



BIOGAS UPGRADING FOR VEHICLE FUEL AND PIPELINE INJECTION

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Capture your biogas....

Midwest Digesters

Downers Grove, IL



Wausau, WI



Glenbard, IL



Kenosha, WI



Green Bay, WI



St. Cloud, MN



Beaver Dam, WI



Winona, MN



and put it to work!

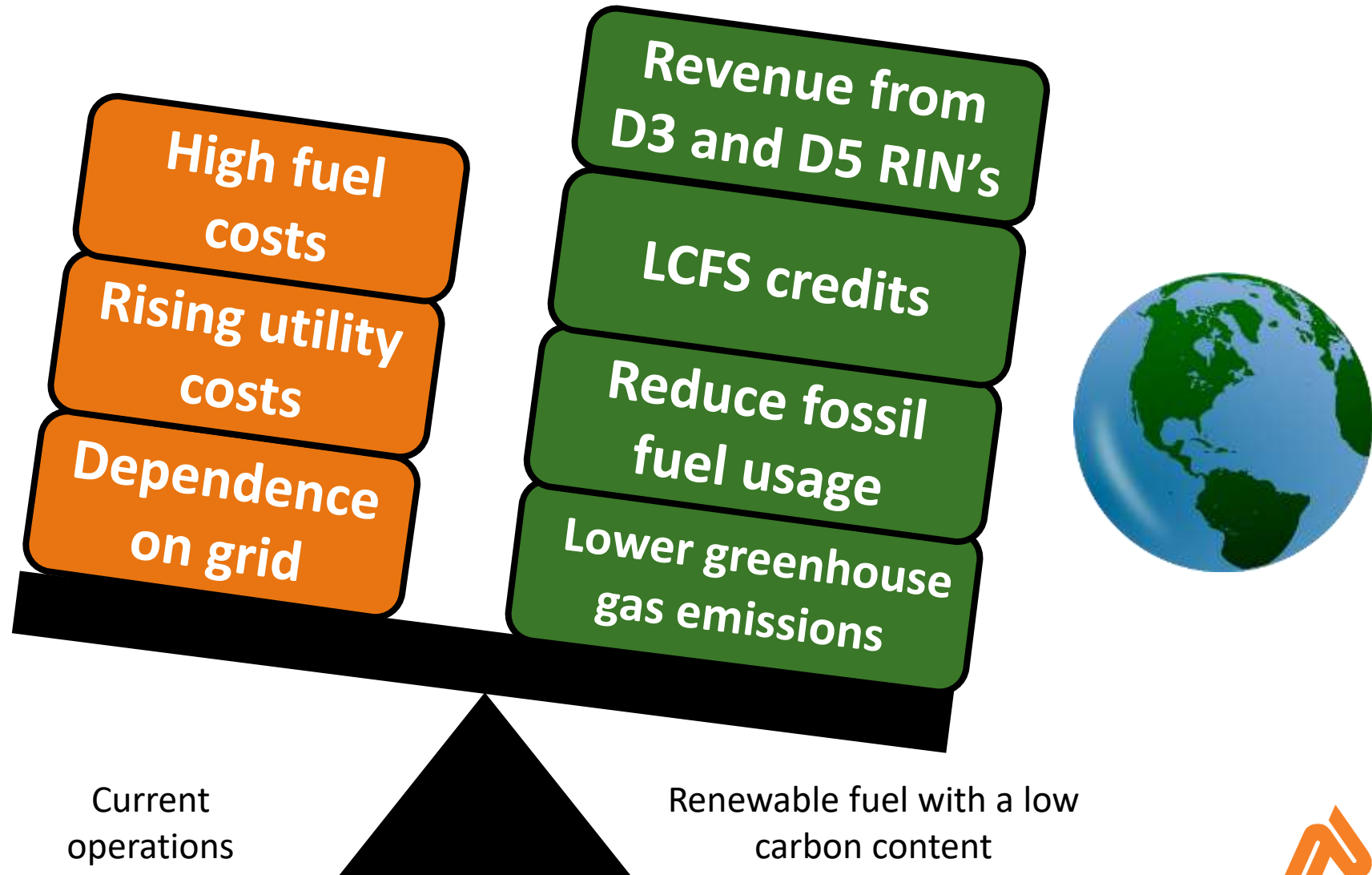
- Boiler Fuel
- Electricity Production
- Heat Recovery



Fuel for Vehicles



DRIVING FACTORS FOR RNG



RIN DETAILS

RIN Type	Description	GHG Reduction Requirement	Price 5/1/19
Cellulosic Biofuel (D3)	Municipal wastewater plants and landfill biogas qualify (Cellulose, hemicellulose, or lignin)	60%	\$1.55/RIN \$2.33/GGE
Advanced Biofuel (D5)	Produced from non-corn starch, renewable biomass	50%	\$0.34/RIN \$0.51/GGE

- <https://www.biocycle.net/2017/11/13/101-for-rins/>

GETTING STARTED: RIN BASIC INFORMATION

- A RIN credit is a serial number assigned to each gallon of renewable fuel as it is introduced into U.S. commerce
- Fossil fuel suppliers must have a percentage of their fuel be renewable and achieve some of these levels through RIN
- Federally mandated volumes are in place until 2022
- Only biogas used as renewable transportation fuel can generate RINs
- RIN Agents - similar to Carbon Credit Exchange Brokers

WHY RNG AS VEHICLE FUEL?

