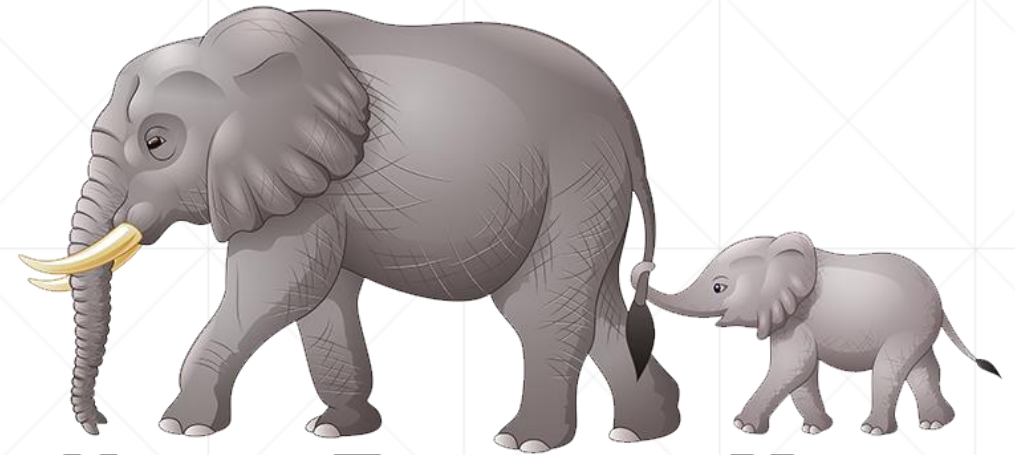


Thursday, September 21, 2023



URBAN ELEPHANT MEDIA

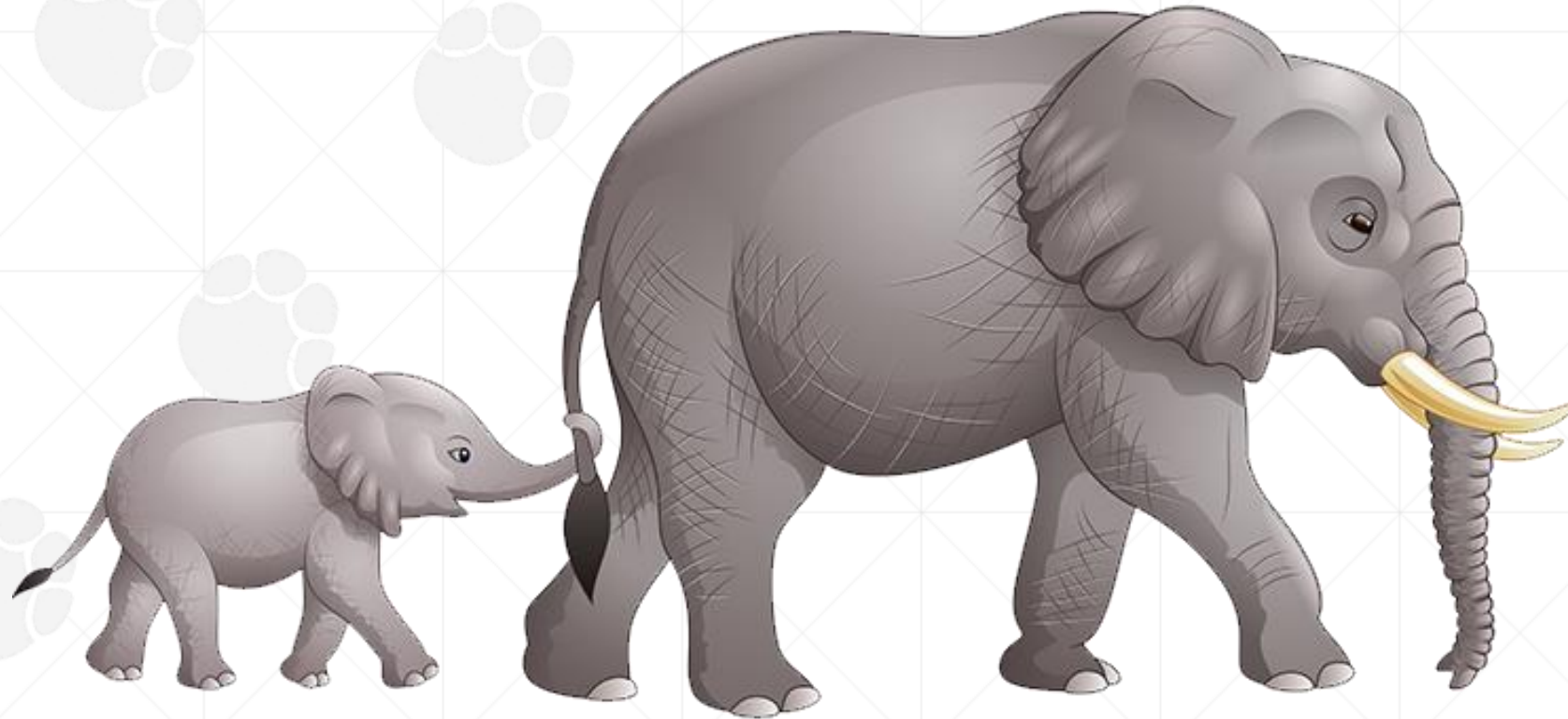
~ PRESENTS ~

Innovative Biogas Solutions

Proven Designs and Customized Systems

Presented by Unison Solutions

Sponsored by Unison Solutions



URBAN ELEPHANT MEDIA

PEER-TO-PEER LEARNING MADE EASY

Sustainability Training for Urban Designers and Policymakers

Randy Rodgers, Director of Big Ideas
Randy@UrbanElephantMedia.com
563-513-1244

UrbanElephantMedia.com

Our Sponsor



Our Presenters



Dave Broihahn
President
Unison Solutions

Biogas systems: Proven designs and customized systems



UNISON
SOLUTIONS
— Employee Owned —



Overview



- Company founded on January 1, 2000
- Employee Owned: November 2020
- 65 Employees (11 Engineers)
- 65,000 ft² manufacturing facility
- Over 380 systems sold worldwide

