

RNG WORKS



Delivering Renewable Natural Gas & Healthy Soils



**BIOENERGY
DEVCO**



BIOENERGY DEVCO

DELIVERING RENEWABLE NATURAL GAS
AND HEALTHY SOILS

A Presentation for
RNG Works 2020

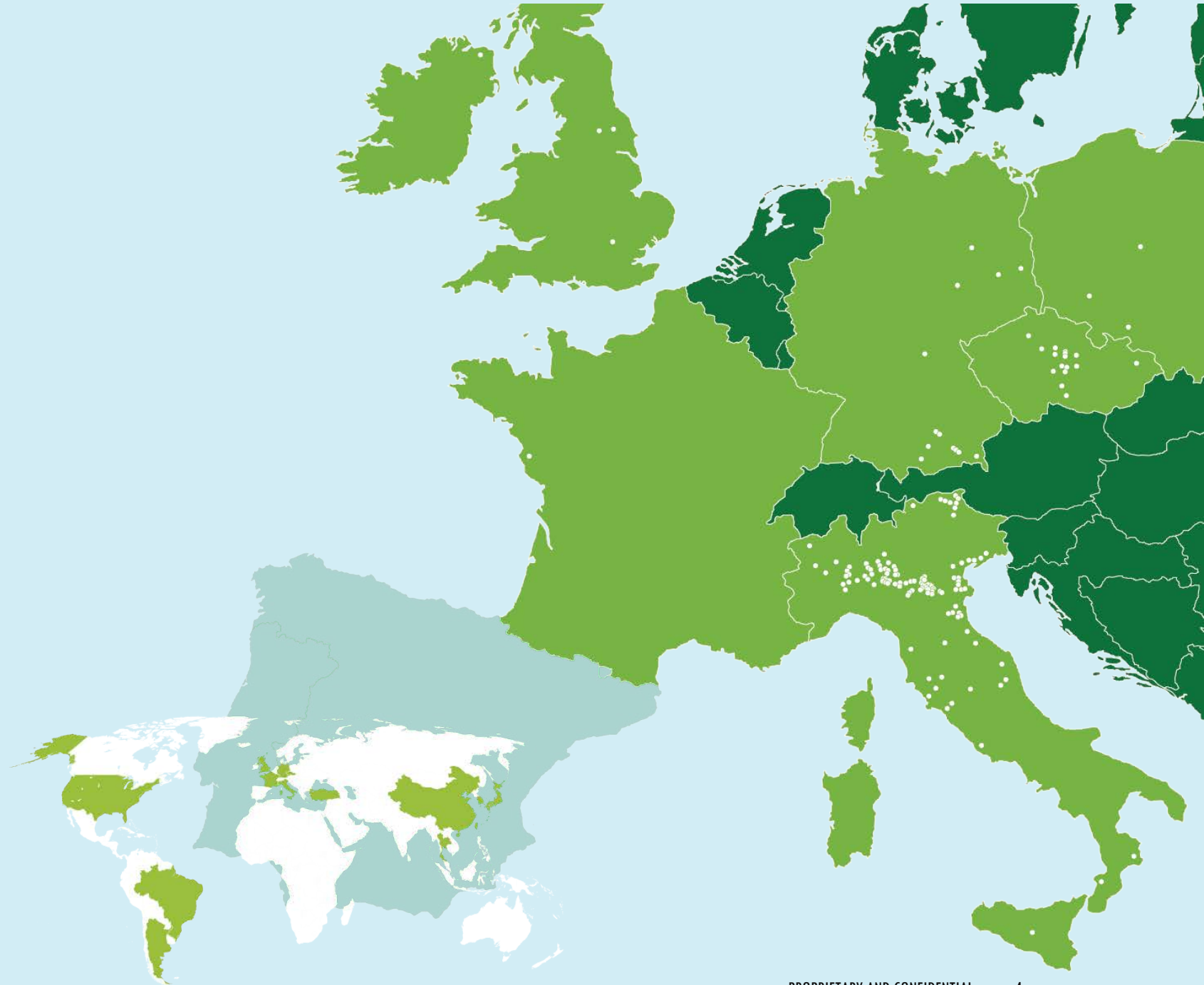
A GLOBAL LEADER IN THE FINANCE, DESIGN, BUILD AND OPERATION OF ANAEROBIC DIGESTORS

