



Pipeline RNG Project

John Welch, P. E.

Director

Dane County Dept of Waste & Renewables

Dane County Waste & Renewables

- ❑ 1 Active landfill & 2 closed landfills
 - 250,000 tons/yr
- ❑ C&D MRF
- ❑ Clean Sweep
- ❑ Compost
- ❑ LFGTE
- ❑ RNG system
- ❑ Tours, recycling events, sharps program, etc



Dane County Biogas Projects

- ❑ Landfill Gas to Energy (LFGTE)
- ❑ Waste heat – multiple buildings
- ❑ Manure digester projects
- ❑ Evaluated food waste digester
- ❑ RNG fueling station – Pilot system & expansion
- ❑ High BTU pipeline grade gas
- ❑ CO2 Sequestration Pilot Project
- ❑ Food waste feasibility with City of Madison

Decomposing Waste Produces Landfill Gas

❑ Landfill Gas Components

- Methane – 50-55% ← Energy!!!
- Carbon Dioxide – 40-45% } Added Value?
- Nitrogen – 5-10% }
- Oxygen – Less than 0.5%
- VOCs, H₂S, Siloxanes, H₂O, etc

❑ Gas Temperature 80-120 F



Use of Biogas Resource



Dane County LFG History



- ❑ LFGTE Plants at 2 landfills – started 1995
- ❑ 4MW per year – 4,000 homes of renewable electricity
- ❑ Net \$2.5-3.0 million/yr in profit
- ❑ High PPA for electricity...until the markets shifted

Dane County's Future – High BTU



Dane County's Future – RNG

- ❑ Biogas from landfill and off-site biogas sources
- ❑ Gas is cleaned up
- ❑ Pipeline injection
- ❑ Off-load station – clean lakes
- ❑ Started project January 2017
- ❑ Construction started July 2018
- ❑ Construction completed 2019



Dane County's RNG Project

- ❑ County ownership
- ❑ Private O&M for first 3 years
- ❑ \$29M capital
- ❑ Quick pay back – RIN markets fluctuate
- ❑ Revenue streams
 - Gas – compared to frac gas
 - RINs (Renewable Identification Number)
 - Federal program: Renewable Fuels Standard (RFS)
 - ~~LCFS (Low Carbon Fuels Standard)~~
 - ~~California program~~

RNG Project Timeline

- ❑ 9/2016 – Project Budgeted
- ❑ 1/2017 – RFP to hire EcoEngineers
- ❑ Mid-2017 – RFP to hire BIOFerm
- ❑ 2017 – Equipment design – offload station added
- ❑ Late 2017 – RFP to hire TetraTech
- ❑ Early 2018 – Issue RFB for construction
- ❑ **Early 2018 – Pipeline Interconnect Discussions**
- ❑ Mid 2018 – RFP for RINs marketing – BlueSource
 - No LCFS
- ❑ July 2018 – Construction starts – multiple contractors
- ❑ April 2019 – Injected first gas
- ❑ Today – negotiating offload agreements

Dane County's RNG Facility Construction



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Dane County's RNG Facility Construction



BIOFerm™ Gas Upgrading Technology at

DANE COUNTY LANDFILL BUP



Project Gas Upgrading Specifications

Two Stage PSA: BUP2500i
Plant Footprint: 24,000 ft²
Gas Utilization: Pipeline Injection
Energy Content: >967 BTU/scf
Pipeline Requirements: Exceeds ANR pipeline specs
Raw Gas Capacity: 2,500 scfm
Raw Gas: 56% CH₄, 34% CO₂, 6.6% N₂, >430 ppm H₂S
Product Gas: 1,340 scfm



Skid-Ready PSA Installation Includes:

- >Fully Integrated Control System
- >Landfill Gas Filtration
- >Biological Sulfur Removal Unit
- >Landfill Gas Compressor
- >VOC and H₂S Removal
- >Thermal Oxidizer
- >Gas Chilling
- >Booster Blower
- >RNG Compressor



Two Stage PSA Process Steps

1. Raw biogas is compressed
2. Cooling system removes condensed water vapor
3. Activated carbon removes trace components such as H₂S, VOCs, and siloxanes
4. Conditioned biogas is channeled through PSA adsorbers filled with carbon molecular sieves for adsorption
5. First stage of adsorption removes CO₂, H₂O, NH₃, and parts of O₂ and N₂
6. Second stage removes remaining O₂ and N₂
7. RNG is injected into the grid, or upgraded to CNG



