WWOA Conference
Wisconsin Dells, WI

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SOLUTIONS

Converting Biogas into Energy and Vehicle Fuel

October 8, 2015

Tony Schilling

Leaders in Biogas Technology

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Capture your biogas….

Municipal Digesters

Palm Beach, FL

South Monmouth, NJ

Sheboygan, WI

Industrial & Ag Digesters

Sierra Nevada Brewery, NC

KB Compost, OH

Seneca Foods, MN

Landfills

La Crosse, WI

Cherry Island, DE

Mountain View, CA

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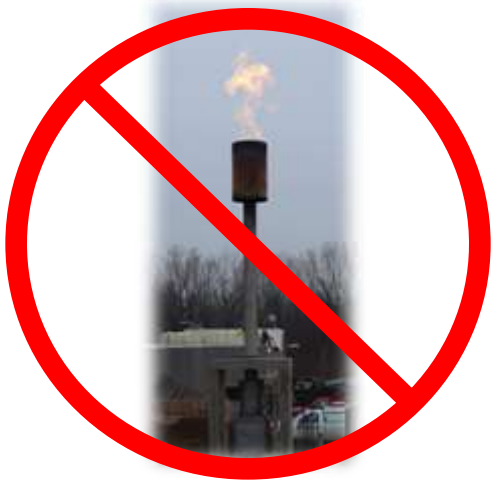
and put it to work!

- Boiler Fuel
- Electricity Production
- Heat Recovery
- Fuel for Vehicles



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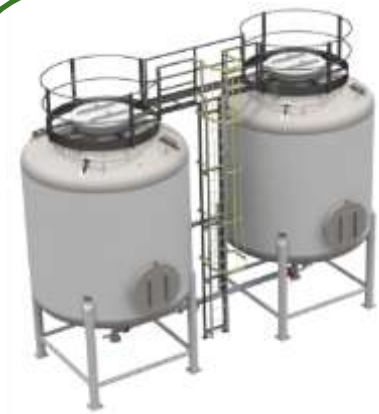
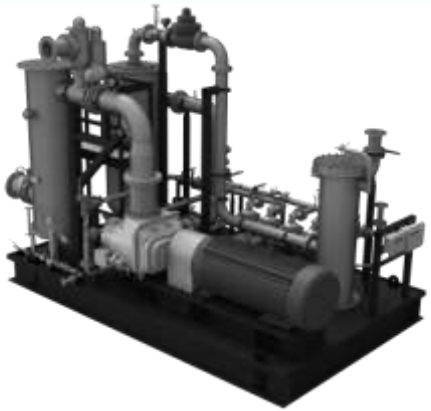
Traditional Biogas Conditioning System Process Flow Diagram

Digester or Landfill



Hydrogen Sulfide Removal



Gas Compression/ Moisture Removal

Siloxane/VOC Removal

Biogas Conditioning System

MicroTurbines

IC Engines

Boilers

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Case Study's
Electricity and Heat Production

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Sheboygan, WI WWTF

Site Information

- Western Shore of Lake Michigan, serves 7 communities
- 56.8 MGD municipal plant (Avg. flow 18.4 MGD)
- 300 scfm of biogas produced

Project Timeline

- 2006 - Phase 1 Project Installed (10) CR30's
- 2011 - Phase 2 Project Installed (2) CR200's
- 2013 - NetZero Energy - 2013 Grand Award

Gas Conditioning Equipment

- Gas Compression/Moisture Removal
- Siloxane Removal

End Use Equipment

- (10) Capstone CR30 Turbines, produce 300 kW of electricity and thermal energy
- (2) Capstone CR200 Turbines, produce 400 kW of electricity and thermal energy

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Danville, IL Sanitary District

Site Information

- 16 MGD municipal plant (Avg. flow 5-8 MGD)
- 50 scfm of biogas produced

Project Timeline

- 2008 - Project Planning Begins
- 2012 - System Start Up

Gas Conditioning Equipment

- Gas Compression/Moisture Removal
- Siloxane Removal

End Use Equipment

- (1) Tech 3 IC Engine, produces 150 kW of electricity and 778,000 BTU/hour of thermal energy

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Dubuque, IA WRRC

Site Information

- 40 MGD municipal plant (Avg. flow 14 MGD)
- 350 scfm of biogas produced

Project Timeline

- 2012 - Phase 1 Project Installed Boiler Fuel
- 2013 - Phase 2 Project Installed (1) CR600

Gas Conditioning Equipment

- Hydrogen Sulfide Removal
- Gas Compression/Moisture Removal
- Siloxane Removal

End Use Equipment

- Boiler Fuel for thermal energy
- (1) Capstone CR600 Turbine, produces 600 kW of electricity and thermal energy

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Downers Grove, IL Sanitary District