220 plants,
22 years of experience,
3 international grids,
full microbiological lab,
guaranteed and insured
performance

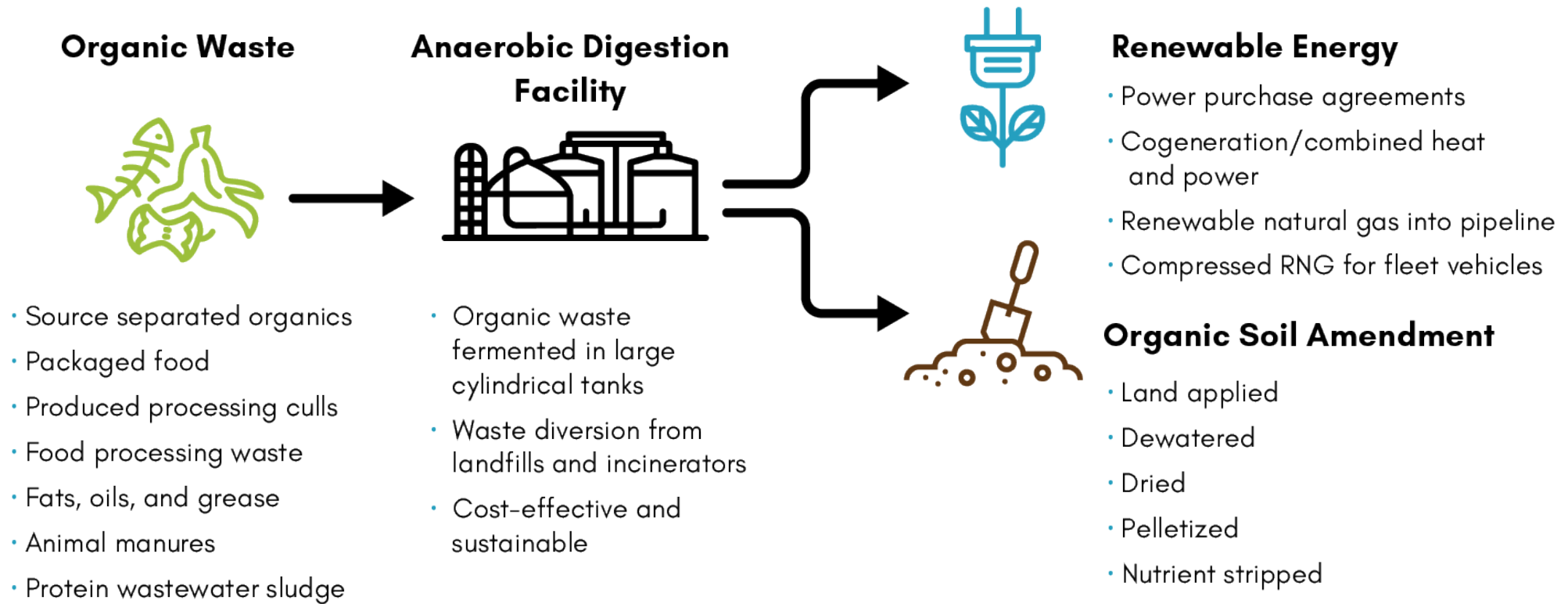


220+ MODULAR BIOGAS PLANTS

EUROPE, ASIA, NORTH AMERICA,
SOUTH AMERICA



WHAT IS ANAEROBIC DIGESTION?