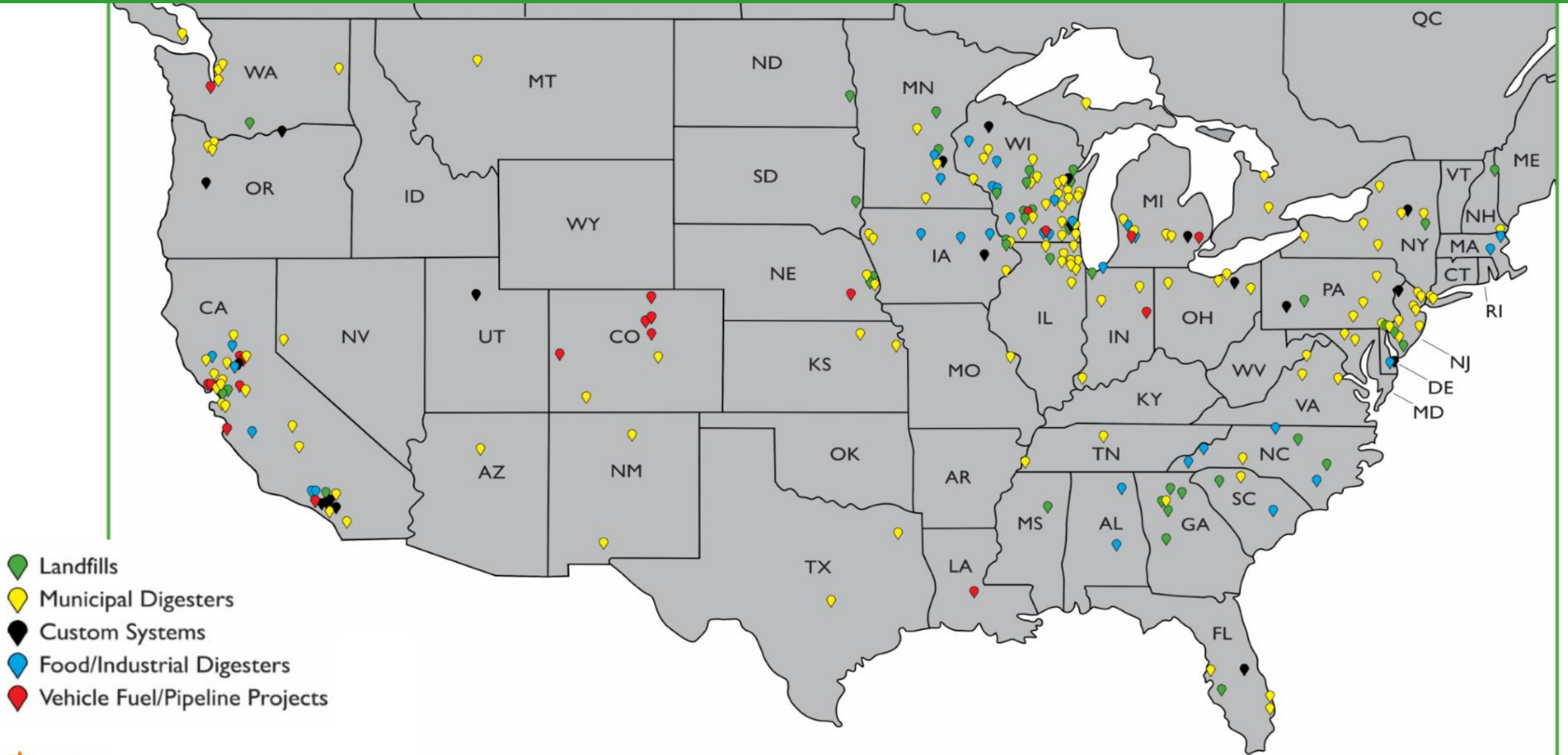
Proudly manufactured in the USA



Made in the USA

Dubuque, IA

Unison project map



Sales team



Dave Broihahn,
President
23 years



Adam Klaas,
Sales Manager
17 years



Eric
Wilgenbusch
16 years



Curt
Schiesl
5 years



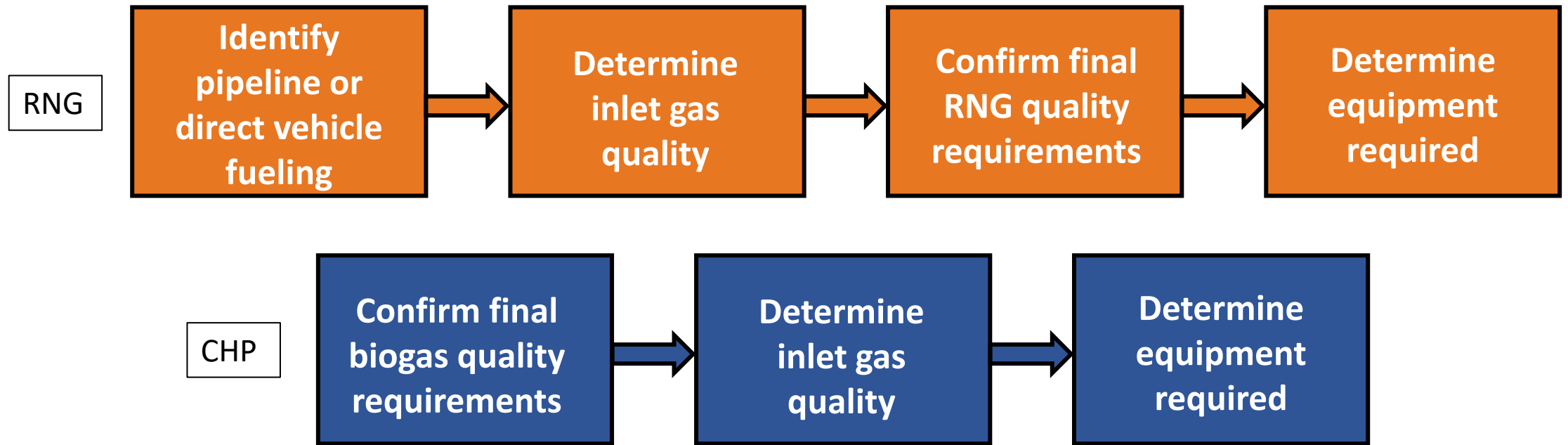
Nick
Oberbroeckling
5 years



Kim Murdock-
Timmerman
12 years

Our professional staff has over 100 years of combined experience in biogas applications

Steps to a successful biogas project



Good working relationships with your manufacturing and supply partners

REDUCE INSTALLATION COSTS

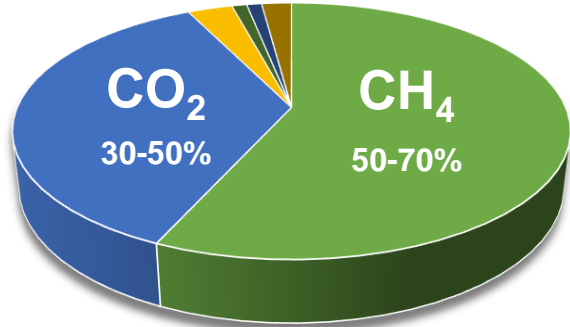
Fuel quality specification

Constituents	Raw Biogas	CHP	RNG*
Methane	50-80%	50-80%	
Wobbe Index			1,185-1,285 BTU/ft ³ max
Higher Heating Value (HHV)			Min. 985 BTU/ft ³
Carbon Dioxide (CO ₂)	20-50%	20-50%	<2%
Nitrogen (N ₂)	0-1%	0-1%	
Oxygen (O ₂)	0-1%	0-1%	0.2%
Hydrogen Sulfide (H ₂ S)	≤10,000 ppm	ND	0.25 grains of H ₂ S/100 scf
Moisture/Water Vapor Content	100% R.H.	25% R.H.	7 lb/MMscf
Siloxanes and Volatile Organic Compounds	<2,000 ppm	ND	ND to 1 ppm
Biologicals			4 x 10 ⁴ /scf (qPCR per APB, SRB, IOB)
Additional specs			Mercury, Ammonia