Site Information

- 11 MGD municipal plant (Avg. flow 8 MGD)
- 160 scfm of biogas produced

Project Timeline

- June 2014 - System Start Up

Gas Conditioning Equipment

- Hydrogen Sulfide Removal
- Gas Compression/Moisture Removal
- Siloxane Removal

End Use Equipment

- (1) Tech 3 IC Engine, produces 280 kW of electricity and thermal energy

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Plymouth WI Utilities, WI

Site Information

- 1.01 MGD municipal plant
- 50 scfm of biogas produced

Project Timeline

- December 2014 - System Start Up

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

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Lloyd Ray Farms; Yadkinville, NC

Site Information

- Agricultural - Covered Lagoon/Digester
- 50 scfm of biogas produced

Project Timeline

- December 2013 - System Start Up

Gas Conditioning Equipment

- Gas Compression/Moisture Removal

End Use Equipment

- (1) Capstone CR65-ICHP Turbine, produces 65 kW of electricity

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Potawatomi Casino; Milwaukee, WI

Site Information

- Digester - Food waste from Casino and local grocery stores
- 700 scfm of biogas produced

Project Timeline

- October 2013 - System Start Up

Gas Conditioning Equipment

- Gas Compression/Moisture Removal

End Use Equipment

- (2) Waukesha IC Engines, produce 2 MW of electricity and thermal energy

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GreenWhey Energy; Turtle Lake, WI

Site Information

- Food/Industrial Waste Digester
- 1,100 scfm of biogas produced

Project Timeline

- June 2013 - System Start Up

Gas Conditioning Equipment

- Gas Compression/Moisture Removal

End Use Equipment

- (2) Caterpillar 3520 Engines, produces 3.2 MW of electricity

GreenWhey ENERGY, INC.

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Grande Cheese; Brownsville, WI

Site Information

- Food/Industrial Waste Digester
- 140 scfm of biogas produced

Project Timeline

- November 2013 - System Start Up

Gas Conditioning Equipment

- Gas Compression/Moisture Removal

End Use Equipment

- (2) Capstone CR200 Turbines, produces 400 kW of electricity

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Sierra Nevada Brewery; Fletcher, NC

Site Information

- Food/Industrial Waste Digester
- 250 scfm of biogas produced

Project Timeline

- December 2013 - System Start Up

Gas Conditioning Equipment

- Gas Compression/Moisture Removal

End Use Equipment

- (2) Capstone CR200 Turbines, produces 400 kW of electricity and sends gas to a Boiler

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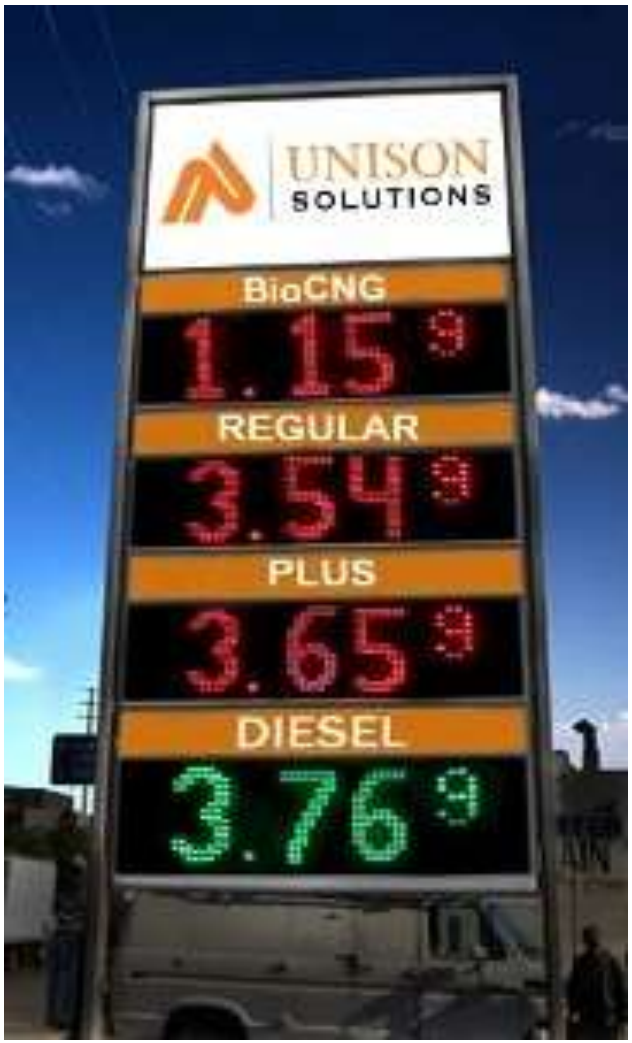
Alternative Fuels: Renewable Natural Gas

BioCNG™

Unison Solutions' patent pending system to convert biogas to a gaseous vehicle fuel, RNG - *Renewable Natural Gas*.