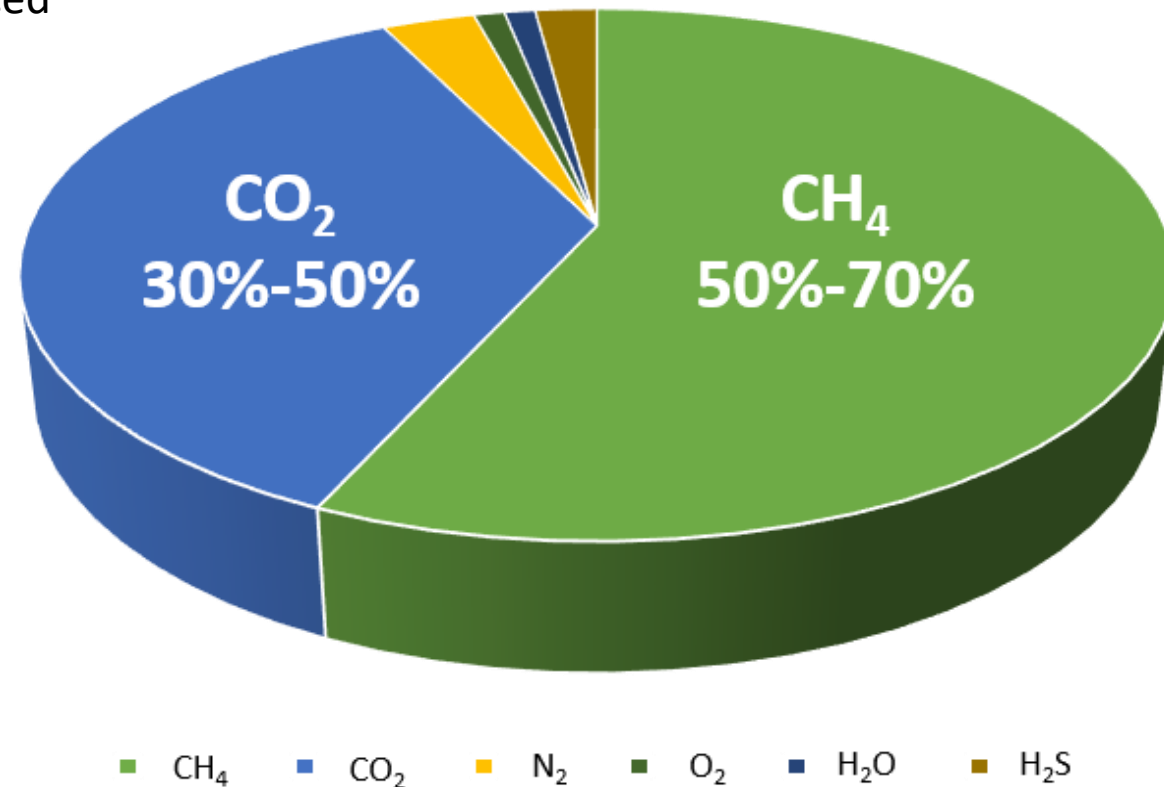
- Current Natural Gas Price: \$2.55/MMBTU
- Average CNG Price (US): \$2.11/GGE
- 8.8GGE = 1MMBTU
 - Equals \$18.57/MMBTU, (CNG)
 - RINS are above and beyond the sale price of the fuel
- Current D3 RIN Price is \$1.55/RIN (\$2.32/GGE)
 - Each RIN is 77,000 Btu
 - This equates to approximately 1.5 RINS/GGE
 - This equals an additional \$20.42 per MMBTU