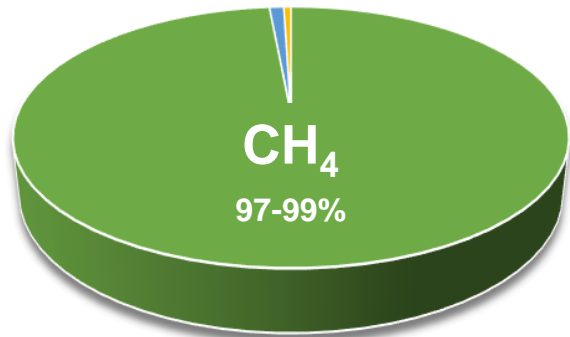
*Example Westcoast Pipeline

Biogas to RNG for pipelines or direct vehicle fueling

**Raw
Biogas**



**Renewable
Natural Gas
(RNG)**

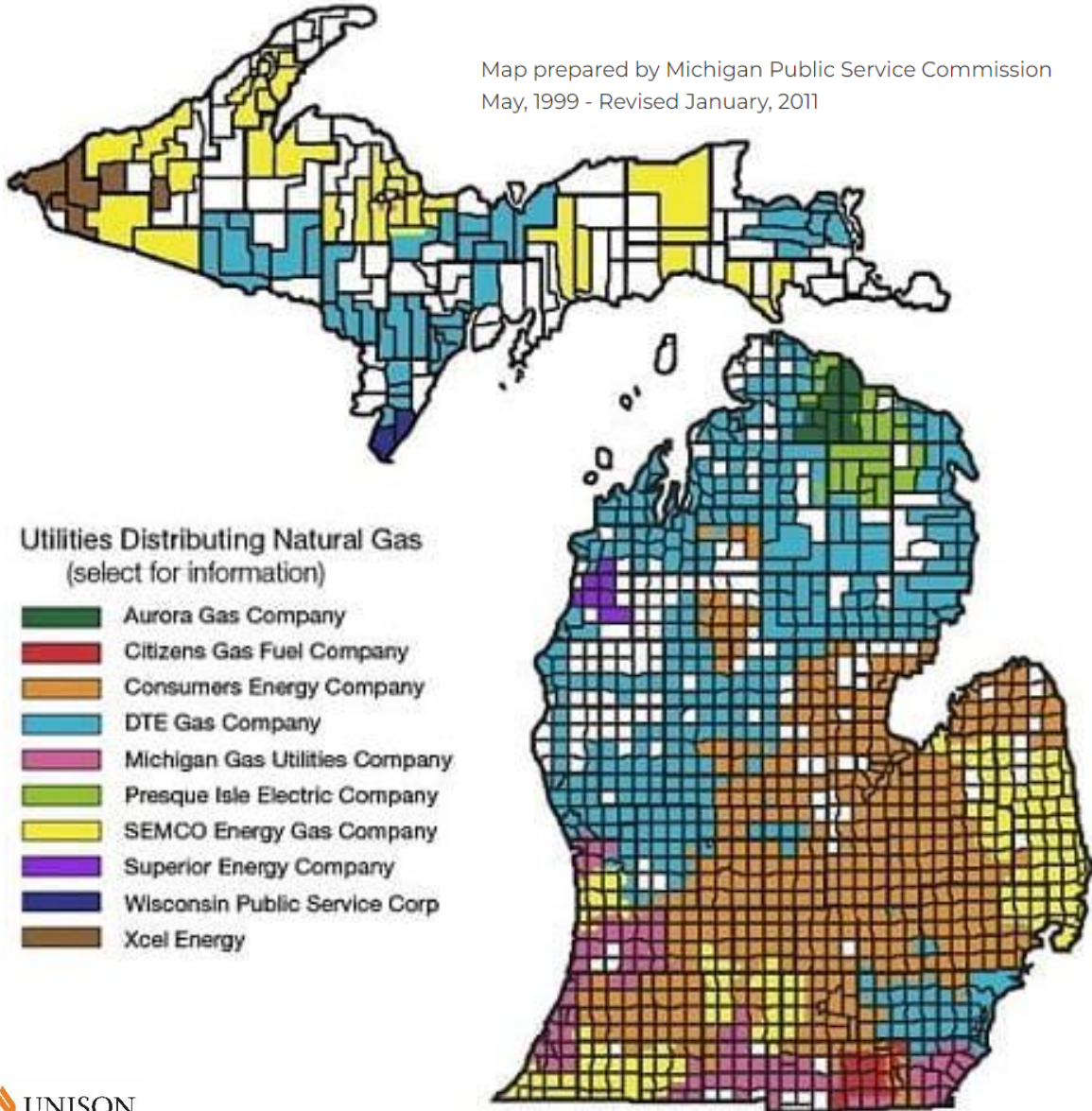


**BioCNG™**

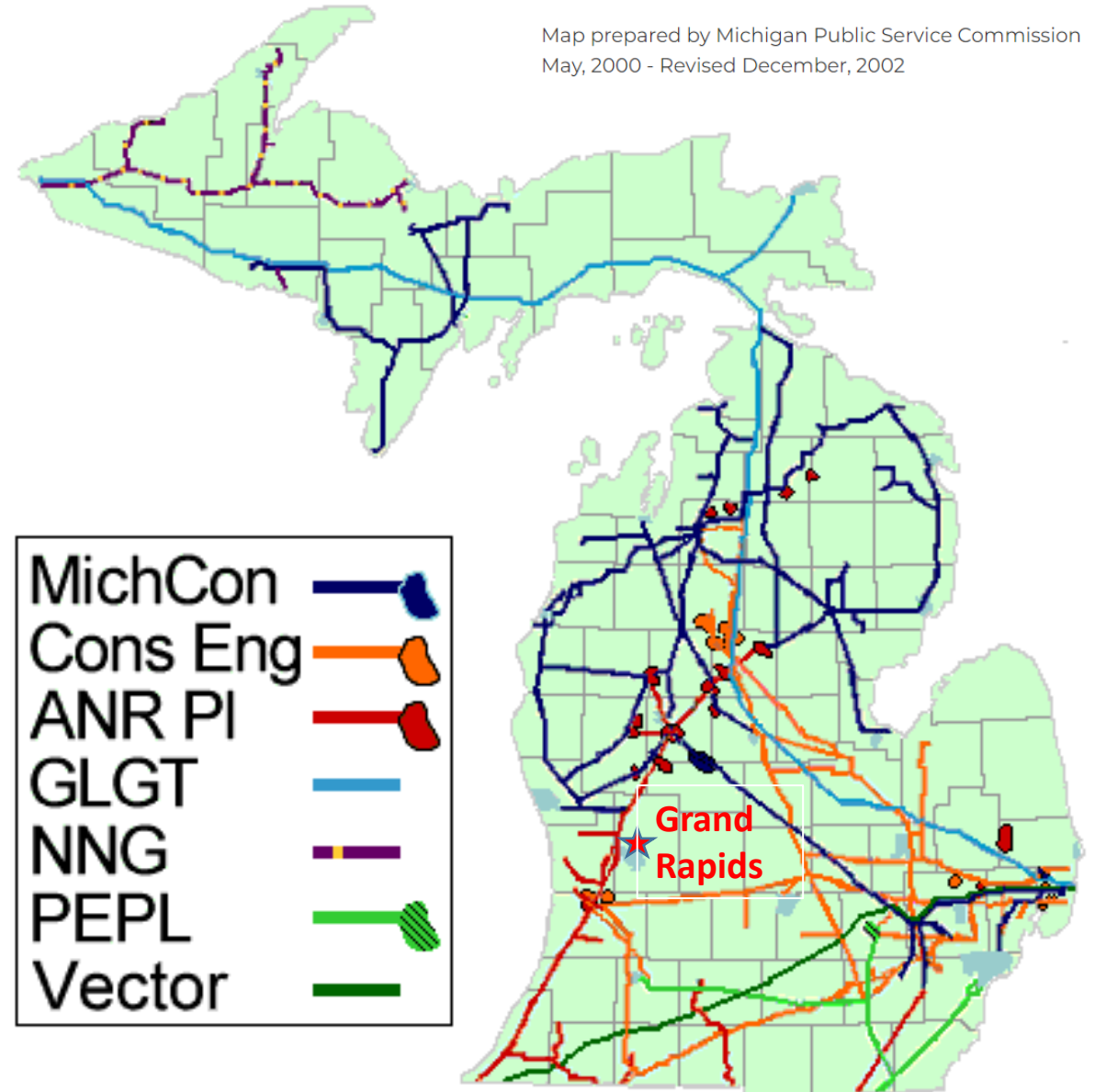


Natural gas pipelines

Map prepared by Michigan Public Service Commission
May, 1999 - Revised January, 2011



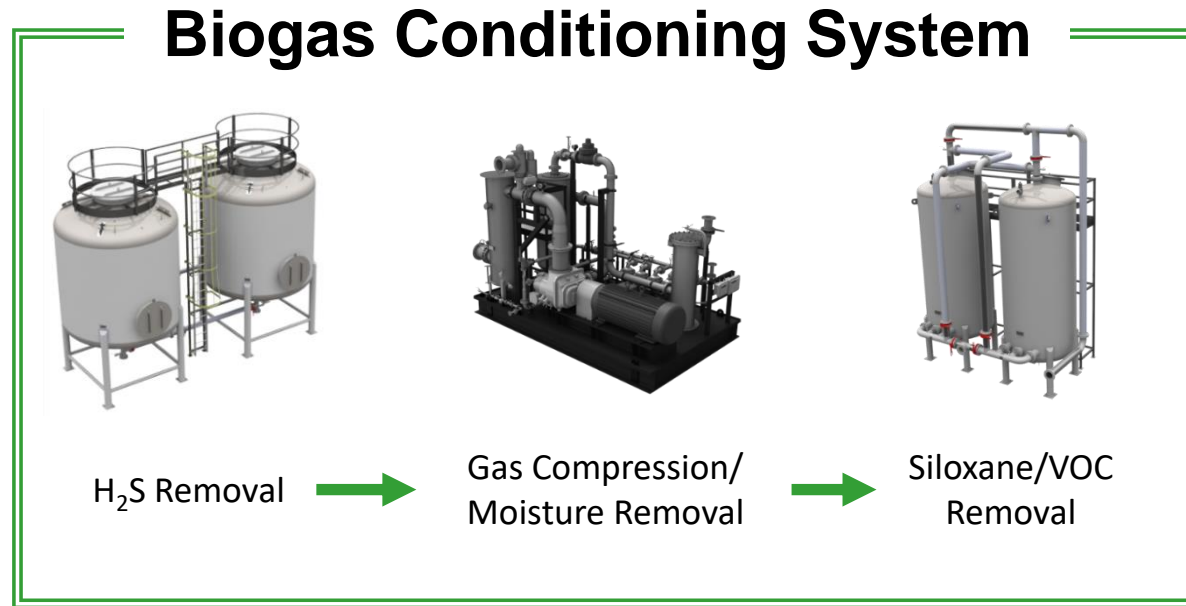
Map prepared by Michigan Public Service Commission
May, 2000 - Revised December, 2002



