriculture accounts for 24% of global GHG emissions.

There's a bigger opportunity globally.

How we innovate matters.
If RNG is so great what is standing in our way?

- Underestimating supply.
  California has the potential to replace all residential natural gas with RNG.

- Short-term thinking.
  Research and development is expensive, but the sooner we get going the sooner we see the returns.

- Misunderstanding infrastructure.
  Investments in the pipeline are necessary if we are serious about capturing methane emissions from waste streams.

- Lack of perspective.
  A narrow focus on combustion leaves out the greater fact that RNG has a net-positive environmental impact.
With a integrated approach we can achieve our goals and preserve choice, while minimizing disruption and cost.
To reach our climate goals we need renewable natural gas

- Support initiatives for capturing methane emissions from waste streams
- Set procurement standards to increase the use of RNG by public utilities
- Develop the market for renewable natural gas
Appendix
Interconnection Tools and Process Improvements
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
RNG Toolkit
(Available at socalgas.com/rg)
For WWTP Biogas

- **A + B + C**
  - Total Value: $44.03/MMBtu

- **C**
  - Renewable Fuel Standard
  - RIN Price = ~$2.12RIN*
  - ~$27.53MMBtu

- **B**
  - Low Carbon Fuel Standard
  - LCFS Price = ~$190/ton CO₂
  - ~$13.24/MMBtu**

- **A**
  - Commodity Price of Natural Gas
  - $3.26/MMBtu***

Prices as of 10/05/18
* 2018 Vintage D3 RIN's
** Assumes carbon intensity for WWTP of 30 gCO₂/MJ
*** Approximate Henry Hub Natural Gas Future Price – Nov 2018
http://progressivefuelslimited.com/Auth_RIN/PFL_RIN_Recap.pdf

What are the Market Drivers to Produce RNG?
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
$105.36/MMBtu

Renewable Fuel Standard
RIN Price = ~$2.12 RIN*
~$27.53/MMBtu

Low Carbon Fuel Standard
LCFS Price = ~$190/ton CO2
~$74.57/MMBtu**

Commodity Price of Natural Gas
$3.26/MMBtu***

Prices as of 08/03/18
* 2018 Vintage D3 RIN's
** Assumes carbon intensity for Dairy Biogas of -276 gCO2/MJ
*** Approximate Henry Hub Natural Gas Future Price – Nov 2018
http://progressivefuelslimited.com/Auth_RIN/PFL_RIN_Recap.pdf
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>SGIP Minimum Renewable Fuel Blending</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application Year</td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td>2016</td>
</tr>
<tr>
<td>2017</td>
</tr>
<tr>
<td>2018</td>
</tr>
<tr>
<td>2019</td>
</tr>
<tr>
<td>2020</td>
</tr>
</tbody>
</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
Biomethane: Assigned Commissioner Amended Scoping Memo and Ruling (R.13-02-008)

Overview

➢ Scoping Memo issued on 7/5/18 by CPUC mostly focused on gas quality specifications and pipeline injection standards for biomethane

➢ In accordance with Section 399.24 and with Executive Order B-48-18 issued on January 26, 2018, it is the CPUC’s future intention to consider issues within this, or a successor proceeding, that pertain to the safe, cost-effective development of other renewable gases, such as renewable hydrogen

➢ Scoping Memo states it is important to establish a standardized utility biomethane interconnection tariff and standardized interconnection pro forma forms for the use of biomethane projects across California

• Directs the utilities to jointly file a proposed standard biomethane interconnection tariff and proposed standard pro forma interconnection form
SB 1440 (Hueso)

Overview

➢ On September 23, 2018, Governor Brown signed SB 1440 which requires the Public Utilities Commission, in consultation with the State Air Resources Board, to consider adopting specific biomethane procurement targets or goals for each California gas corporation.

➢ At this point in time, it is not clear the process/procedure/steps the CPUC will take to “consider adopting biomethane specific targets or goals”
SB 1383 (Lara) – Approved by Governor 9/19/16

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

Some RNG Related Sub-Parts of SB 1383

- Methane emissions reduction goals shall include the following targets to reduce the landfill disposal of organics:
  - A 50-percent reduction in the level of the statewide disposal of organic waste from the 2014 level by 2020
  - A 75-percent reduction in the level of the statewide disposal of organic waste from the 2014 level by 2025

- 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

- The state board shall develop a pilot financial mechanism (PFM) to reduce the economic uncertainty associated with the value of environmental credits, including credits pursuant to the Low-Carbon Fuel Standard regulations
  - ARB has published a draft SB 1383 Pilot Financial Mechanism concept paper (May 2018)
SB 1383 - Dairy RNG to Pipeline Pilot Project

Representative model

1. Digester at Each Dairy
   - Digester #1 (X,000 cows)
   - Digester #2 (X,000 cows)
   - Digester #3 (X,000 cows)

2. Biogas Conditioning Facilities and Collection Lines
   - Biogas Conditioning and Upgrading Facility
   - Biogas Gathering Lines
   - Monitor and Meter Biogas (optional)
   - Remove H2S & H2O (optional)
   - Biogas Compressor

3. Biogas Conditioning and Upgrading Facility
   - Biogas Conditioning/Upgrading Facility

4. Pipeline Lateral and Compression
   - Pipeline Lateral and Compression
   - Point of Receipt

5. Interconnection (Point of Receipt)
   - Interconnection (Pipeline Extension)

6. Interconnection (Pipeline Extension)
   - Existing Pipeline Network

7. NGV Fueling Station or Other End-use

Applicant Funded Equipment
Applicant-Owned Pipeline Infrastructure
Utility-Owned Pipeline Infrastructure
**Interconnection: Overview of Components**

Two Primary Components of the Term “Interconnection”

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

- **Customer Pipeline** (RNG from biogas conditioning/upgrading plant)
- **Utility Pipeline**
- **“Point of Receipt”**
- **“Pipeline Extension”**
"Point of Receipt" Component of the Interconnection

The Point of Receipt

1. **Monitors gas quality** to ensure it meets SoCalGas Rule 30 Gas Quality Specifications (e.g. CO$_2$, O$_2$, total inerts, heating value, H$_2$S)

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** 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 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

**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
### 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>
</tbody>
</table>

Utility Pipeline Extension
Estimated Breakdown of Lifecycle Costs to Produce and Inject RNG into the Pipeline
{based on 1.5 million scfd of biogas for 15 years}

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.

Location is Key!!

Breakdown includes interconnection subsidy of 50%, maximum of $3.0 million per project.
Biogas Conditioning and Upgrading Projects
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 an evaluation of current biogas upgrading technologies. Included in the report is a high-level impact assessment for removing nitrogen and oxygen.