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BioCNG™ Vehicle Fueling System Process Flow Diagram

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Traditional System with Addition of CO_2 Removal System

Digester or Landfill → BioCNG™ Gas Conditioning System → CNG Vehicle Fueling Station and Vehicles

BioCNG™ Gas Conditioning System → MicroTurbines, IC Engines, Boilers

Potential Energy Produced

Vehicle Fuel

Electricity

Heat

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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

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BioCNG™
Biogas to Vehicle Fuel Systems



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*

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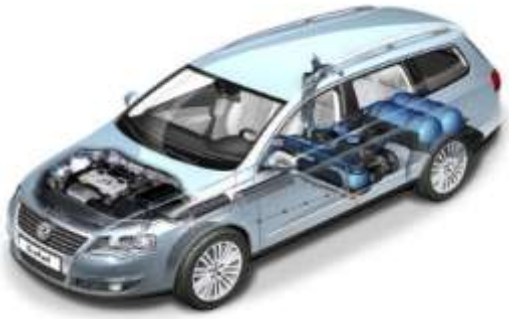
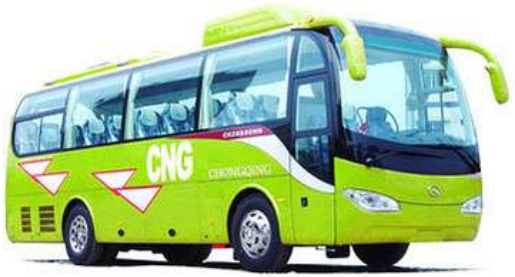
Compressed Natural Gas Vehicles





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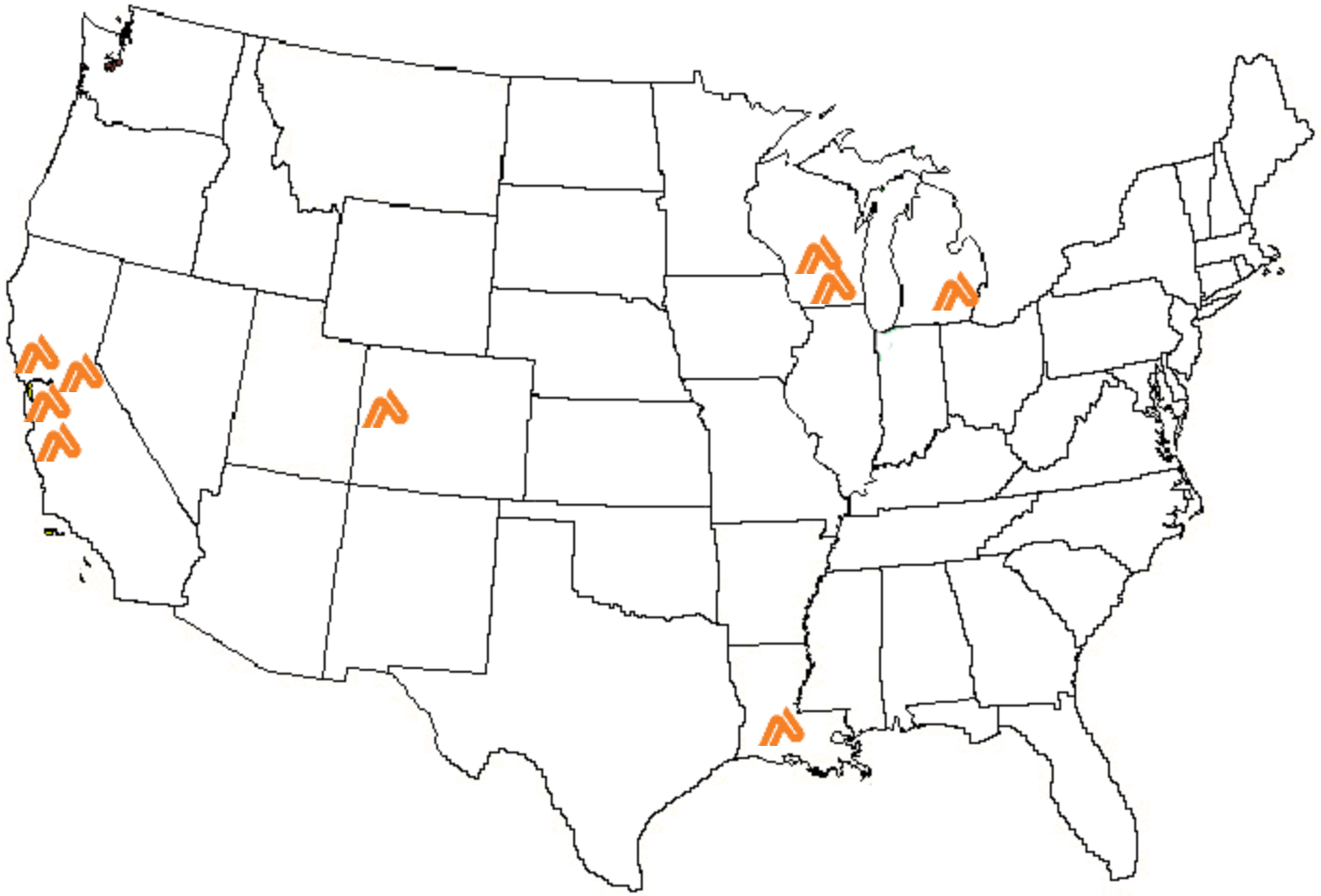
BioCNG™ Projects