Biogas cogeneration system (CHP):



Digester or Landfill



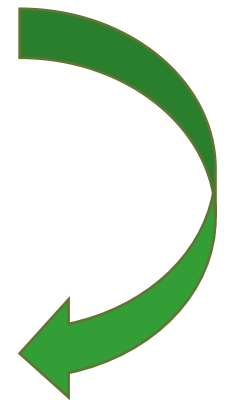
IC Engines



MicroTurbines



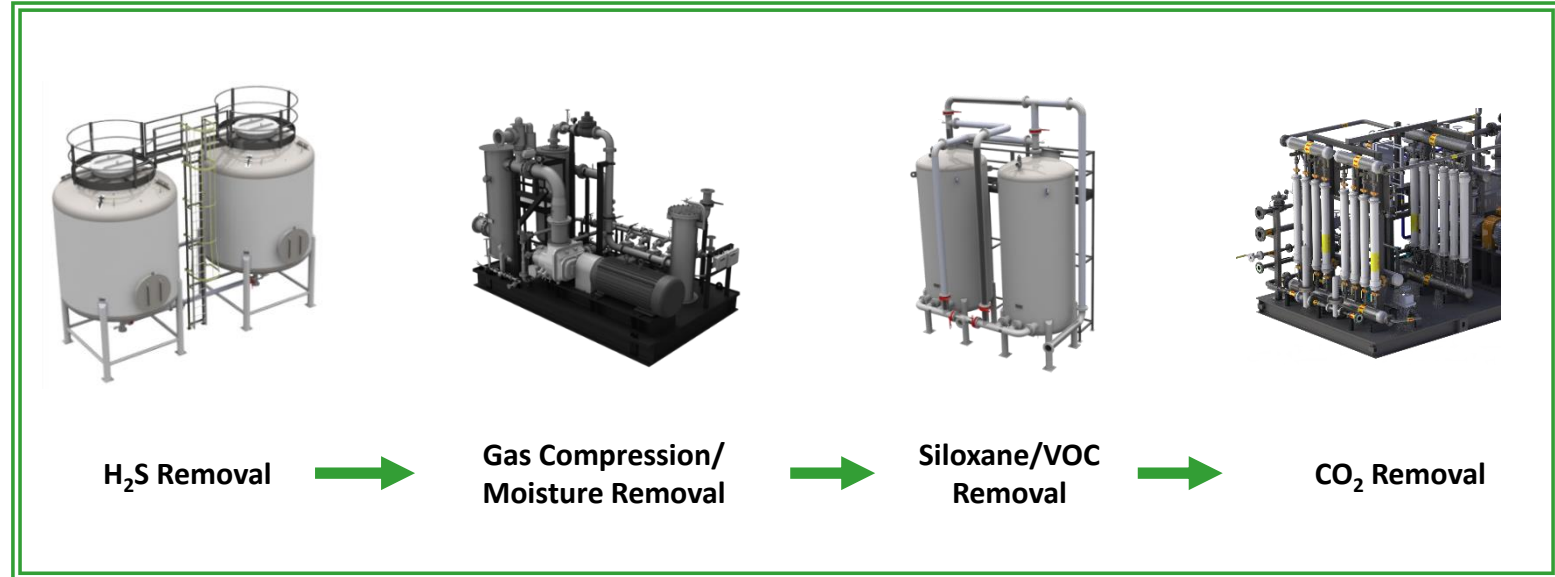
Boilers



Biogas upgrading system (RNG):



