

MIDWEST GOVERNORS ASSOCIATION

Maximizing Bioenergy Resources in the Midwest

October 11-12, 2017





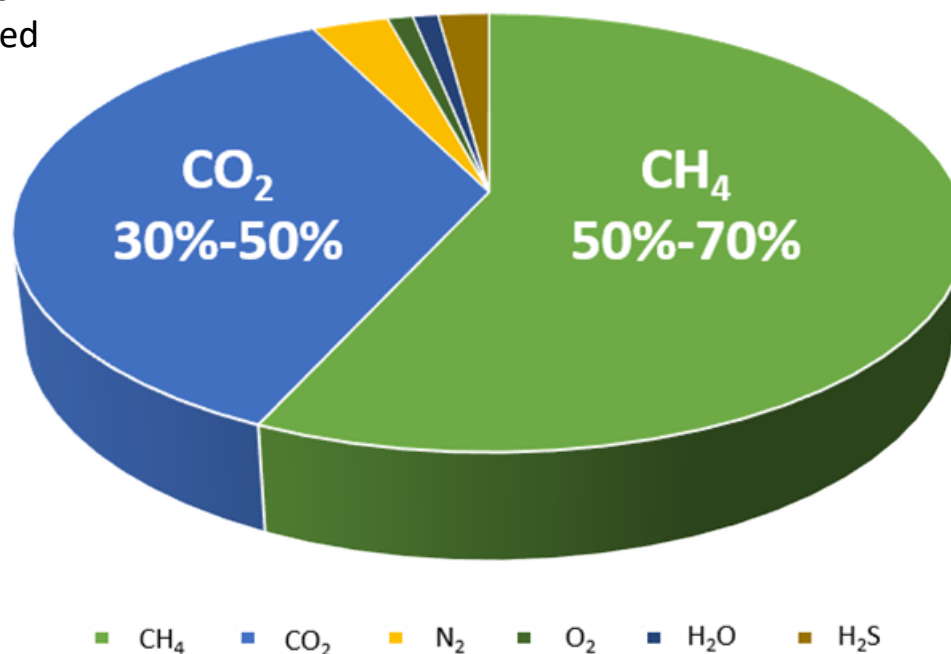
BIOGAS TO ENERGY AND VEHICLE FUEL



BIOGAS

bi·o·gas, 'bīōˌgas/, *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



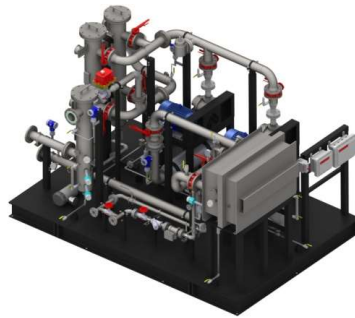
BIOGAS CONDITIONING SYSTEMS



Digester or Landfill



Hydrogen Sulfide Remova.



Gas Compression/
Moisture Removal



Siloxane
Removal



Micro Turbine



IC Engine-Generator



Boiler



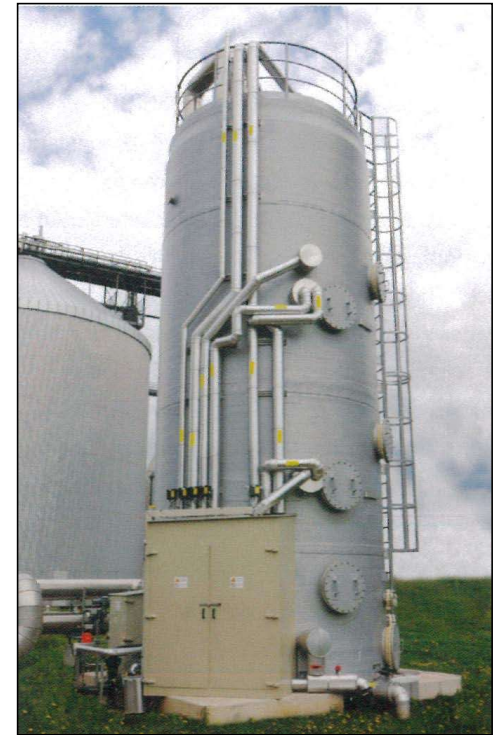
HYDROGEN SULFIDE (H₂S)

- Equipment Damage from Corrosion (Hydrosulfuric Acid)
- SO_x Emissions
- Health and Safety Issues
(1000 ppm will cause an individual to lose consciousness)
- Odor Control
- Causes fouling of Siloxane Removal Media
- Measure levels with either lab testing, colorimetric tubes, or onsite meter.