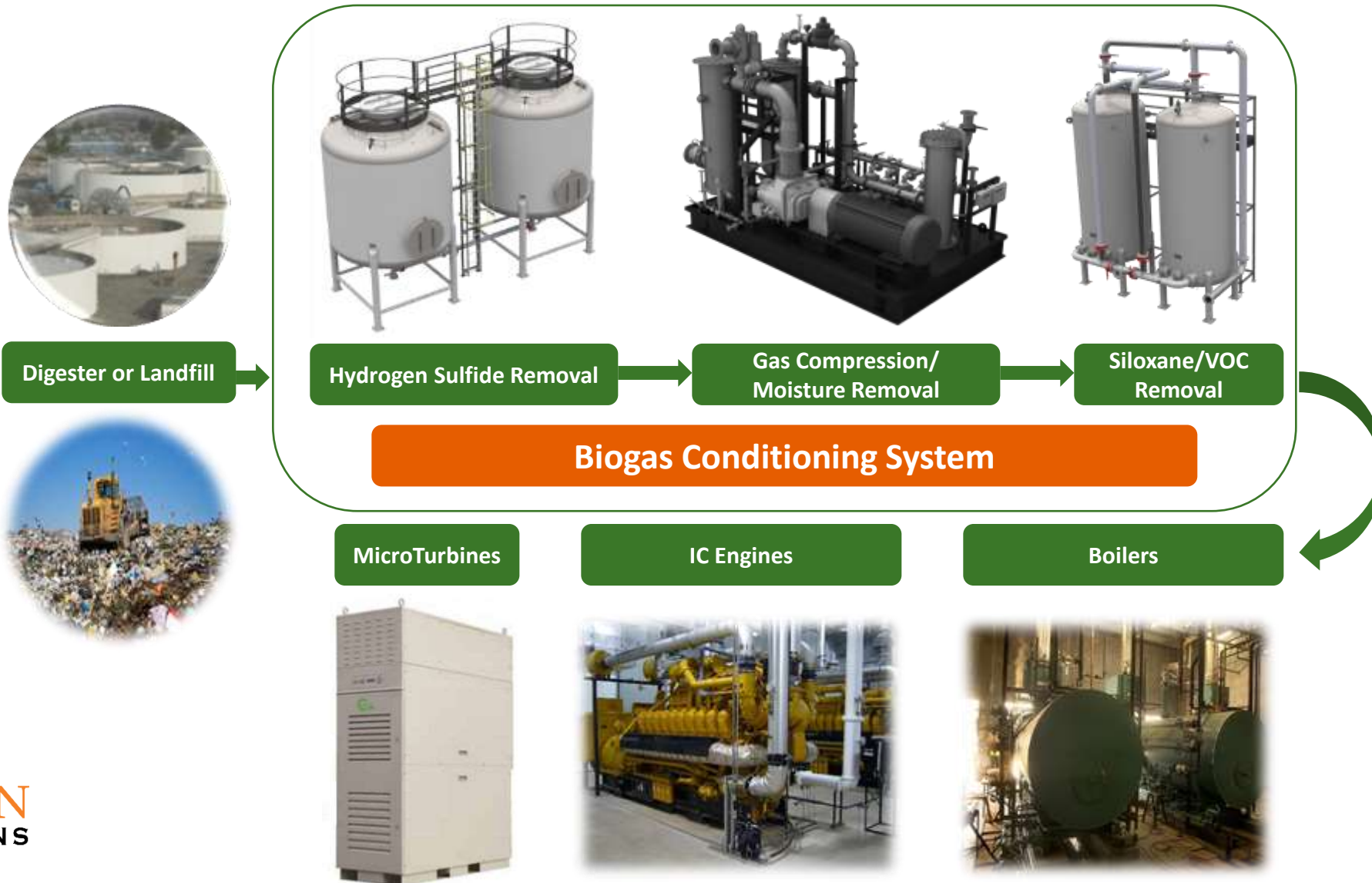
Step 1 - Biogas testing

bi·o·gas, 'bīō, gas/, *noun*, gaseous fuel, especially methane, produced by the fermentation of organic matter.

- Methane, CH₄
- Carbon Dioxide, CO₂
- Nitrogen, N₂
- Oxygen, O₂
- Hydrogen Sulfide, H₂S
- Moisture
- Particulates
- Siloxanes
- Volatile Organic Compounds



Biogas Conditioning System: Process Flow Diagram



Why Hydrogen Sulfide Removal?

- Equipment damage from corrosion (Hydrosulfuric Acid)
- SO_x Emissions
- Health and safety issues (1,000 ppm will cause an individual to lose consciousness)
- Odor control
- Causes fouling of siloxane removal media
- Measure levels with either lab testing, Draeger tubes, or onsite meter

Hydrogen Sulfide Removal Systems



Ferric Oxide, Fe_2O_3 coated (reaction)