Digester or Landfill



CNG Vehicle Fueling Station



Vehicle Fuel/Pipelines

Ease of installation: Piping pre-fitted



Ease of installation: Skid mounted equipment



In-house QA/QC



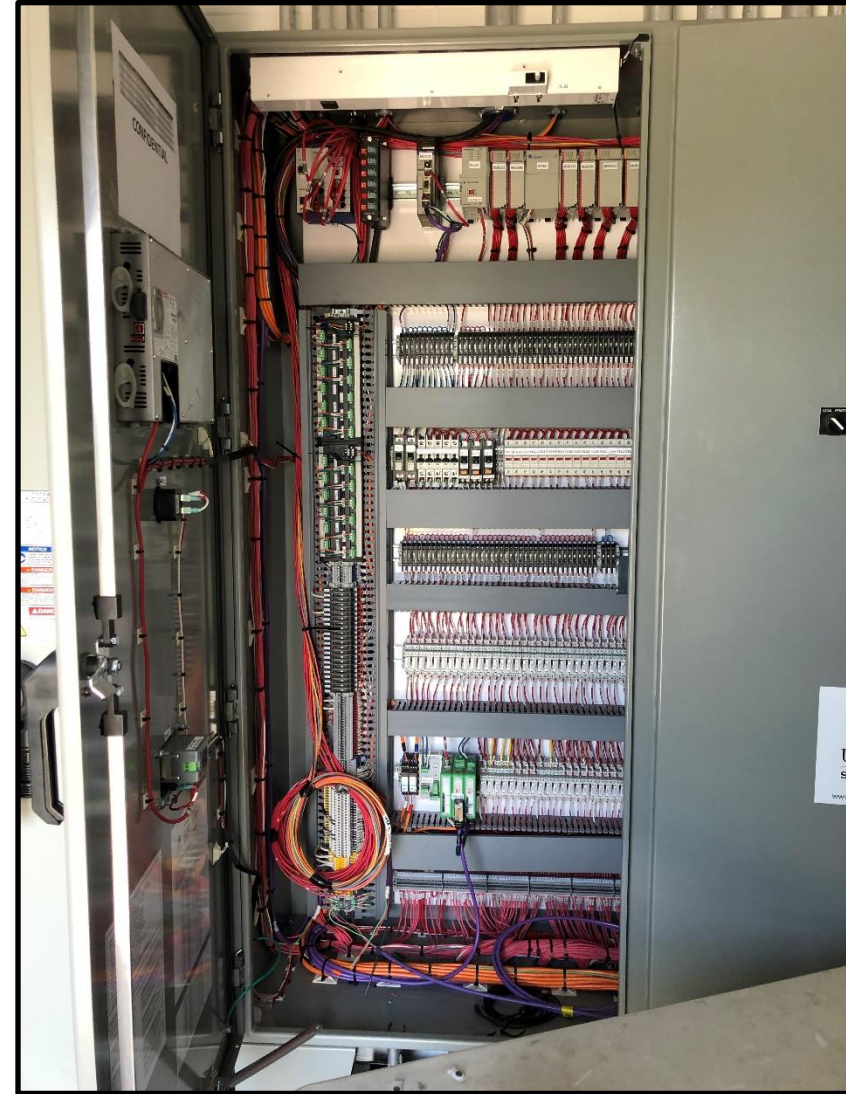
Faster start-up: Factory testing



Ease of installation: Enclosures



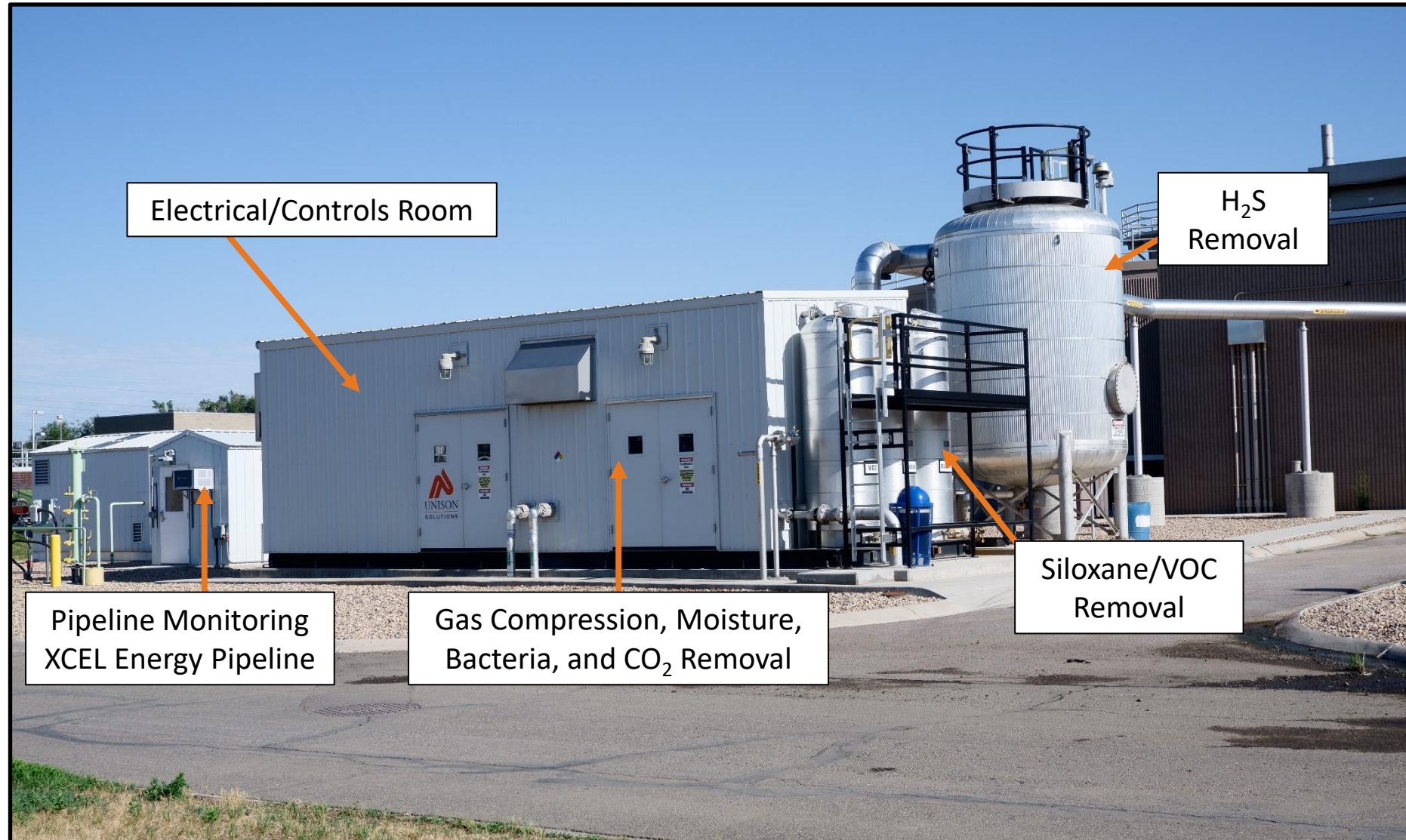
Ease of installation: Enclosures with electrical rooms



South Platte Renew, Colorado



- Littleton-Englewood, CO
- 20 MGD plant
- 400 scfm
- Start-up: October 2019



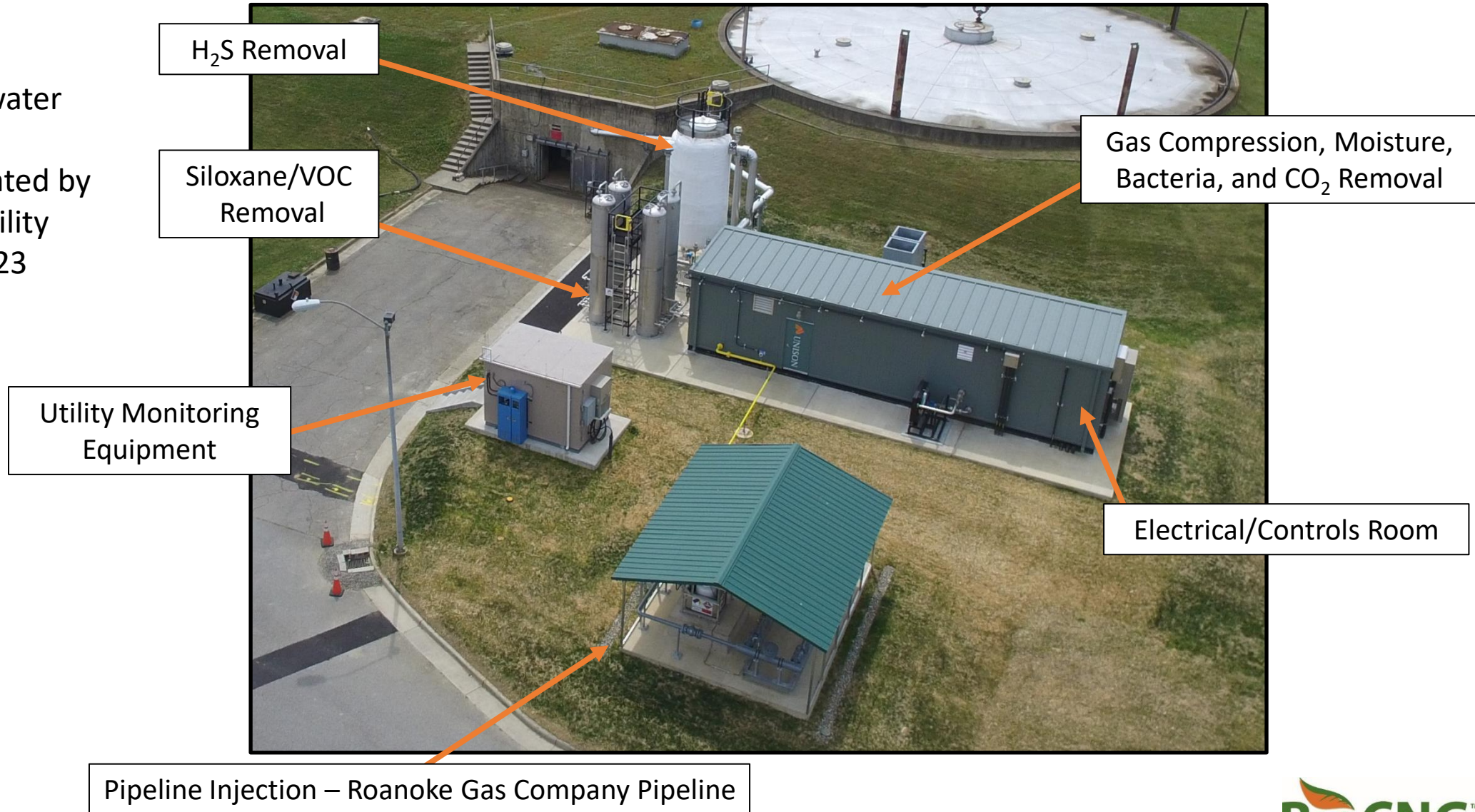
Ease of installation: Enclosures with electrical rooms



Roanoke Regional WPCP, Virginia



- 37 MGD Plant
- Municipal wastewater
- 400 scfm system
- Owned and operated by the natural gas utility
- Start-up: April 2023



Cold weather application

- East Lansing, MI
- 18.75 MGD Plant
- Municipal wastewater
- 175 scfm system
- 633kW_e engine
- Able to run complete WWTP if extended power outage
- Start-up: February 2022