OUR STRATEGIES



Recycle Excess Organics Headed for Landfills or Incineration Reducing Greenhouse Gases

Change how cities, states, agricultural entities, corporations and academic institutions efficiently manage the more than 1.4 billion tons of manure, organics and processing materials that are currently land-applied



Produce Truly Renewable Natural Gas from Organic Waste

Provide a sustainable means to creating zero waste and treating organic matter and waste in an economical yet clean, rapid, efficient, profitable and sustainable way



Use Natural Fermentation vs. Incineration: A Natural Scientific Methodology

Much like a cow's stomach on an industrial scale, anaerobic digestion is nature's fermentation process and is the best methodology/technology to recycle organic matter into clean renewable energy and organic soil amendment



Ensure Business Efficiency and Environmental Effectiveness

Present a turnkey plan to finance, develop, and scale an anaerobic digestion solution using our proven 20-year success record with more than 220 plants built throughout the world using our BTS technology

EXPERIENCE AND DIFFERENTIATORS

- 220+ modular biogas plants in Europe, Asia, and North America with a rated energy capacity of 250,000 MMBtu+
- Guaranteed and insured facility performance
- Injecting renewable natural gas into 3 international grids with gas cleaning and interconnection services
- Goal-defined project development and finance
- Build, assembly, maintenance, and operations
- Commissioning
- Fully automated with associated telemetry
- Lab testing, monitoring and nutrient management support from a dedicated microbiology laboratory with 22 years of performance data
- Proprietary and patented equipment



LOCAL ORGANIC FUEL INPUTS



ORGANIC FEEDSTOCKS

- Fruits and vegetables
- Meats and dairy
- Fats, greases, and oils
- Packaged food
- Poultry, hatchery and DAF waste
- Dairy manure



INDUSTRIES

- Food processing and distribution
- Foodservice/Hospitality
- Agriculture
- Public institutions
- Municipalities
- Academic Institutions

OUR ENERGY AND SOIL OUTPUTS



RENEWABLE NATURAL GAS

- Electricity / CHP
- Grid Injection
- Fleet Vehicle
- Hydrogen Batteries
- Cogeneration
- Summer/winter “peaker”



ORGANIC SOIL AMENDMENT

- Class A
- Dewatered
- Dried
- Granulated
- Nitrogen/Phosphorus Stripping

ALL ABOUT RNG

- RNG is pipeline-quality and fully interchangeable with conventional natural gas
- RNG is the only renewable energy source that can be used with existing pipeline infrastructures
 - It enables political economies to transition to a carbon-neutral fuel base without modifying existing pipeline infrastructure
- RNG can be used as a transportation fuel in the form of compressed natural gas (**CNG**) or liquefied natural gas (**LNG**)