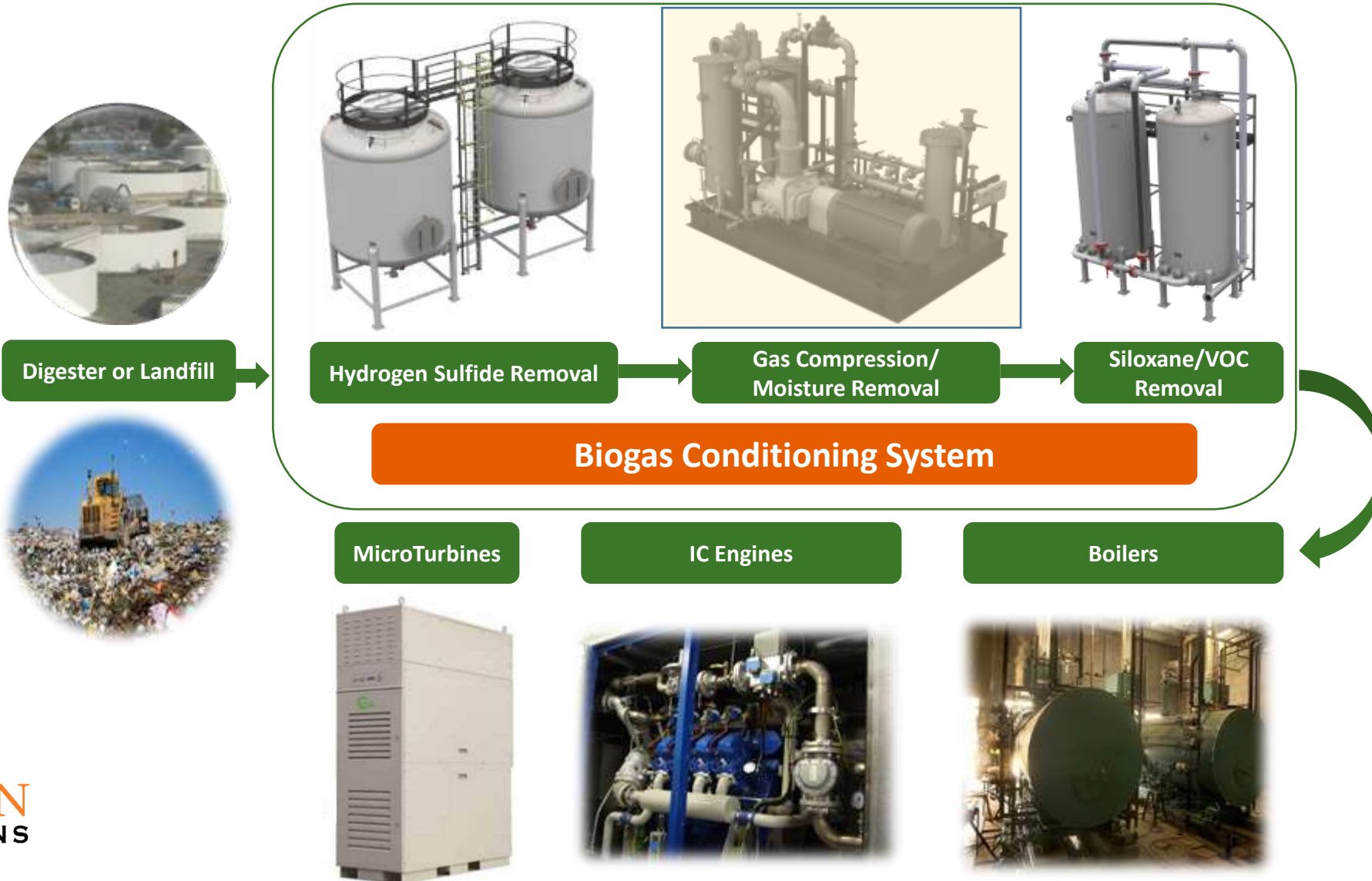
- Wood based
- Clay based

Ferric hydroxide pellet (adsorption)

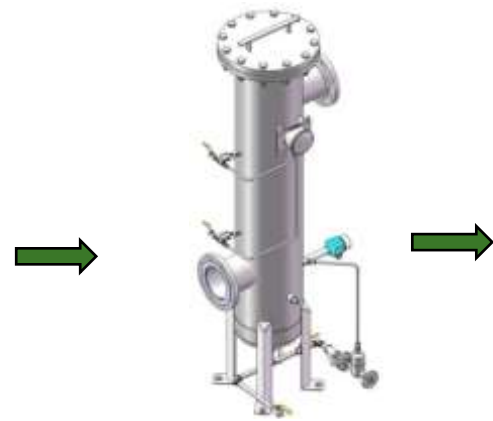
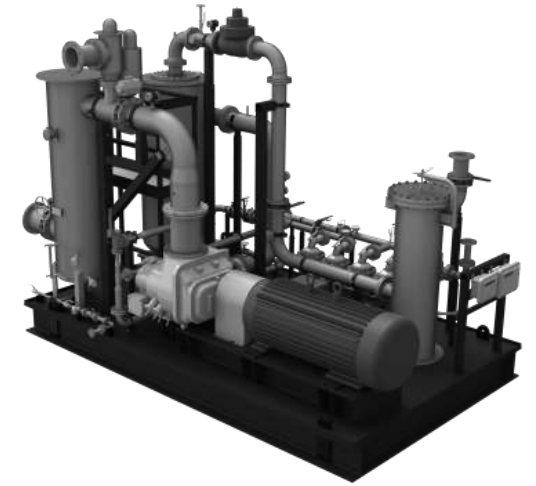


Wausau WWTP, WI

Biogas Conditioning System: Process Flow Diagram



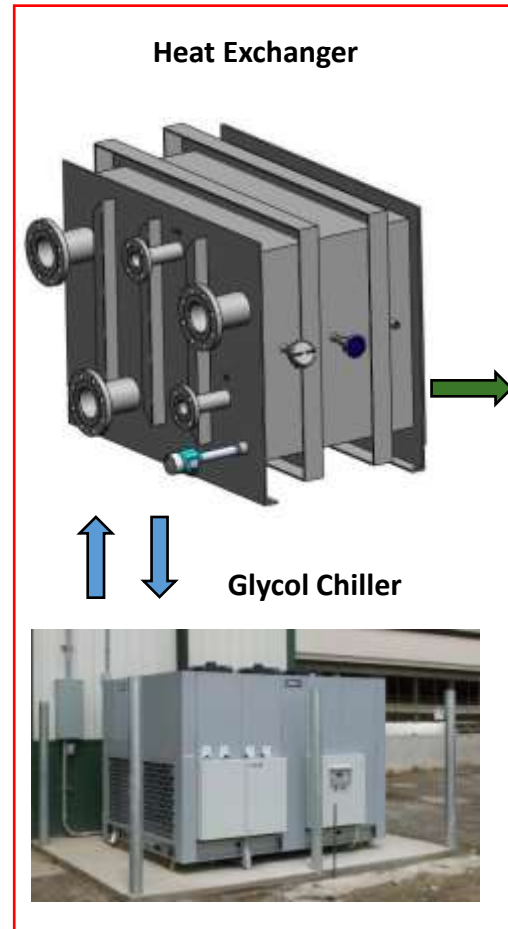
Moisture & Particulate Removal: Major Components