Ease of installation: Enclosures with electrical panels



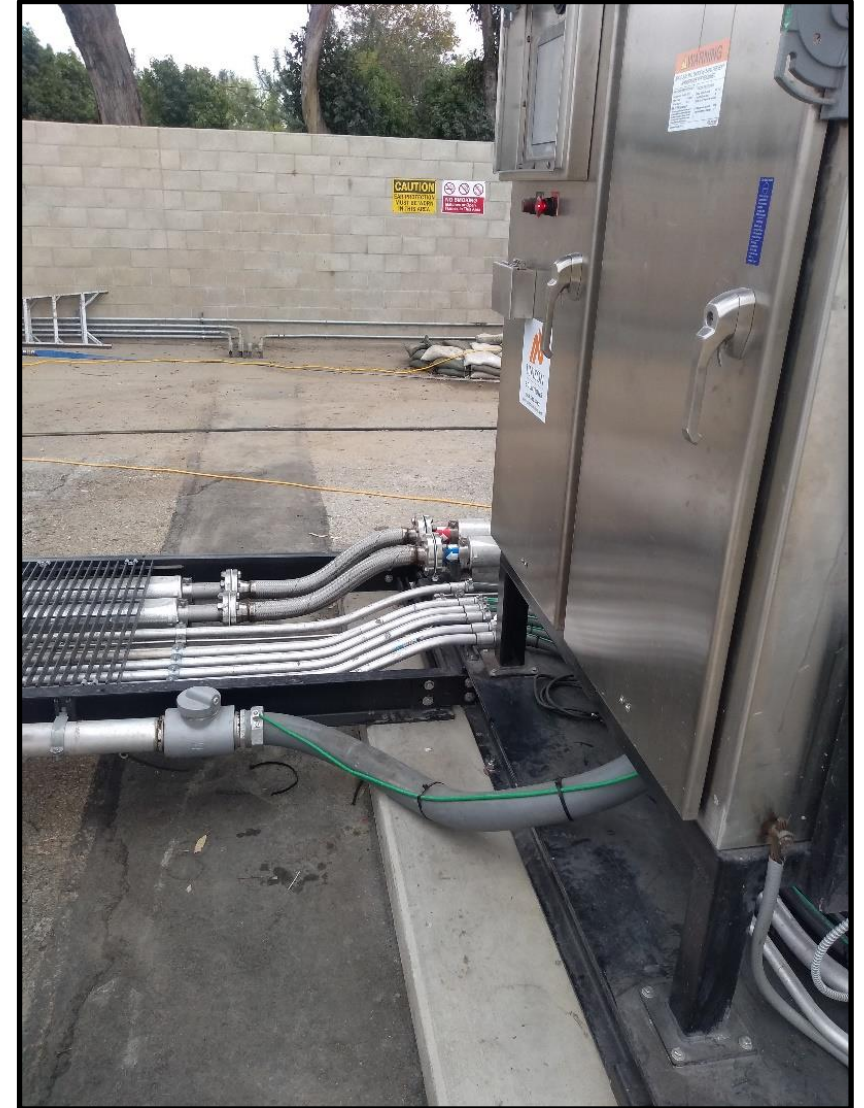
508A

Meeting site requirements: Explosion proof panels



698A

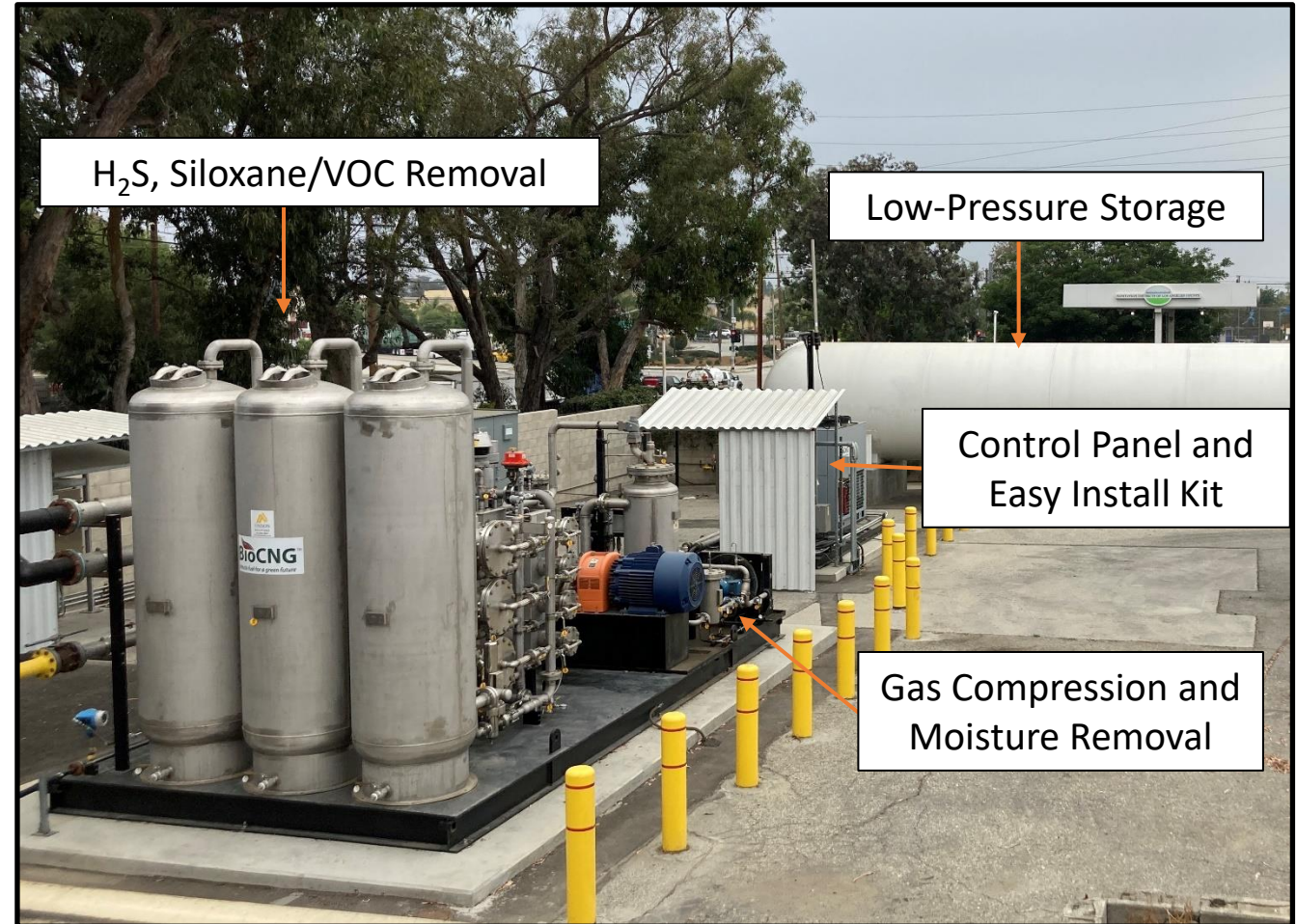
Ease of installation: Easy install kits



JWPCP, Carson CA



- Joint Water Pollution Control Plant
- 400 MGD Plant
- Municipal waste
- 400 scfm system for vehicle fueling
- Start-up: October 2020



Meeting site requirements: Vessel access



Redlands WWTF, CA



- 9.5 MGD Plant
- Municipal waste
- 170 scfm system feeding (3) multi-pass horizontal boilers
- Start-up: February 2022



H₂S, Siloxane/VOC Removal
with Custom Platform



Gas Compression and Moisture Removal

Meeting site requirements: Vessel access



Meeting site requirements: Vessel access



Meeting site requirements: Vessel access



Meeting site requirements: Indoor installation

- Oneida WPCP, NY
- 48 MGD Plant
- Municipal waste
- 250 scfm system feeding Capstone turbines
- Start-up: 2019