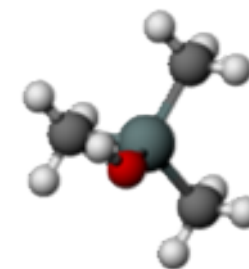
H₂S REMOVAL SYSTEMS

- Filtration medias
 - Wood based
 - Clay based
 - Ferric hydroxide
 - Carbon
- Biological systems for sites with high H₂S



SILOXANES

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



SILOXANE IMPACT ON EQUIPMENT

Siloxanes Organic Compounds with Silica
Tetramethyl silane
Trimethyl silanol
Hexamethyldisiloxane (L2)
Hexamethylcyclotrisiloxane (D3)
Octamethyltrisiloxane (L3)
Octamethylcyclotetrasiloxane (D4)
Decamethyltetrasiloxane (L4)
Decamethylcyclopentasiloxane (D5)
Dodecamethylpentasiloxane (L5)
Dodecamethylcyclohexasiloxane (D6)

VOC Volatile Organic Compounds (Commonly Found)
Acetone
Benzene
Chlorobenzene
Decane
Ethylbenzene
Heptane
Hexane
Isopropyl Alcohol
Octane
Xylene
Toluene
22-35 compounds typically reported



SILOXANE/VOC REMOVAL

Coal



Coconut shell



Wood



Extruded pellets



4 x 8 mesh chips



Silica gel - spheres



Silica gel – irregular shaped



GLENBARD WASTEWATER AUTHORITY GLEN ELLYN, IL

Site Information

- 47 MGD municipal plant (Avg. Flow 16 MGD)
- 200 scfm of biogas produced

Gas Conditioning Equipment

- H₂S removal – Iron Sponge
- Gas compression/Moisture removal
- Siloxane removal

End Use Equipment

- (2) Nissen IC Engines
 - 750 kW of electricity - 60% of plants electrical requirements
 - 2.88 MMBTU/hr - 96% of plants thermal energy requirements



PLYMOUTH UTILITIES, WI

Site Information

- 1.01 MGD municipal plant
- 50 scfm of biogas produced

Gas Conditioning Equipment

- Gas compression/Moisture removal
- Siloxane removal

End Use Equipment

- (2) Capstone CR65-ICHP turbines, produce 130 kW of electricity and thermal energy