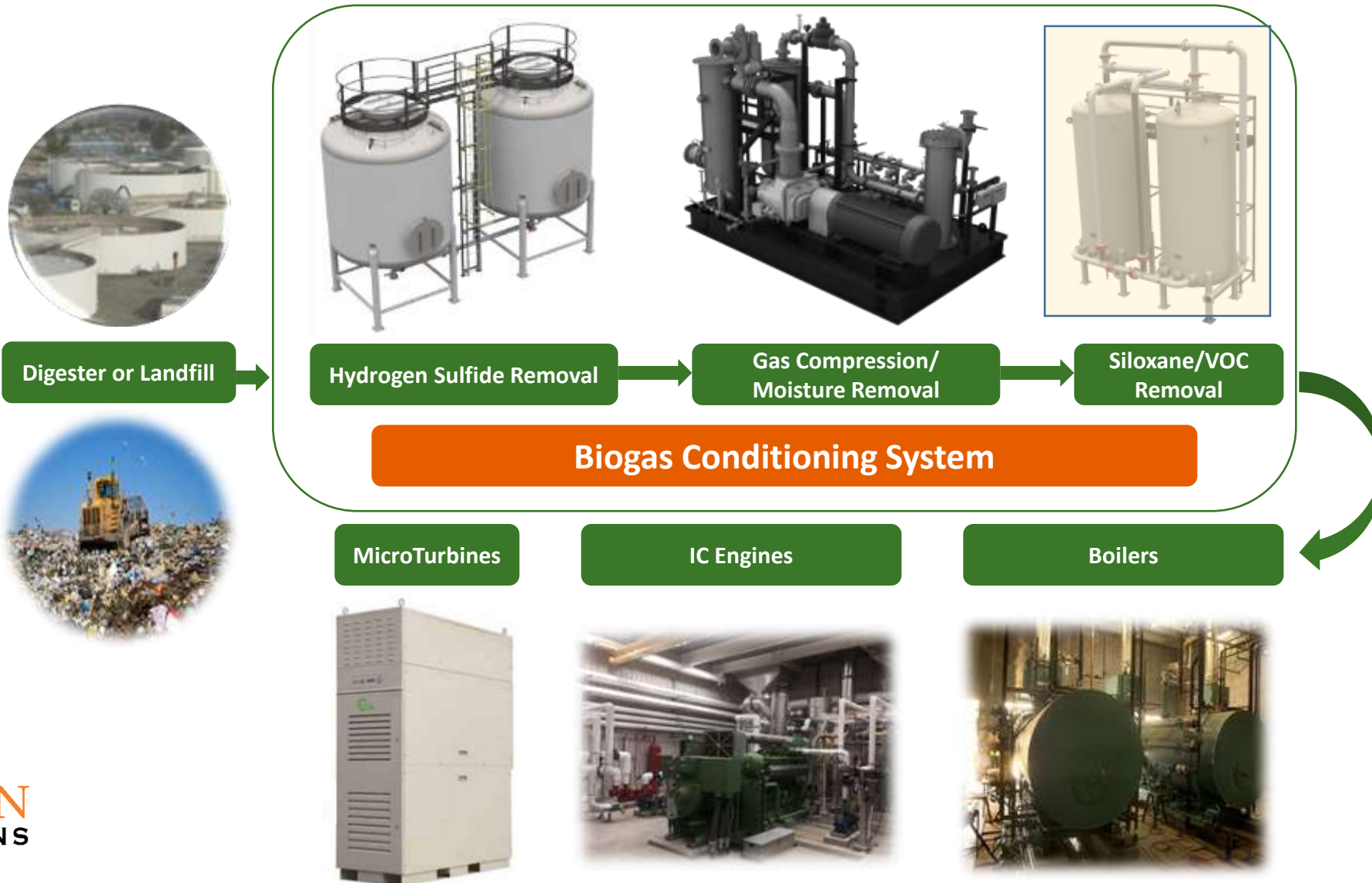
Gas Blower Inlet
Moisture/
Particulate Filter



Compressor

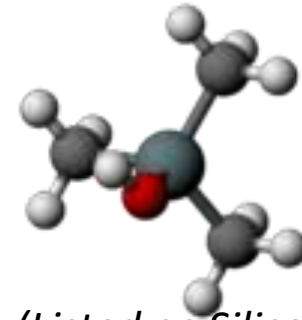


Biogas Conditioning System: Process Flow Diagram



What is a Siloxane?

- Silica and organic compounds are combined (Organosilicon)
- Used in many consumer and *industrial products (*Listed as Silicones as the ingredient on products*)
 - Shampoo
 - Conditioner
 - Deodorant
 - Food additives
 - * Dry Cleaning Solutions
 - * Windshield Cleaning Products
 - * RTV Silicone Cleaner
- Siloxanes break down in landfills and digesters, and combine with the methane gas



Siloxane Impact on Equipment



- When methane gas is used as a fuel, the siloxanes form SiO_2 Silicon Dioxide, and precipitate to a hard deposit on surfaces
- Significant impact on electrical generation systems
 - Increased down time for maintaining equipment
 - Increased costs for components, i.e. spark plugs, valve seats
 - Engine rebuild time is more frequent



