

# Gas Upgrading RNG Standards

## Biogas to RNG for Pipeline Injection

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# What is RNG

- Renewable Natural Gas: Biogas which is a direct replacement for Natural Gas
- Either:
  - Compressed Natural Gas
  - Liquefied Natural Gas

# Biogas Sources

- Landfills
- Agricultural Digesters
- Waste Water Treatment Plants
- Food Waste Digesters



# Biogas Makeup

- 30 to 70% Methane
- 20 to 50% Carbon Dioxide
- 0 to 20% Nitrogen
- 0 to 5% Oxygen
- 0 to 10,000 ppmv H<sub>2</sub>S
- 0 to 20 ppmv Siloxanes
- 0 to 1000 ppmv other Organic Compounds

# Medium BTU gas

- Uses
  - Engines
  - Turbines
  - Boilers
  - Direct Heat Applications
- Minimal Treatment:
  - Compression
  - Dehydration
  - Possible H<sub>2</sub>S removal
  - Possible Siloxane Removal

# High BTU Gas (RNG)

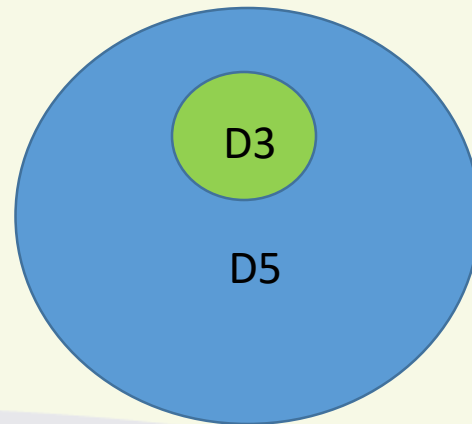
- RNG:
  - Compressed Renewable Natural Gas
  - Liquified Natural Gas Natural Gas
- Extensive Treatment:
  - Compression
  - Dehydration
  - H<sub>2</sub>S, VOC, NMOC, N<sub>2</sub>, O<sub>2</sub>, CO<sub>2</sub>, Siloxane Removal

# RNG

- Making RNG is more expensive than other biogas use options. So why do it?
  - To Generate RINs (Renewable Identification Numbers)
  - The RIN system was created by the RFS (Renewable Fuel Standard) program to reduce GHG emissions and reliance on foreign energy
  - California LCFS (Low Carbon Fuel Standard)

# RIN Types

- There are multiple types of RINs but only two concern us:
- D3 RINS: Cellulosic Biofuel (highest value fuel)
- D5 RINS: Advanced Biofuel (lower value fuel)

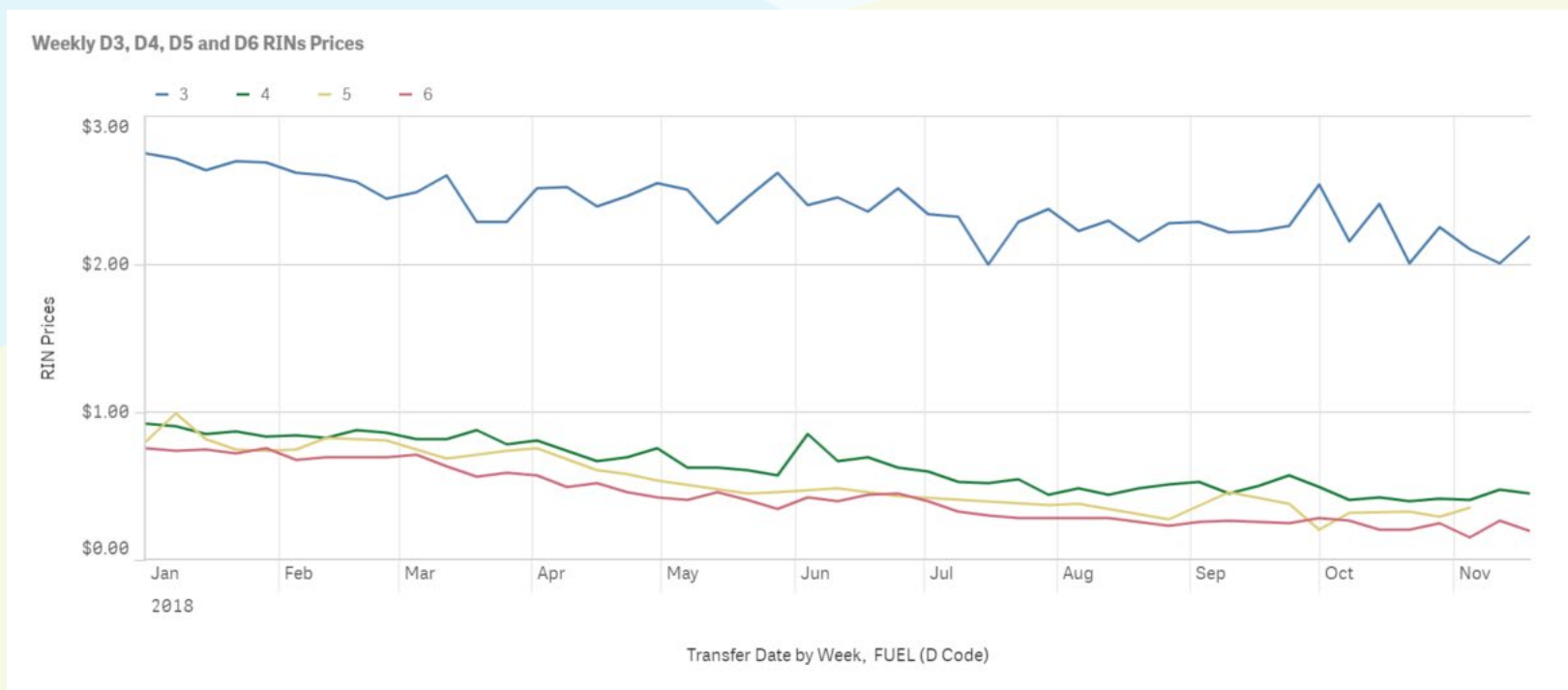




# D3 RINS

- Sources of D3 RINS
  - Landfill Gas
  - Agricultural Digester
  - MSW Digester
  - Waste with a 75% cellulosic content
- Sources of D5 RINS
  - All other digester waste