DOWNERS GROVE SANITARY DISTRICT, IL

Site Information

- 11 MGD municipal plant
- 160 scfm of biogas produced

Gas Conditioning Equipment

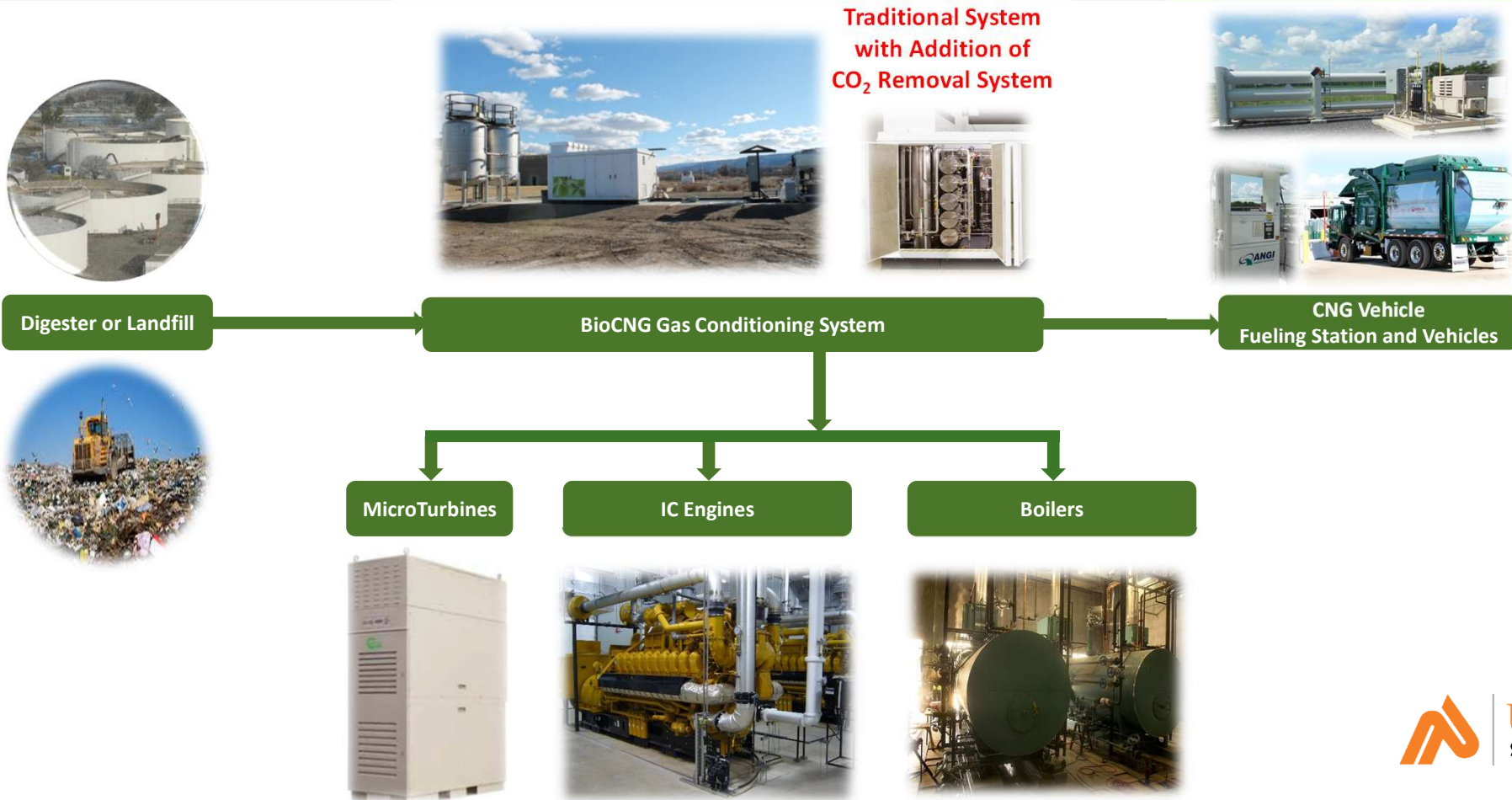
- H₂S removal, Specially activated carbon
- Gas compression/Moisture removal
- Siloxane removal

End Use Equipment

- (2) IC Engines
 - Produce 665 kW of electricity
 - Produce 3.5 MMBTU/hr thermal energy



BIOCNG FUELING SYSTEM PROCESS FLOW DIAGRAM



BioCNG MODELS

Model	Biogas Inlet Flow (scfm)	Fuel Production (GGE/day)	Fuel Production (DGE/day)
BioCNG 50	50	185 - 300	160 - 260
BioCNG 100	100	370 - 600	320 - 520
BioCNG 200	200	740 - 1,200	640 - 1,040
BioCNG 400	400	1,480 - 2,400	1,280 - 2,080



BioCNG FUEL PRODUCTION



Model	Ford F-150	Waste Hauler	School Bus
BioCNG 50	16	5	4
BioCNG 100	32	10	8
BioCNG 200	64	20	16
BioCNG 400	128	40	32

* Assumes 1 fill per day per vehicle

JANESVILLE WWTP, WI

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



RIVERVIEW LAND PRESERVE, MI



- Riverview, MI
- Start-up: May 2013
- Gas Flow: 100
- Fast Fill – vehicle fueling