Siloxane/VOC Removal

Coal



Coconut shell



Wood



Extruded pellets



4 x 8 mesh chips

Silica gel - spheres



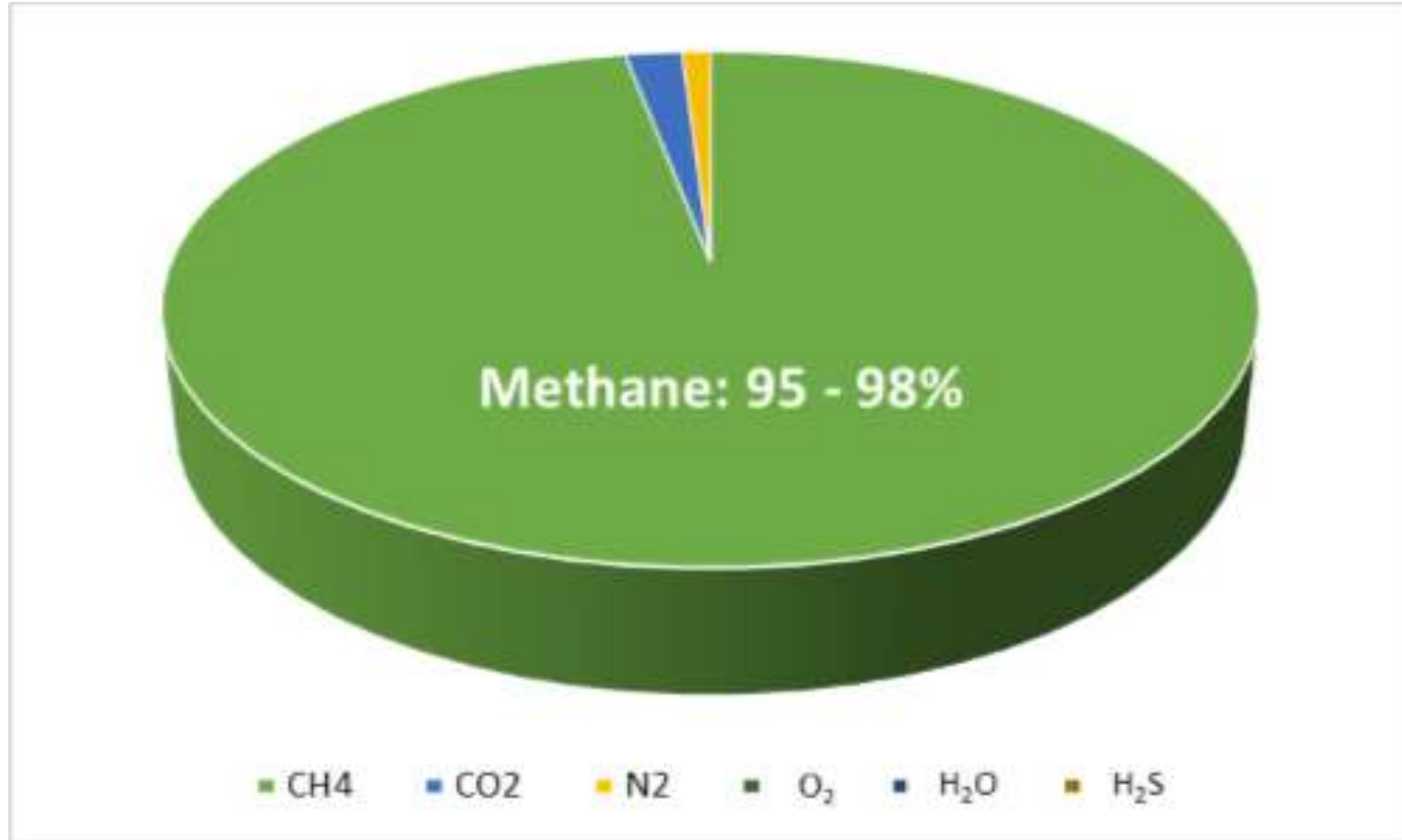
Silica gel – irregular shaped



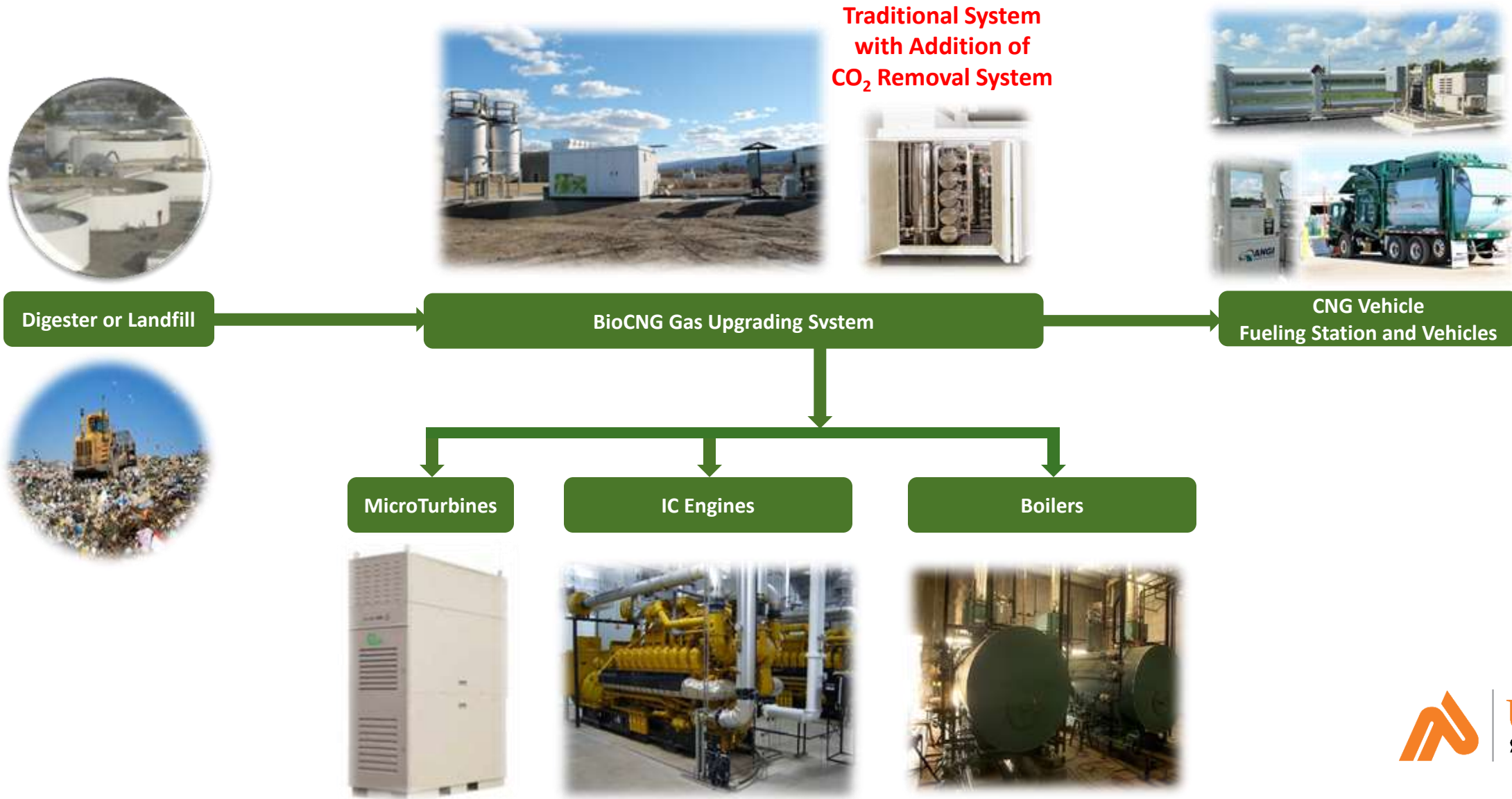
Biogas

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BioCNG FUELING SYSTEM PROCESS FLOW DIAGRAM