# Historical RIN Pricing



# Value of D3 RINS

- Dairy Digester with 770 SCFM inlet Flow at 65% methane: 30 MMBTU/HR
- \$2.25/D3 RIN is equivalent to \$29/ MMBTU
- $30 \text{ mmBTU/hr} * 24\text{hr/day} * 365 \text{ days/year} * \$29/\text{mmBTU} = \$7.6 \text{ million/year}$
- Add to this Natural gas prices (approximately \$1 million/year)

# RNG Standards

- To qualify for RINS the RNG must be put into a pipeline or sold as LNG
- Pipeline injection is the most common use
- The RNG must meet the requirements of the pipeline Tariff

# LCFS Credits

- “Regulated Parties” who provide fuel in California, Oregon, and British Columbia are required to provide low carbon intensity fuel.
- Fuel sold into these markets are eligible for low carbon fuel standards (LCFS) Credits in addition to RINs.

# Typical Pipeline Tariff

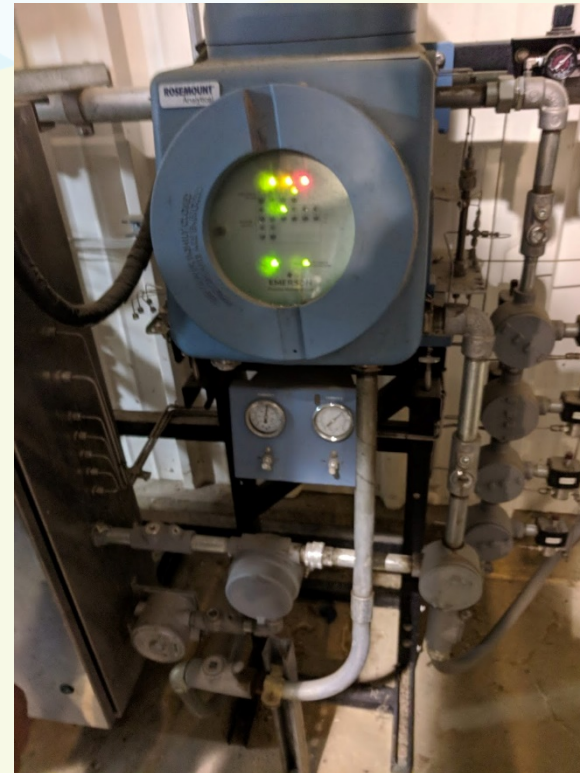
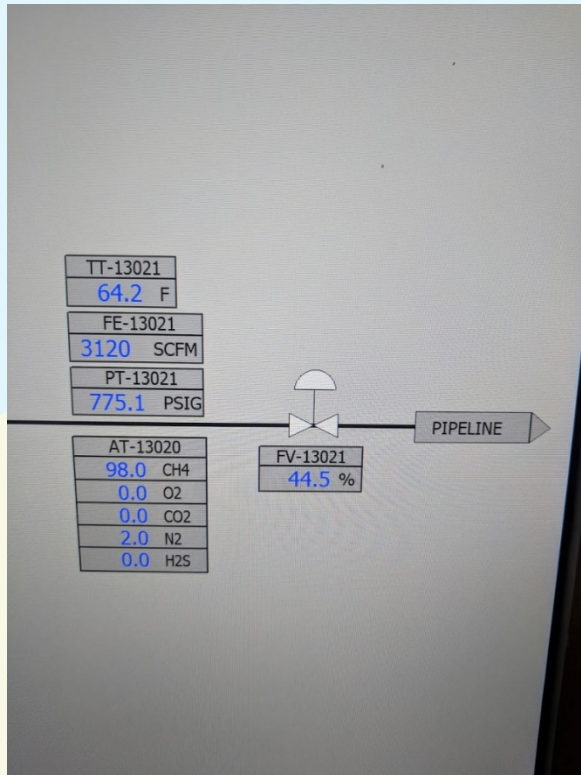
- |  |                                |
|--|--------------------------------|
| • Typical Tariff                       | Biogas                         |
| • 970 BTU/CF                           | 400-700 BTU/CF                 |
| • 0.25 Grains H <sub>2</sub> S(4 ppmv) | 0-10,000 ppmv H <sub>2</sub> S |
| • 0.02% Oxygen                         | 0-5% Oxygen                    |
| • 1.25% Carbon Dioxide                 | 30-50% CO <sub>2</sub>         |
| • 4% Inerts                            | 30-50% Inerts                  |
| • 7lbs/1000 CF Water                   | Saturated                      |

# Biogas Specific Tariffs

- Kinder Morgan REETHINK Program
  - Limits Siloxanes to 1 ppmv
  - Limits Vinyl Chloride to 3.3 ppmv
  - Requires Extensive Verification and Testing that can keep the facility out of the pipeline.

# Verification of Gas

- Pipeline Gas Testing (Gas Chromatograph)





# Valves and Flare

- Out of Specification Gas is diverted to the Flare