ALL ABOUT DIGESTATE

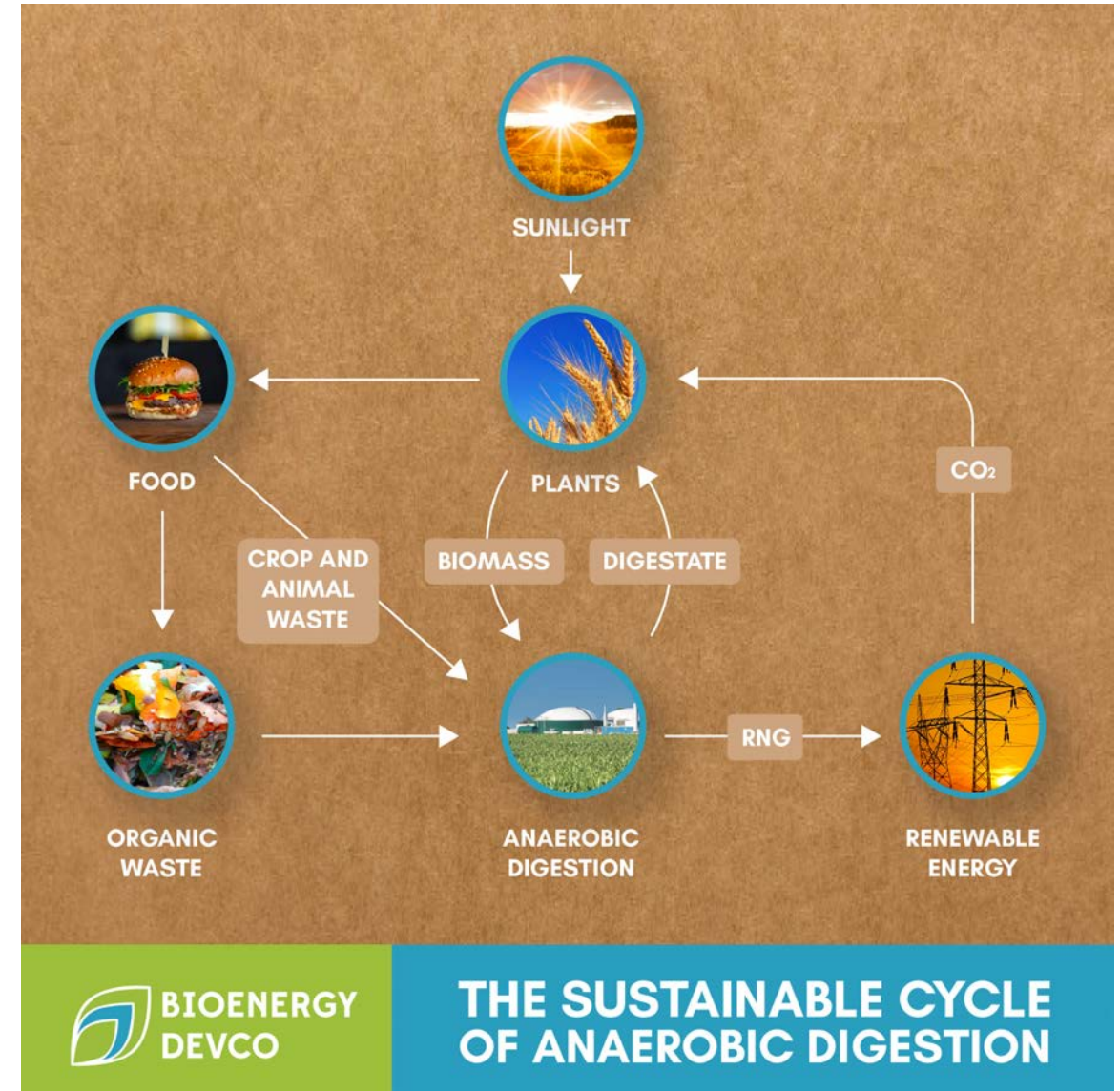
- Digestate improves the soil health of our farms and communities by recycling nutrients and carbon in organic waste back to the soil
- Dewatered digestate can be used as livestock bedding, in consumer horticulture, and more
- Digestate can be used as a plant nutrient source in lieu of synthetic fertilizers
- All the nutrients contained within the feedstock of AD are embodied within the digestate



THE CIRCULAR ECONOMY

The main idea of circularity is the use of waste as a resource by mimicking nature's cycle. In nature there is no waste, every natural process has a purpose and the end products become resources for the next natural process.

- Biogas as an energy carrier
- Reduction of GHG emissions
- Energy security
- Biogas as raw material – further use of carbon dioxide and methane
- Soil regeneration and carbon sequestration
- Multi-contributor of Local Economies – From waste liability and water eutrophication to energy security, soil enrichment, GHG mitigation, job creation





**A typical commercial-scale AD facility generates
275,000 mmBTUs of energy, the equivalent of:**

the annual electricity
consumption of 6,635
US households.

1,978,417 gallons of
diesel fuel.

11,870,503 miles of
tractor trailer fuel.

4,240 trips across the
US by a tractor trailer.