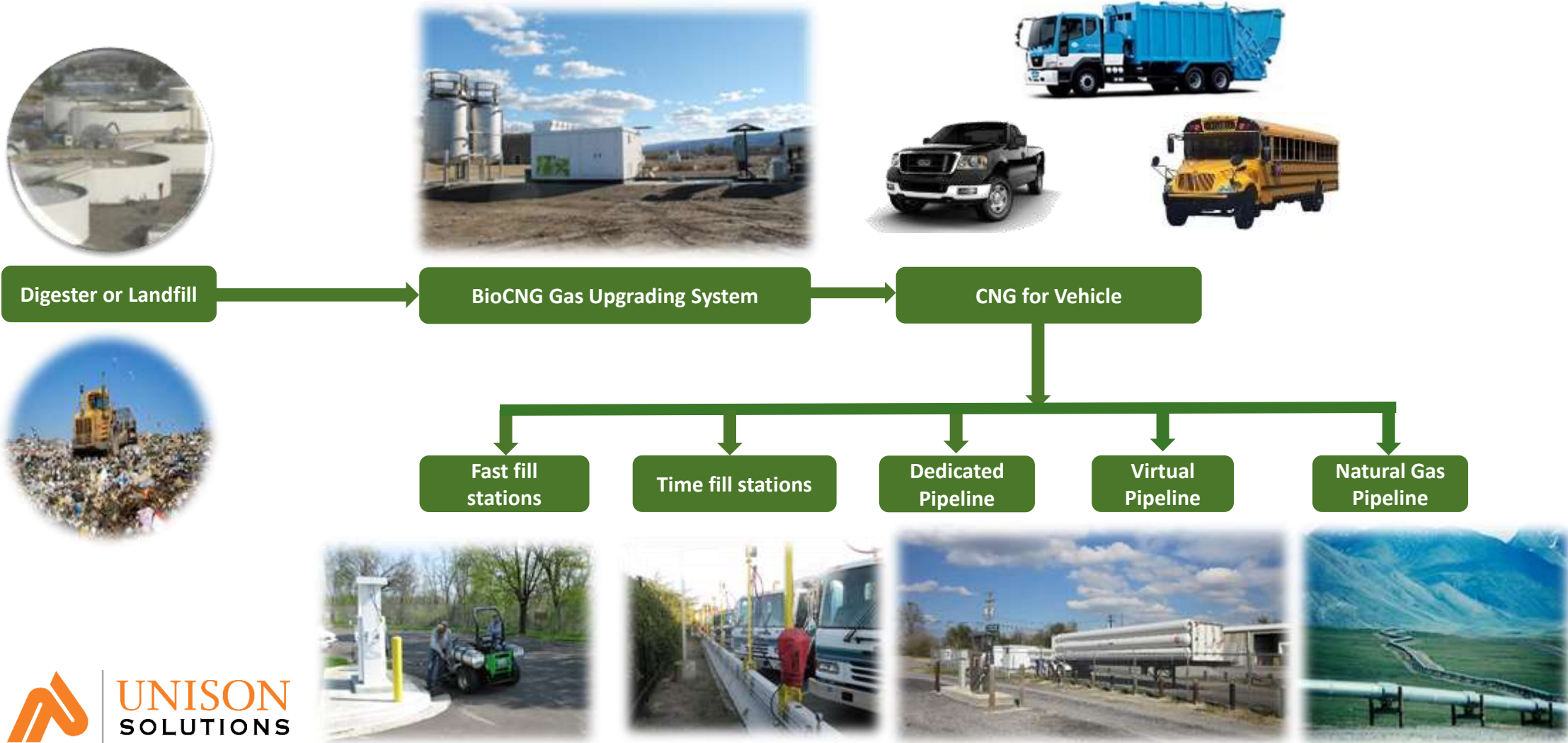


JANESVILLE WWTP, WI – FAST FILL

- Janesville, WI
- Start-up: November 2010
- Gas Flow: 140scfm
 - BioCNG 50
- Fast Fill – vehicle fueling
- (4) CR65 micro turbines
- (1) CR 200 micro turbine



BIO-CNG FUELING SYSTEM PROCESS FLOW DIAGRAM



BLUE LINE TRANSFER – TIME FILL



- South San Francisco, CA
- 8 Dry Anaerobic Digesters
 - 11,200 tons of food and green waste diverted per year
- Gas Flow: 100 scfm
- Time Fill – CNG fueled waste haulers
- Fast fill – small amount of high pressure storage on site for emergency fill

In operation since 2015



BioCNG™

**UNISON
SOLUTIONS**

PERSIGO WWTP, GRAND JUNCTION, CO

DEDICATED PIPELINE



- Population – Approximately 80,000, Grand Junction and Mesa County
- Located on the Colorado River
- 12.5 MGD municipal plant (Avg. flow 8 MGD)
- 100 scfm of biogas produced
- In operation since April 2015