H₂S Removal



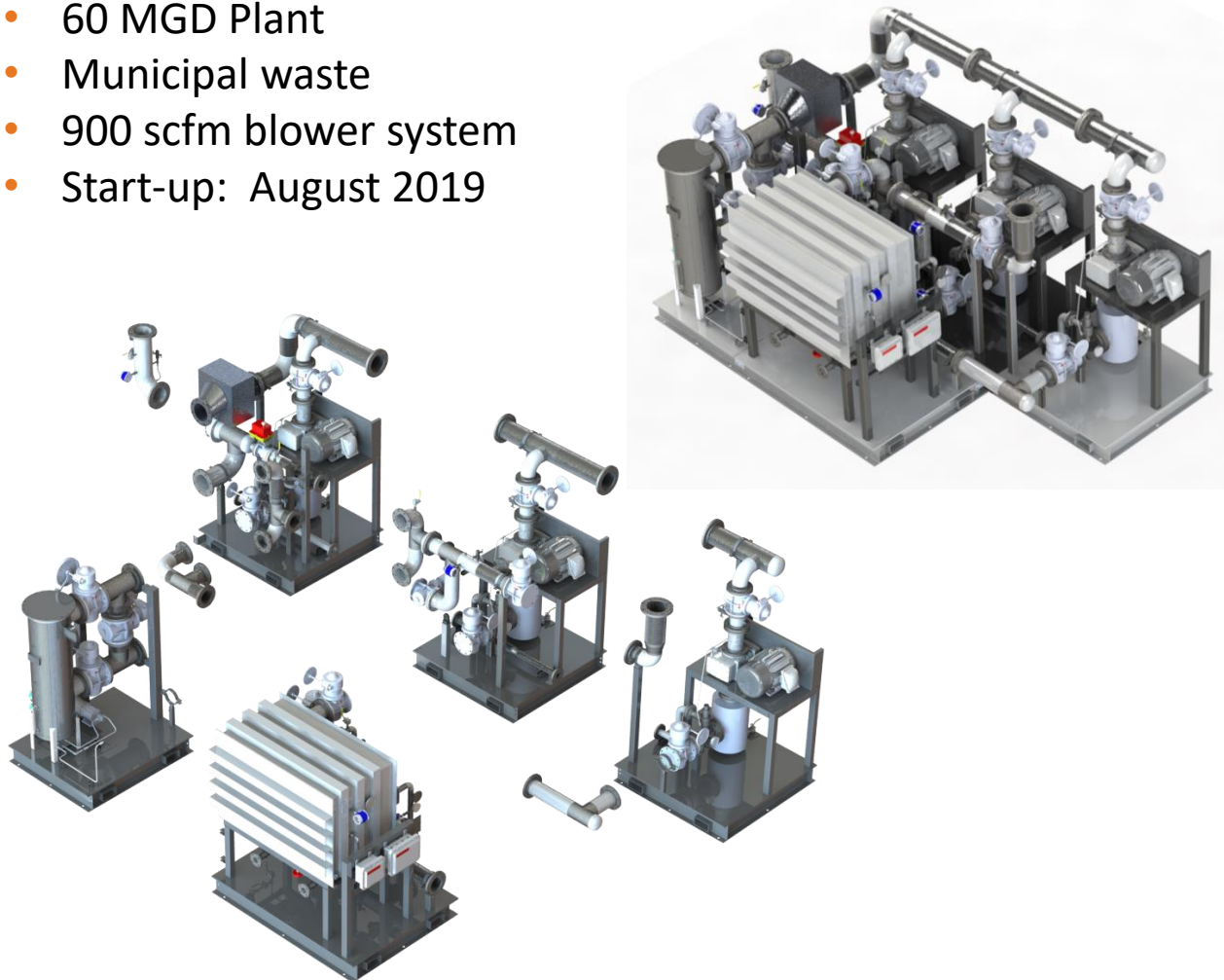
Gas Compression, Moisture,
Siloxane/VOC Removal



Capstone Turbines

Meeting site requirements: Existing building layout

- Papillion (Papiro) Creek WWTP, Bellevue, NE
- 60 MGD Plant
- Municipal waste
- 900 scfm blower system
- Start-up: August 2019



Meeting site requirements: Existing building layout

- Jamestown WWTP, NY
- 12 MGD Plant
- Municipal waste
- 50 scfm compressor system
- Start-up: January 2011



RNG & electrical generation

- Roseville, CA
- 12 MGD Plant
- Gas flow: 400 scfm
- Fast-fill: Municipal bus fueling
- System component redundancy



Redundancy and modular design



- Grand Rapids WRRC, Michigan
- 40 MGD Plant
- Municipal waste
- 2 – 400 scfm systems
- Oxygen removal system
- Start-up: December 2021



H₂S Removal



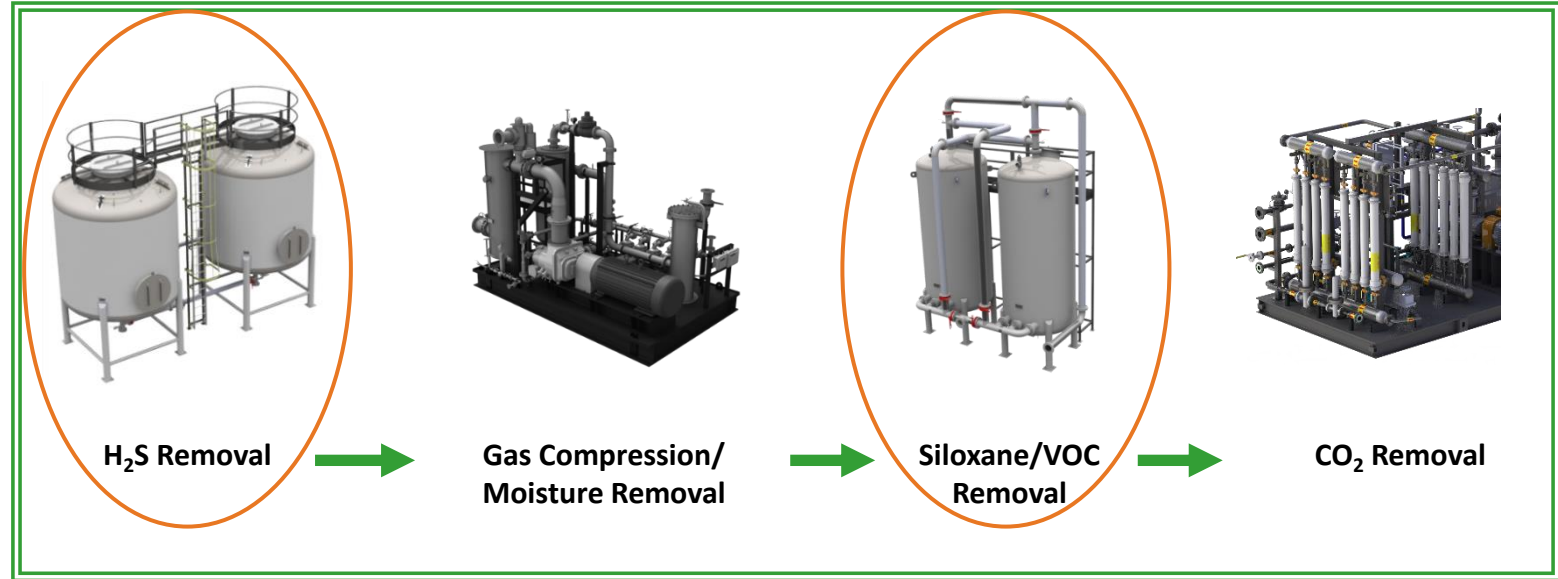
Gas Compression, Moisture, Bacteria,
CO₂ and Siloxane Removal

Pipeline Injection – DTE Energy Pipeline

O & M costs



Digester or Landfill



CNG Vehicle Fueling Station



Vehicle Fuel/Pipelines

Hydrogen Sulfide (H₂S)

- Where does H₂S come from?
 - Landfills: the breakdown of calcium sulfate used in building materials
 - Digesters: sulfate-reducing bacteria (SRBs) convert the sulfate ion to sulfide
- Equipment damage from corrosion
- SO_x emissions
- Health and safety issues
- Odor control
- **Causes fouling of siloxane/VOC removal media**
- Measure levels with either lab testing, colorimetric tubes, or on-site meter



