What is Renewable Natural Gas (RNG)?

- For energy purposes, RNG is chemically identical to pipeline quality natural gas.
- Renewable Natural Gas is a product of gas derived from the decomposition of organic materials in renewable waste streams.
- RNG uses the same infrastructure as fossil natural gas: pipelines, gas compressors, refueling stations, and vehicle engine technology.
- Potential for billions of GGEs annually from existing biogas sources.

Key Difference:

RNG = Renewable
Natural Gas = Geologic

Sources of RNG:
- Landfills
- Wastewater Treatment Plants
- Livestock Facilities
- Commercial & Residential Food Waste

RENEWABLE NATURAL GAS PRODUCTION
HOW RNG IS MADE

Renewable natural gas (RNG), or biomethane, is a pipeline-quality gas that is fully interchangeable with conventional natural gas and thus can be used in natural gas vehicles. RNG is essentially biogas (the gaseous product of the decomposition of organic matter) that has been processed to purity standards.

**STEP 1**
**FEEDSTOCK SOURCE**
Animal manure is collected and delivered to an anaerobic digester to stabilize and optimize methane production. The resulting biogas can be processed into RNG and used to fuel natural gas vehicles.

Biogas from landfills is also called landfill gas (LFG), as the digestion process takes place in the ground rather than in an anaerobic digester.

**STEP 2**
**CLEANED AND PROCESSED**
To fuel vehicles, biogas must be processed to a higher purity standard. This process is called conditioning or upgrading, and involves the removal of water, carbon dioxide, hydrogen sulfide, and other trace elements.

**STEP 3**
**INTRODUCED INTO THE NATURAL GAS PIPELINE**
The resulting RNG, or biomethane, has a higher content of methane than raw biogas, which makes it comparable to conventional natural gas and thus a suitable energy source in applications that require pipeline-quality gas.

**STEP 4**
**DISPENSED AT CNG FUELING STATIONS**
Like conventional natural gas, RNG can be used as a transportation fuel in the form of compressed natural gas (CNG) or liquefied natural gas (LNG). RNG qualifies as an advanced biofuel under the Renewable Fuel Standard.
Well-to-Wheel Carbon Intensity by Fuel Type

Data from Westport.com derived from GREET 2015.
Renewable Natural Gas Benefits

- Lower local air emissions
- Reduces Direct Greenhouse Gas Emissions of diesel vehicles by 85%
- 75% fewer direct emissions than fossil natural gas
- Complies with current CNG engine warranties
- Aligns with company sustainability strategies

Note: Benefits of RNG are numerous. Shippers who are looking to improve the sustainability of their fleets and meet corporate sustainability goals are partnering with U.S. Gain to help them achieve dramatic reductions in Greenhouse Gas Emissions.
Implications:

With the addition of RNG, the life cycle of GHG emissions can be reduced by an additional 75%. CNG with the addition of RNG represents a compelling opportunity for fleets to achieve their sustainability goals.

Many major municipalities and corporations have implemented sustainability strategies, most of which include the adoption of alternative fuels in their operations.
Converting to RNG from diesel is the equivalent of ...

- **Carbon Sequestered by 283,238 Tree Seedlings Grown for 10 Years**
- **Greenhouse gas emissions from 26,193,049 miles driven by an average passenger vehicle**
- **Greenhouse gas emissions from 3,468 tons of waste recycled instead of landfilled**

Based on 1 Million DGEs. Derived from EPA Greenhouse Gas Equivalencies Calculator.
Timeline for RNG at GAIN Clean Fuel Stations
U.S. Gain RNG Projects

**State Street Landfill, Omaha**
- Currently Online
- 600,000 GGE/Year
- Flowing to CA currently

**Waste Water Treatment facility, Dubuque**
- Begin flowing December 2017
- 600,000 GGE/Year
U.S. Gain RNG Projects

- **Michigan Landfill**
  - Online March 2018
  - 9.6 Million GGE/Year

- **Tennessee Landfill**
  - 1.8 Million GGE/Year
  - Online April 2018
U.S. Gain RNG Projects

- **Texas Landfill**
  - Online December 2018
  - 3.0 Million GGE/Year

- **Wisconsin Landfill**
  - Online Q4 2018
  - Performing due diligence on gas clean up and pipeline connection
  - 8.4 Million GGE/Year