CITY OF GRAND JUNCTION RNG PIPELINE



- Dedicated 5.8 mile pipeline
- Located on the Colorado River
- Extends from WWTP to existing fueling stations



TIME FILL – FUELING STATION



- Time Fill for CNG-Fueled collection trucks and city buses
- Dedicated 5.8 mile pipeline
- 142,000 gallons of gasoline diverted
- CO₂ Reduction of 3 million pounds/year
- 2017 - 62 city and county vehicles total being used
- Saved \$179,000 on gasoline

AT A GLANCE

- Previous raw gas use (untreated) was for boilers on site only
- Provides 280 - 300 GGE per day for city vehicles
- Production costs - \$1.04/GGE
- RIN payback - **\$2.30/RIN (3/29/18)** \$ 3.45/GGE (1.5 D3 RIN/GGE)
- \$1.50/GGE charged to city during payback period
- \$3.91/GGE Net profit
- 6 year payback
- \$2.9M Total project, (\$1.5M for equipment, balance for pipeline)
- Colorado Department of Local Affairs grant - \$500,000



Details provided by site, September 2018



ST LANDRY PARISH, LA LANDFILL VIRTUAL PIPELINE

- Washington, LA
- Operational since March 2012
- Gas Flow: 150scfm
 - BioCNG 50 & 100
- Low pressure fuel storage vessel (120 psi)
- Fast Fill – vehicle fueling

BioCNG™

UNISON
SOLUTIONS



ST LANDRY PARISH-OPELOUSA, LA

- Remote station
- Trailer with 9 low pressure storage tubes (2580 psi)
- Fast Fill – vehicle fueling

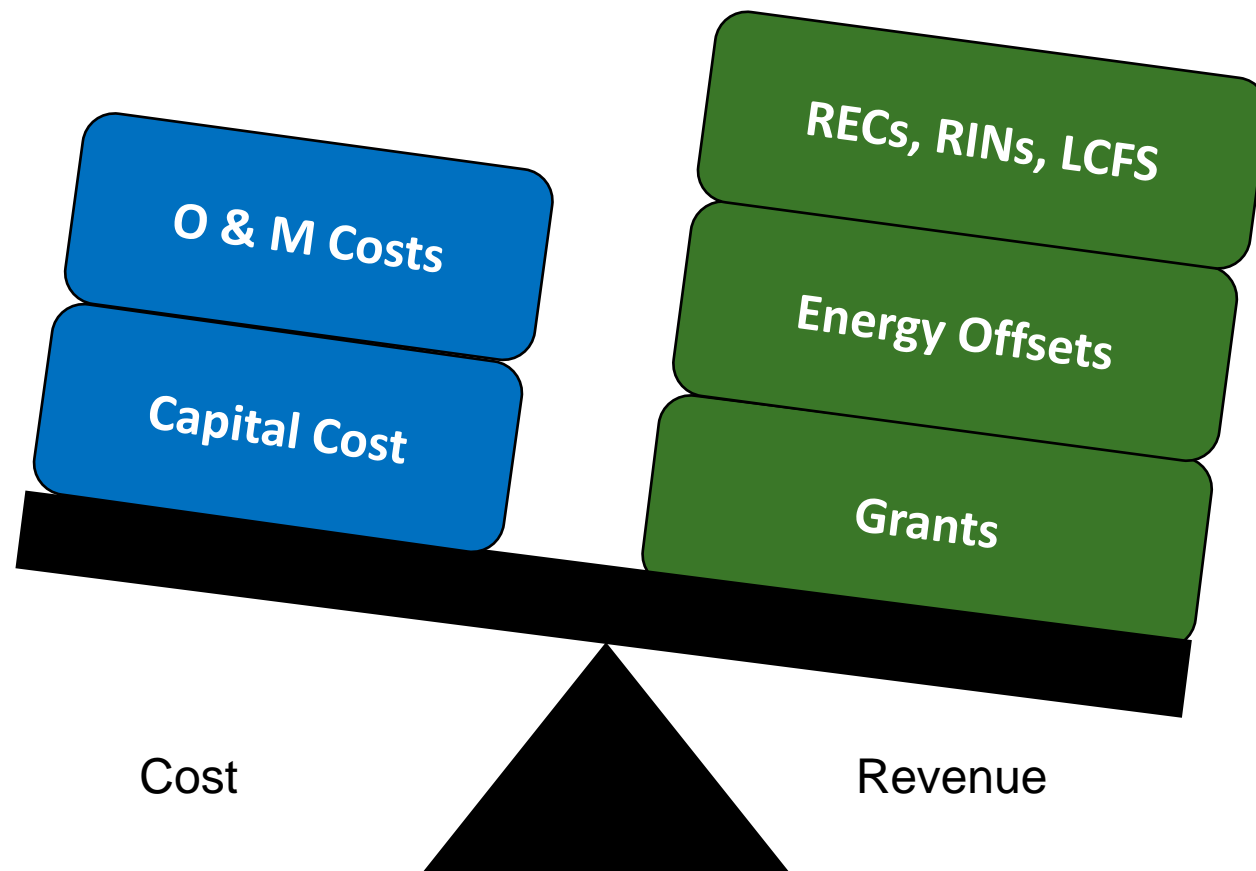


BIOGAS UPGRADING TO PIPELINE INJECTION

- Increased methane recovery
- High BTU product (RNG)
- Dual stage membrane technology
- Nitrogen removal may also be needed



Getting Started on a Biogas to Energy or Vehicle Fuel Project



Getting Started

<http://www.energenecs.com/>

 **energenecs**

www.unisonsolutions.com



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SOLUTIONS