H₂S removal media costs: Media, removal, disposal



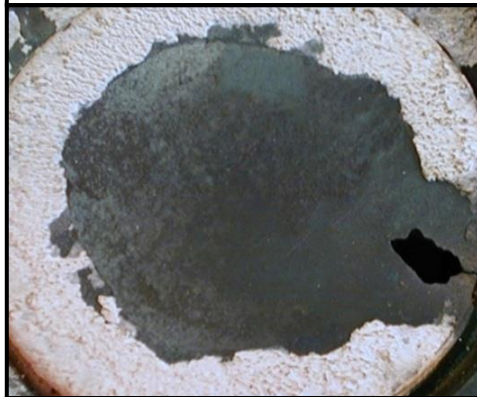
Hydrogen Sulfide (H₂S) - Media for all vessel designs



How siloxanes impact equipment



Turbines



Engines

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



Boilers



Flares

Siloxane/VOC removal media costs



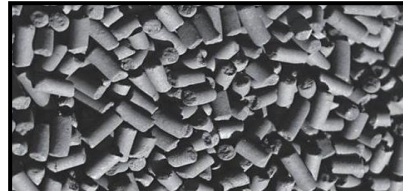
Coconut Shell



Wood



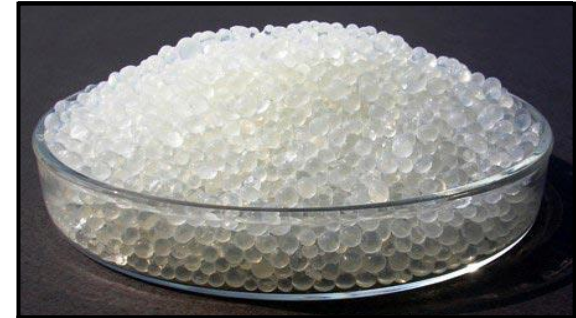
Coal



Extruded Pellets



4 x 8 Mesh Chips

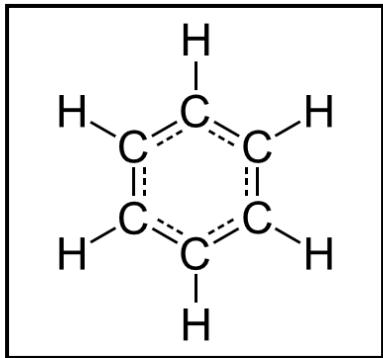


Silica Gel – Spheres

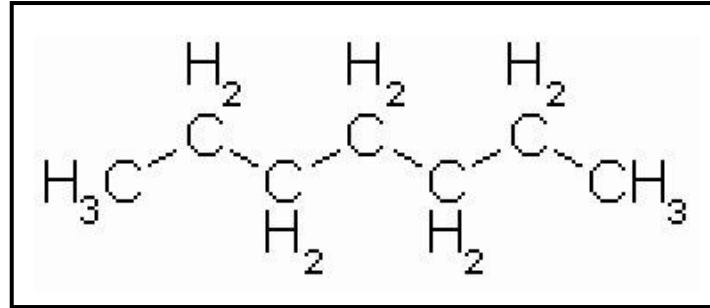


Silica Gel – Irregular Shapes

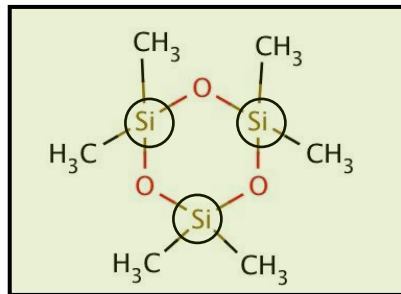
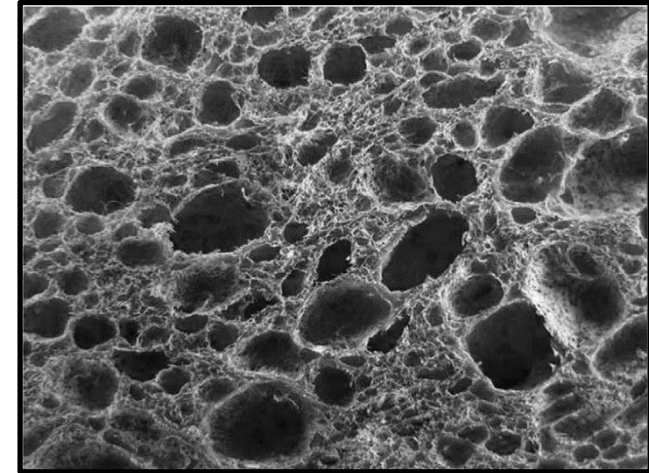
Suitability factors for media systems: Siloxanes, Hydrocarbons, and VOCs



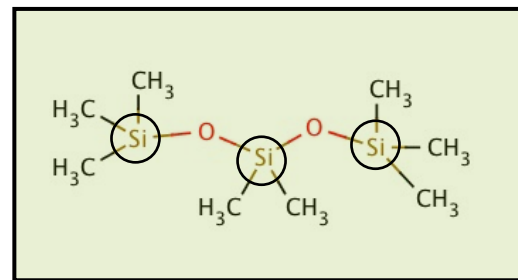
Benzene (C₆H₆)



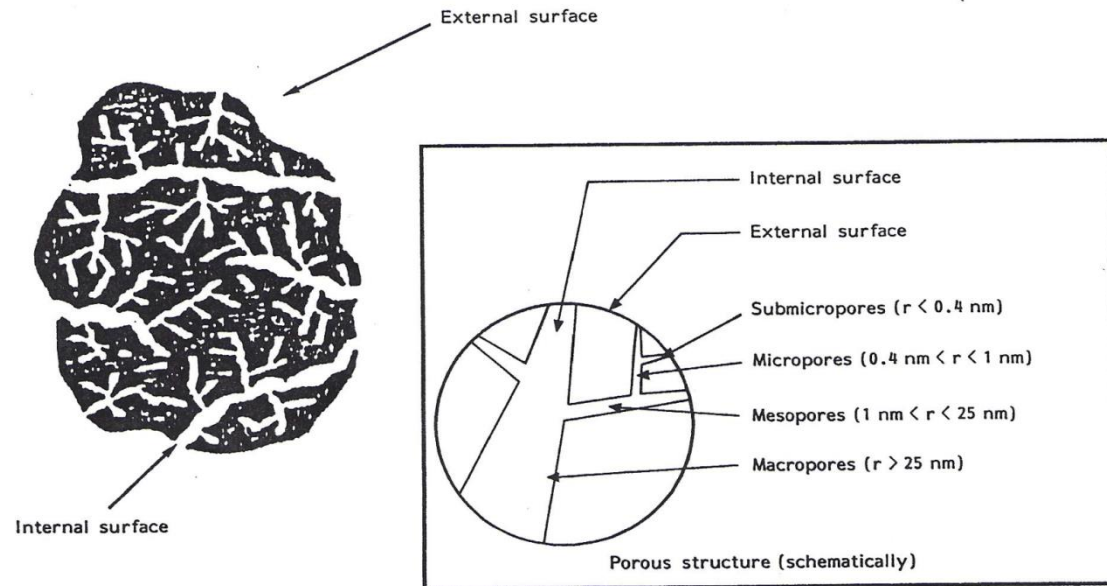
Heptane (C₇H₁₆)



Hexamethylcyclotrisiloxane (D3)



Octamethyltrisiloxane (L3)



Siloxane/VOC removal media for all vessel designs



Media change-out services



Ongoing maintenance, training, etc.



Biogas testing

Before starting a project, we recommend the following biogas tests be performed:

- **Major Components**
 - Methane
 - Nitrogen
 - Oxygen
 - Carbon dioxide
 - BTU calculation
- **Sulfur Compounds, by speciation**
 - Hydrogen sulfide
 - Mercaptans
 - Other sulfide compounds
- **Volatile Organic Compounds (VOCs), by speciation**
 - Follows EPA TO-15 protocol
- **Siloxanes, by speciation**
 - Up to 8 compounds common to biogas

These compounds will also need to be tested on a regular basis to determine media change-out intervals.



Thank you

Visit with us in person!

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OCTOBER

2-4

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