Key Features

- >Typical CH₄ recovery >92-96%
- >High N₂ Rejection
- >Meets stringent pipeline requirements
- >No increased CH₄ losses overtime
- >High processing efficiency

www.biofermenergy.com

info@biofermenergy.com

608.467.5523

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An aerial photograph of an industrial site, likely a Renewable Natural Gas (RNG) production facility. The central focus is a large circular pond with a muddy, brownish surface. To the left of the pond, there are several large, white, spherical storage tanks and numerous smaller white cylindrical tanks. A network of pipes and walkways connects these tanks. In the foreground, there are several large, tan-colored industrial buildings with corrugated metal roofs. To the right of the main tank area, there are several grey and yellow shipping containers, some of which are stacked. A yellow excavator is visible near the pond's edge. The background shows a mix of brown, bare trees and some green grass, suggesting a late autumn or winter setting. The overall scene depicts a complex industrial development project in progress.

RNG Project Development

RNG Project Considerations

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- An aerial photograph of an industrial facility, likely a natural gas processing plant. The image shows several large, white, spherical storage tanks, numerous smaller cylindrical tanks, and various industrial buildings and structures. The facility is situated in a rural or undeveloped area with some trees and open land visible around the perimeter. The overall scene is a complex of industrial infrastructure.
- ❑ Industry direction right now
 - RINS/LCFS
 - Electric Buyback Rates – due to wind, solar, & frac gas
 - ❑ Stringent gas requirements
 - BTU, moisture, CO₂, H₂S, nitrogen, others
 - Expensive treatment – high capital and O&M
 - ❑ Lacking industry wide interconnection standards
 - ❑ Complex projects
 - ❑ Proximity to CNG markets and/or a pipeline?

Design Considerations

- ❑ Gas quality and processing needs (Siloxanes, H₂S, nitrogen, H₂O)
- ❑ Plan for future gas quantities/qualities
- ❑ Regulatory and Permitting Compliance
- ❑ Status of Technology; Reliability; Types of Technologies
- ❑ Ease of Operation
- ❑ Redundancy
- ❑ Safety Issues
- ❑ Aesthetics/Nuisances

Development Steps

1. Find a good biogas site
2. Determine project roles
 - Developer, Tech Provider, Owner, Operator, etc
3. Perform financial pro forma
 - Capital, O&M, Revenue
4. **Obtain pipeline access**
5. Find marketer and end users of the fuel
6. Design, bid, and construct plant
7. Obtain RIN and/or LCFS certifications
8. O&M

Our Interconnect

1. ANR
2. ~2,000 LF pipe installed by ANR
3. Duplicate flow meter and gas chromatograph
4. Tariff gas quality standards

Parameter	ANR Pipeline Specifications
Heating Value (BTU/ft ³)	967 - 1,200
Hydrogen Sulfide (ppmv) ¹	< 4
Total Sulfur (ppmv) ²	< 320
Oxygen (% by volume)	< 1
Carbon Dioxide (% by volume)	< 2
Nitrogen (% by volume)	< 3
Water Vapor (lb./1x10 ⁶ ft ³)	< 7
Temperature (deg. F)	40 < T < 120
Hydrocarbon Dewpoint (deg. F) ³	> 15
Pressure (psig) ⁴	600 - 975