OUR BUSINESS APPROACH



OUR CORE BUSINESS



Our Facility Ownership Models

Owned and Operated

BDC collects and co-digests organic waste from multiple sources

Locally Focused:
100,000 tons per year

Built-To-Suit

Custom designed around a single large entity's challenge in disposal of organic waste in a sustainable yet economical manner

Public / Private Partnership

Based on municipal organic waste and power purchase demands

STRONG RETURNS TO THE COMMUNITY

- Increases the lifespan of a local landfill, reducing percolates, increasing water quality
- Reduces odor as organic waste is deposited into sealed tanks
- Shrinks waste transport costs and associated environmental impact
- Reduces greenhouse gases and enables CO₂ and methane capture and use
- Reduces pathogens and antibiotic use in the environment as digested waste is effectively pasteurized and dried digestate can be used as bedding material
- Creates both direct and indirect jobs to construct and manage the facility as well as attend to the resulting offtake use and distribution



OUR TECHNICAL APPROACH





MICROBIOLOGICAL DIFFERENCE

- First laboratory dedicated exclusively for the biogas world
- Collect empirical values that capture biogas efficiency of inputs
- dinaMETAN database ensures optimization of the microbiological recipes best suited to obtaining the highest quality biogas and digestate from available feedstocks



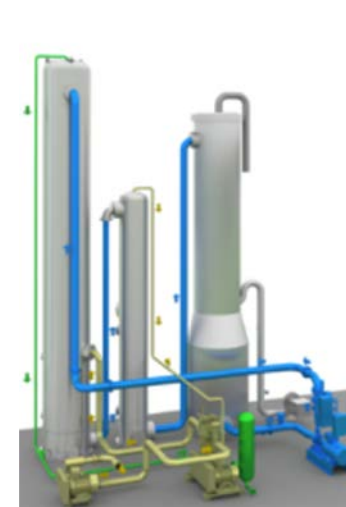
OUR GAS UPGRADING TECHNOLOGY

bioMETANw

- Pressure water washing process
- Biogas is dissolved using CO₂ and hydrogen sulfide in water and separating from the biogas. A counter-flow water process in a packed column ensures water absorbs the “unwanted” gases.

bioMETANm

- Membrane processing
- Biogas is first purified from hydrogen sulfide and then brought to higher pressure. The methane is separated from CO₂ using membranes. A sequence of separation stages, combined with CO₂ recovery allows 100% separation of the methane.



CURRENT PROJECTS



OUR 2020 ANAEROBIC DIGESTORS IN ENGINEERING AND CONSTRUCTION



Maryland Food Center Authority (MFCa)

- **Location:** Jessup, MD
- **Feedstocks:** 110,000 tons/year of food waste, FOG, and dairy DAF
- **CI Score:** (46.07)
- **Gas Production:** 295,000 mmBTU/year
- **Target Operation Date:** Q2 2021

Bioenergy Innovation Center

- **Location:** Blades, DE
- **Feedstocks:** Up to 200,000 tons/year of poultry DAF, waste activated sludge, and hatchery waste
- **CI Score:** (75)
- **Gas Production:** 350,000+ mmBTU/year
- **Target Operation Date:** Q3 2021

