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Biogas to Renewable Natural Gas (RNG):

A Guideline for Water Resource Recovery Facilities

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Introduction

The United States is the largest global consumer of natural gas and depends on natural gas for almost one-quarter of its energy needs. While standard natural gas is a fossil fuel that requires tremendous energy to extract, renewable natural gas (RNG) can be produced from the anaerobic digestion of organic wastes such as sewage; fats, oils, and greases; the organic fraction of municipal solid waste; agricultural waste; and industrial organic waste. RNG is pipeline quality gas derived from biogas that is fully interchangeable with natural gas.

Biogas is made up of 55–60% methane, 40–45% carbon dioxide, and small amounts of nitrogen, oxygen, hydrogen sulfide, siloxanes, and moisture. To be categorized as RNG, a "drop-in" fuel, the water, carbon dioxide, hydrogen sulfide, and other trace elements must be scrubbed from the biogas.

Of the 16,000 water resource recovery facilities (WRRFs) in the US, approximately 1500 use anaerobic digestion to stabilize solids and generate biogas, as shown in Figure 1. Typical uses for WRRF biogas include boilers to provide process and space heating and combined heat and power (CHP) technology. Many facilities also flare some or all of the biogas generated on site. Treatment of biogas to RNG is very limited, but more and more facilities are exploring this option for on-site fleet vehicle fueling and export to local gas utilities by means of pipeline injection. The environmental and financial benefits of RNG have become attractive.

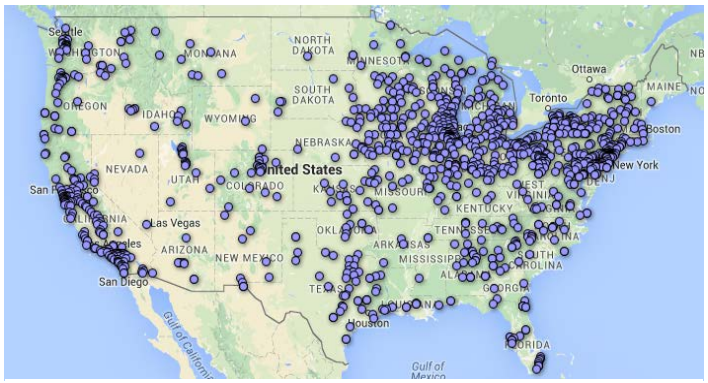

Figure 1. Operational Biogas Systems in the US – data from biogasdata.org

Renewable Natural Gas – *pipeline quality gas derived from biogas that is fully interchangeable with natural gas*

Biogas – *unconditioned raw gas composed of methane and CO_2, generated from Anaerobic Digestion*

Why Pipeline Injection?

Case-by-case analyses should be conducted to determine the most cost-effective and operationally feasible end use for biogas at a WRRF. However, choosing pipeline injection over other end uses can provide unique benefits such as:

- lower operating costs
- higher revenues
- lower compression on-site required compared to vehicle fueling
- potentially greater emissions reductions for offsetting transportation fuel
- no or limited storage required for smooth operation
- no vehicle traffic compared to on-site vehicle fueling

What Are the National RNG Quality Standards for Injection?

Gas quality describes the physical and chemical properties of a gas stream. Like natural gas streams, biogas can contain a range of contaminant concentrations based on supply source and level of processing prior to delivery into a local distribution company (LDC). As such, local RNG quality standards have been developed to ensure consistent quality RNG is injected into pipelines across the country.

Unfortunately a national standard has not yet been developed. The lack of a national quality standard has resulted in natural gas utilities working independently with state utility commissions to develop multiple discrete standards. As a result, there are a wide range of gas quality standards in place around the country, if they exist at all, making it very challenging for WRRF RNG producers to inject into the pipeline.

It is important to note that natural gas utilities also often have "anti-degradation requirements" requiring that all pipeline gas being injected into the system meet the average quality characteristics of the existing supply. As a

result, utilities often have higher requirements on RNG injectors, such as WRRFs, than they can routinely meet themselves. The biggest areas of concern related to gas quality include:

- **Heat Value** – Ranges from 960 to 990 BTU/cf.
- **Oxygen** – Ranges from 0.4% to 0.1%. Will require additional equipment if less than 0.2%.
- **Siloxanes** – Ranges from no requirement to less than 0.3 PPM, which is below detection limits of analytical equipment.
- **Other Contaminants of Concern (CoCs)** – A long list of contaminants developed by the California Public Utilities Commission, based on analysis of raw biogas.

Addressing these parameters requires stripping out CO_2 and other impurities using membranes, pressure swing adsorption systems, or other scrubbing technologies.

Attention by the wastewater community to the variability of RNG quality specifications must be highlighted so that utilities do not impose unfair gas quality standards that are biased against RNG. The American Biogas Council has developed recommended RNG gas quality standards that are reasonable and can be met without excessive treatment capital and operating costs.

What Are the National Standards for Sampling and Monitoring?

There are currently no clear national sampling standards, just like there are no national quality standards, rather they are utility specific. WRRFs should work to avoid real-time monitoring for siloxanes or other constituents that do not have viable testing equipment, as well as work with utilities to demonstrate that RNG gas quality meets parameters initially to reduce the need for follow-up on sampling and monitoring.

What Typical Costs Are Associated with Pipeline Injection?

- Compression to meet utility injection pressure
- Ongoing monitoring for achieving and maintaining a 990 BTU heating value
- Interconnection costs with utility
- Piping to injection location
- Ongoing sampling costs, if required
- Transportation tariff for moving RNG through utilities' distribution system

What Are the Incentives for RNG?

The Federal Renewable Fuel Standard (RFS) provides significant incentives for RNG used as transportation fuel. For more information on credits and incentives, read the WEF Factsheet "Renewable Identification Numbers: A Guideline for Water Resource Recovery Facilities." Some states have their own renewable fuels programs that are allowed to be added to the federal program. The value can be several multiples more than natural gas itself.

Physical Property	Units	Value
Heating Value	BTU/ft^3	960 – 990
Carbon Dioxide	mol %	2
Oxygen	mol %	0.1% – 0.4%
Total Inerts	mol %	5
Hydrogen Sulfide	gr./100 ft^3	0.25
Total Sulfur	gr./100 ft^3	<20
Water	lbs/mmSft^3	7
Siloxanes	ppm(v)	0 – <0.3
Hydrocarbon Dew Point	Fahrenheit	–40
Temperature	Fahrenheit	50 – 120
Dust, Particulate		commercially free*
Biologicals		commercially free*
Heavy Metals		commercially free*

*Commercially free is defined as equal or less than the levels present in conventional natural gas.

Data Source:
http://americanbiogascouncil.org/biogas_purityspecs.asp

ADDITIONAL RESOURCES AT E-WEF.ORG