Biogas for Clean Energy and Market Outlook

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BIOFerm™ Energy Systems

North American Anaerobic Digestion & Gas Upgrading

Expertise

Turnkey anaerobic digestion systems
Turnkey gas upgrading systems

Commitment

Performance guarantee

Experience

450+ anaerobic digestion installations
90+ gas upgrading installations

Reputation

High repeat business

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Biogas Flexibility

Most Versatile Renewable Energy Source

- **Biogas can be produced continuously at local level to reduce carbon footprint, manage waste, and reduce dependence on foreign energy**

- **Biogas can be used in a variety of ways:**
  - Electricity
    - Used onsite
    - Sold to the utility
    - Current lower market value in many US locations, including WI
  - Heat
    - Used in operations, to heat buildings, etc.
  - Renewable natural gas (RNG)
    - *Allows for much flexibility in biogas' use*
    - Injected **and stored** in the natural gas grid for use in businesses, operations, processing, homes….
    - Use as vehicle fuel in the form of CNG/LNG
    - High market value due to RFS/RINS/LCFS

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Biogas Value – RNG

Market Outlook

- RNG value driven by energy value and environmental attributes
  - Federal/state legislation mandate carbon reduction require certain volume of renewables in fuel mix

- **Federal Renewable Fuel Standard (RFS)** and **CA Low Carbon Fuel Standard (LCFS)** = key mandates driving RNG market
- **RFS:**
  - Established in 2005 and modified in 2007, “RFS2”, to establish renewable fuel volume target to **36 billion gallons in 2022**
  - RFS2 goal = reduce dependence on foreign oil and increase use of renewable fuels
  - Requires annual specified volumes of renewables be used in transportation fuel, home heating oil, and/or jet fuel
  - *RNG qualifies as Cellulosic Biofuel under RFS2 and generates D2 RIN when dedicated to transportation fuel*

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Biogas End Users

Industries Can Benefit from Biogas as Clean Energy

- Industries benefit from using (and creating) biogas as fuel:
  - **Food processors**
    - Many processors create organic waste that can diverted to AD to meet zero-waste goals/reduce carbon footprint
    - Can use biogas onsite in the forms of RNG, electricity, heat to power operations, or sell energy
  - **Municipalities**
    - Can divert food/yard waste to AD to meet food waste diversion from landfill legislation and community sustainability initiatives
    - Biogas from WWTP, landfills, and AD can all be utilized to create continuous, local energy, fuel fleet vehicles, etc.
  - **Agricultural operations**
    - Manage manure/nutrients through AD
    - Create energy to power operations/fuel fleet vehicles, or sell

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1) Recent Case Study – RNG from AD Biogas

Major Food Processor to Create RNG from Pork Waste

- Major US food processing company currently creates biogas from AD of food processing pork waste
- **To create higher biogas value, they will upgrade biogas to RNG using Carbotech PSA Gas Upgrading**

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1) Recent Case Study – RNG from AD Biogas

Major Food Processor to Create RNG from Pork Waste

- **Upgraded biogas will produce 440 million scf RNG/year at full capacity**
  - = to 3,371,544 GGE/year
  - = to displacing the gasoline usage for ~6,743 cars
- Raw biogas processing capacity of 1200 scf/minute
- Gas composition of 94% methane

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2) Recent Case Study – Electricity + Heat

Energy from Biosolids

- **Processes 100% of the City's biosolids to make heat and electricity from biogas + high-quality pelletized fertilizer from digestate**
- 3 COCCUS® digesters + 3 EUCO® digesters + 1.8 MW_{el} CHP + 3 additional 600 kW MWM engines (built in 2 phases)
- Processing capacity: 15,000 tons/year dried biosolids
- Provides enough electricity to power ~1,600 homes

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2) Recent Case Study – Electricity + Heat

Plans for Energy from Biosolids + Food Waste Cogeneration

- **Anaerobic digesters will be upgraded to handle food waste ~2018 to make additional heat and electricity + divert organics from landfill**
- New, additional waste stream may include: pre-consumer food waste such as FOGs, grocery waste, food processing waste, etc.:
  - 20,000 – 25,000 tons per year of high-solids food waste
  - 40,000 to 50,000 tons/year liquid food wastes: FOG laden wastes + Non-FOG wastes

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Our Purpose

Redefining “Waste”

At BIOFerm™ we see our role as “re-definers” of waste. We hope to provide the tools for industries to make the most of the resources within their reach–

nothing is waste until you waste it.

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BIOFerm™ Energy Systems
440 Science Drive, Suite 300
Madison, WI 53711

608-467-5523

www.BIOFermEnergy.com
info@BIOFermEnergy.com