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Rodefeld Landfill; Madison, WI

PHASE 1

1,600 scfm Biogas Conditioning System for CAT engines

December 2009

PHASE 2

Prototype BioCNG™

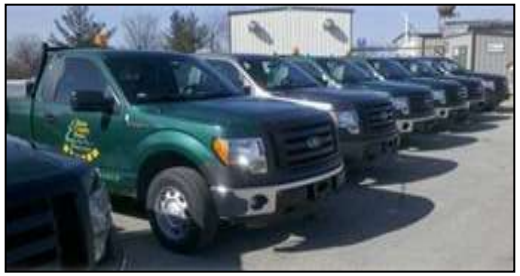
December 2010

PHASE 3

Upgrade to a BioCNG™ 50 Permanent Storage and Fueling Station

2015

Temporary Fueling Station



Upgrading county fleet to CNG vehicles

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St. Landry Parish Landfill; Washington, LA

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ST. LANDRY PARISH SOLID WASTE

PHASE 1

PHASE 2

Gas Collection and Control System (GCCS)

On-site flare – monitoring for carbon credits

BioCNG™ 100 Added

Winter 2008

October 2011

Site work for Vehicle Fueling System

April 2012

BioCNG™ 50

Summer 2015

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City of Janesville WWTF; Janesville, WI

Site Information

- 19 MGD municipal plant (Avg. flow 13.5 MGD)
- Current Average Flow - 12.5 MGD
- 130,000 cfd of biogas produced

Project Timeline

- November 2010 - Phase 1 Project Installed (4) CR65's
- November 2011 - Phase 2 Project Installed (1) CR200
- April 2012 - Phase 3 Project Installed BioCNG™

Gas Conditioning Equipment

- Gas Compression/Moisture Removal
- Siloxane Removal
- Carbon Dioxide Removal

End Use Equipment

- (4) Capstone CR65-ICHP Turbines, produces 260 kW of electricity and thermal energy
- (1) Capstone CR200 Turbine, produces 200 kW of electricity and thermal energy
- (1) BioCNG™ System produces vehicle fuel

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Persigo WWTF; Grand Junction, CO

Site Information

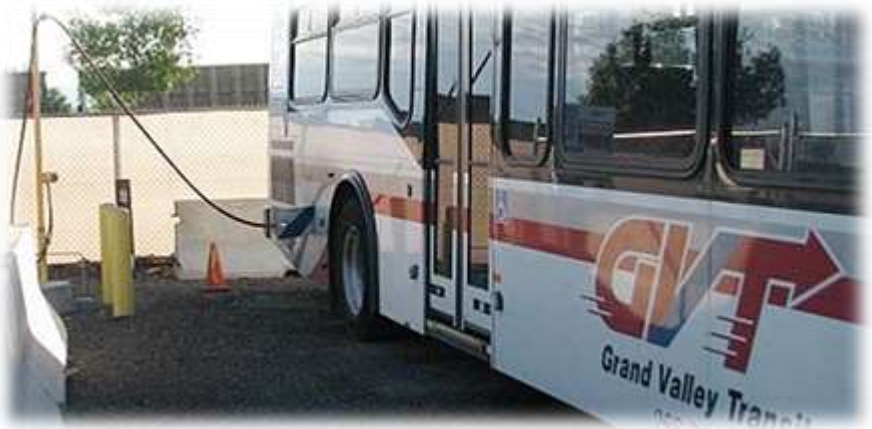
- 12.5 MGD municipal plant (Avg. flow 8 MGD)
- 100 scfm of biogas produced

Project Timeline

- April 2015 - System Start Up

Gas Conditioning Equipment

- Hydrogen Sulfide Removal
- Gas Compression/Moisture Removal
- Siloxane Removal
- Carbon Dioxide Removal



End Use Equipment

- Time Fill for CNG-Fueled collection trucks and city buses
- 5.8 mile pipeline from the wastewater facility to the fueling facility
- 142,000 gallons of gasoline diverted = CO_2 emissions reduction of 3 million pounds/year

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Contact Information

Thank You!

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