MARYLAND FOOD CENTER AUTHORITY

Location: Jessup, MD

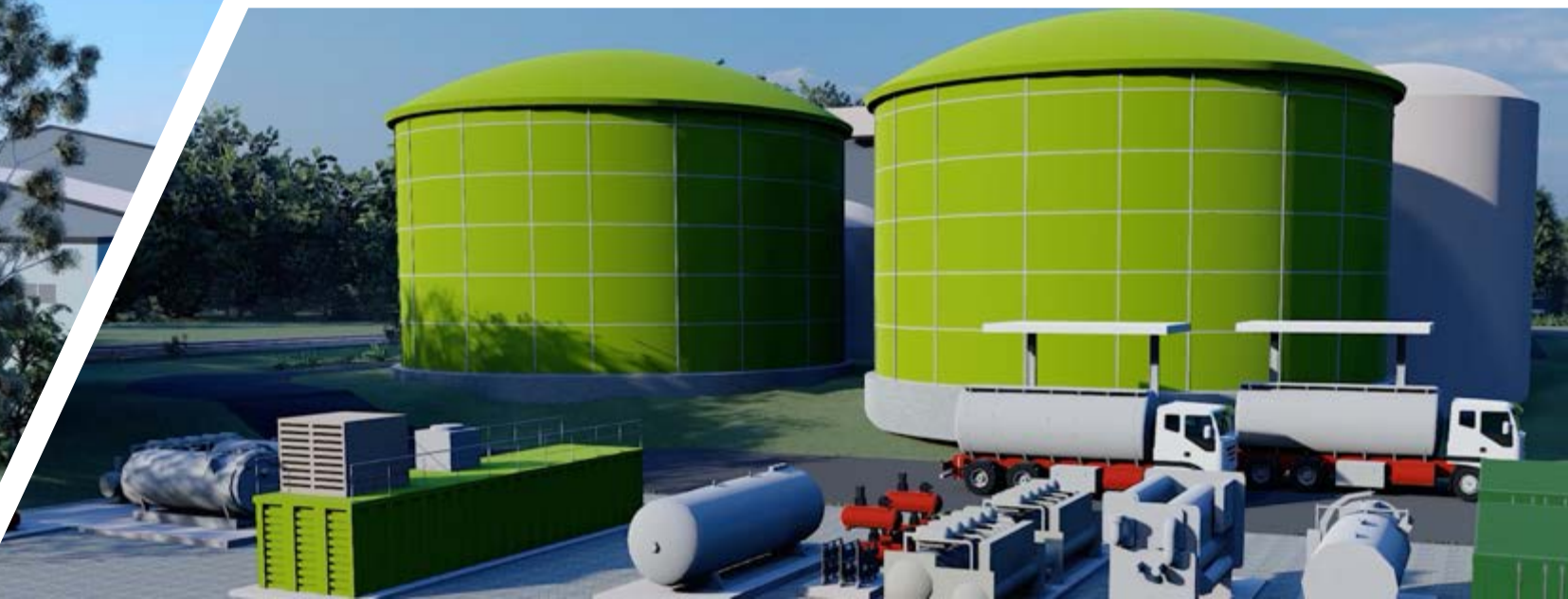
Feedstocks: 110,000 tons/year of food waste, FOG, and dairy DAF

CI Score: (46.07)