How Utilities Can Help

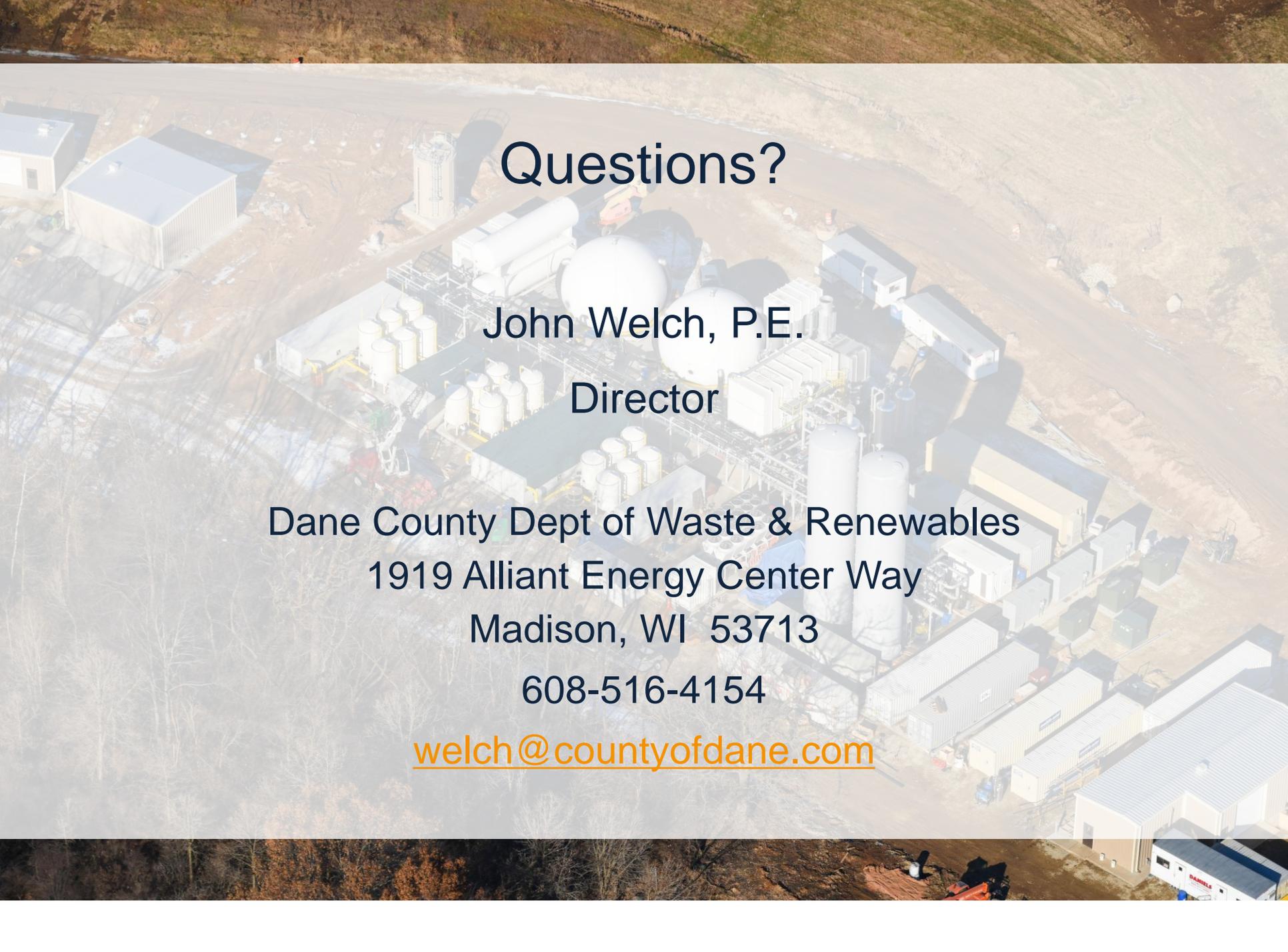
- ❑ Interconnect standards
- ❑ Interconnect costs
- ❑ Gas quality requirements
 - N₂, CO₂, total balance gas, O₂
- ❑ Shut-in assistance – equipment design & staffing
- ❑ Voluntary carbon reduction programs
 - Decarbonize your gas using RNG

What's Next?

Possible future add-on options:

- ❑ Waste heat capture
- ❑ Grow local CNG network
- ❑ CO2 capture
- ❑ Onsite electric production



An aerial photograph of an industrial facility, likely a wastewater treatment plant or energy center. The facility features several large white spherical storage tanks, numerous smaller cylindrical tanks, and various industrial buildings and structures. The site is surrounded by a mix of dirt, gravel, and some vegetation. The text is overlaid on a semi-transparent white background.

Questions?

John Welch, P.E.
Director

Dane County Dept of Waste & Renewables
1919 Alliant Energy Center Way
Madison, WI 53713
608-516-4154

welch@countyofdane.com