Gas Production: 295,000 mmBTU/year

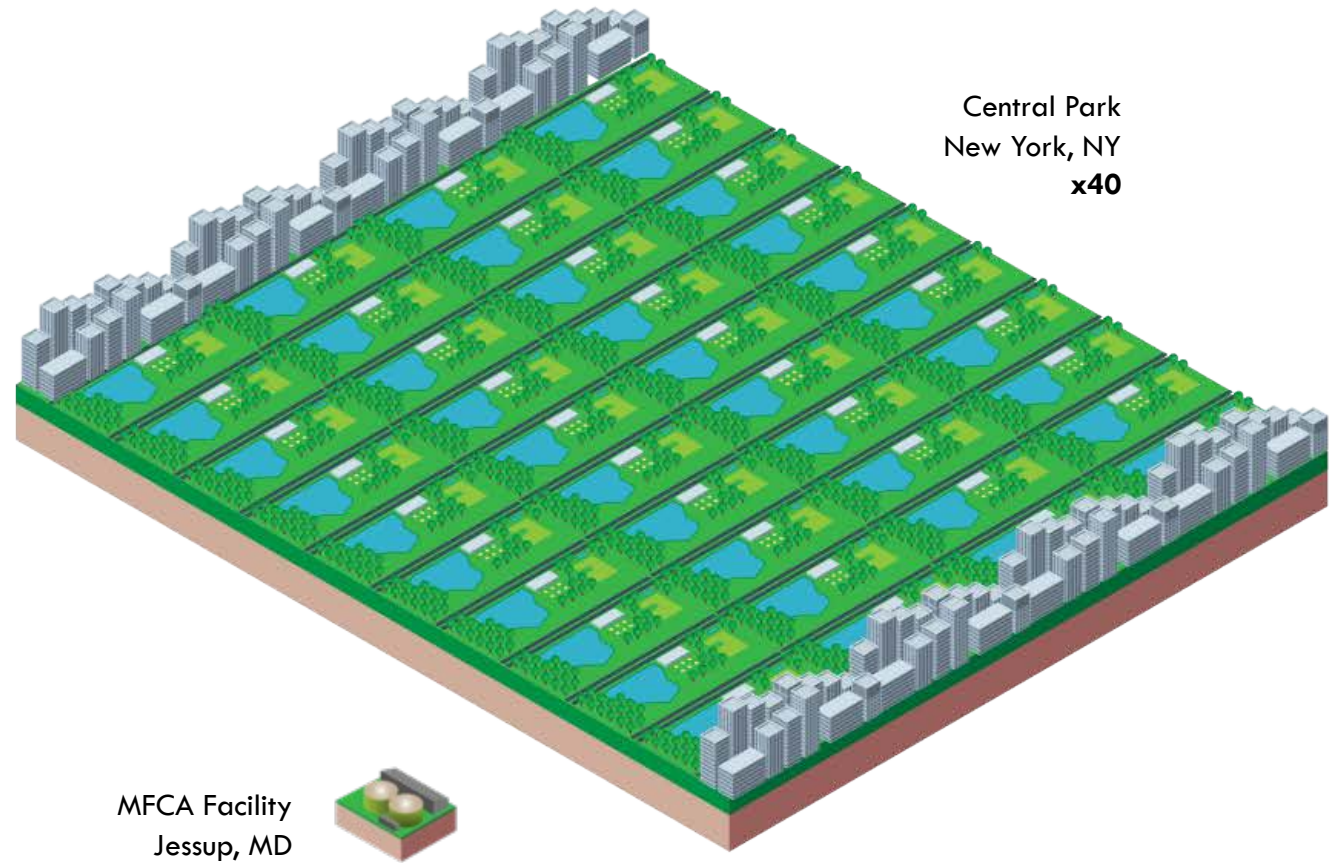
Target Operation Date: Q3 2021





THE IMPACT OF ANAEROBIC DIGESTION AND WASTE DIVERSION

Our MFCAs facility will save about 26,000 tons of CO₂e_q from the atmosphere each year - the same environmental impact that a forest area **40 times** the size of Central Park can provide!



BIOENERGY INNOVATION CENTER

FORMERLY PERDUE AGRIRECYCLE

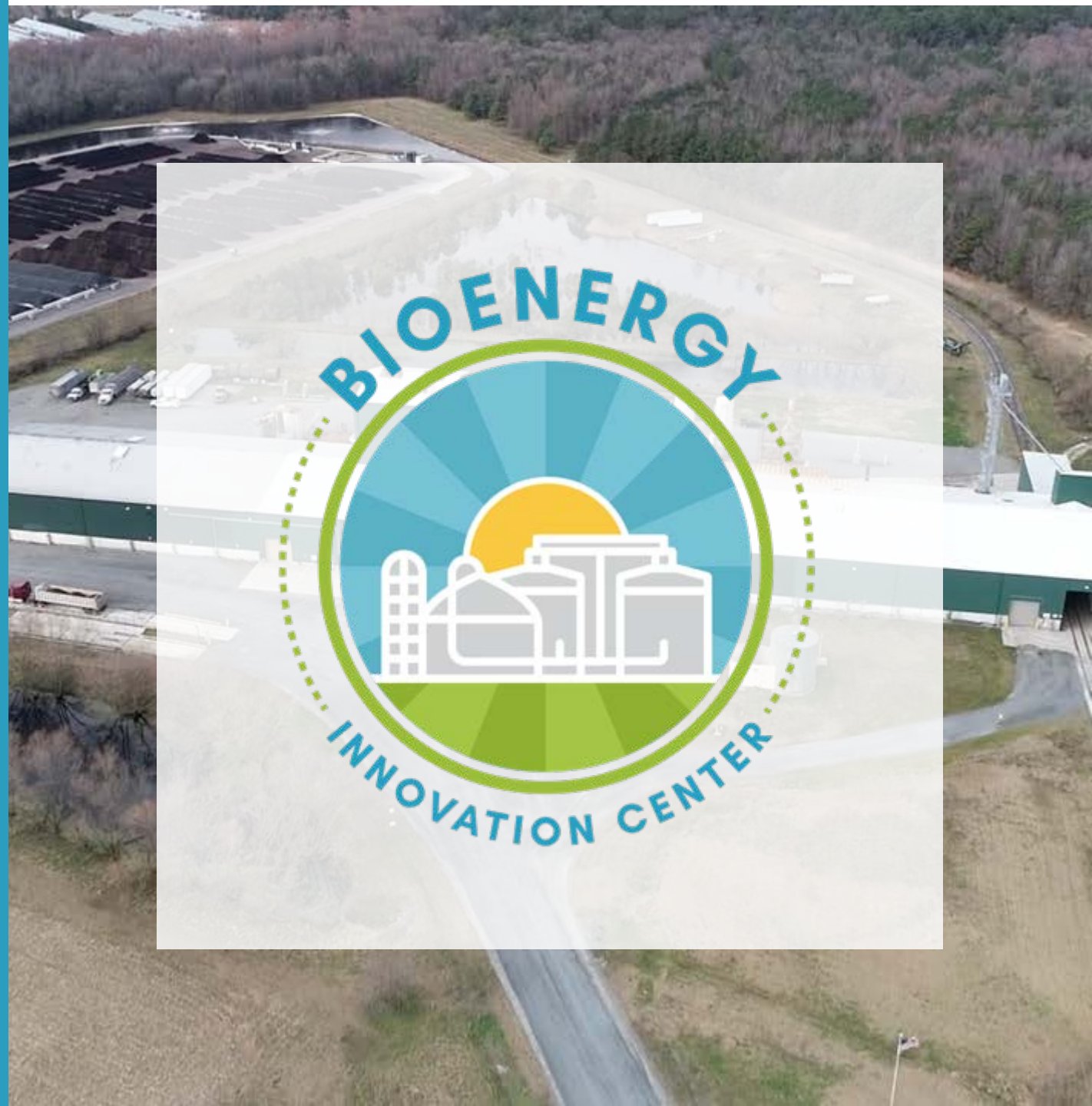
Location: Blades, DE

Feedstocks: Up to 200,000 tons/year of poultry DAF, waste activated sludge, litter and hatchery waste from Perdue and other waste providers

CI Score: ~(40)

Gas Production: 350,000+ mmBTU/year

Target Operation Date: Q3 2021





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Chicken waste conversion project may ease ground water contamination

By TOM BYRNE • DEC 12, 2019

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The Green

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A different approach to addressing ongoing concerns about ground water contamination by waste produced from poultry plants is coming to the First State.

A Maryland-based company has developed technology to tackle the issue - and is bringing it to Delaware.



NEWS WEATHER SPORTS NOTICIAS WATCH LIVE ...

Bioenergy DevCo takes over Perdue's Sussex facility

December 10, 2019 by Camila Fernandez



SEAFORD, Del. – "We're very confident that the technology that we bring will be successful here in Delaware," said Shawn Kreloff, Bioenergy DevCo's CEO.

Perdue Farms is celebrating after striking a twenty-year deal with Bioenergy DevCo, a Maryland company that is taking over their composting operation in Delaware.

"Perdue has made a major commitment to the environment out here," said Kreloff.

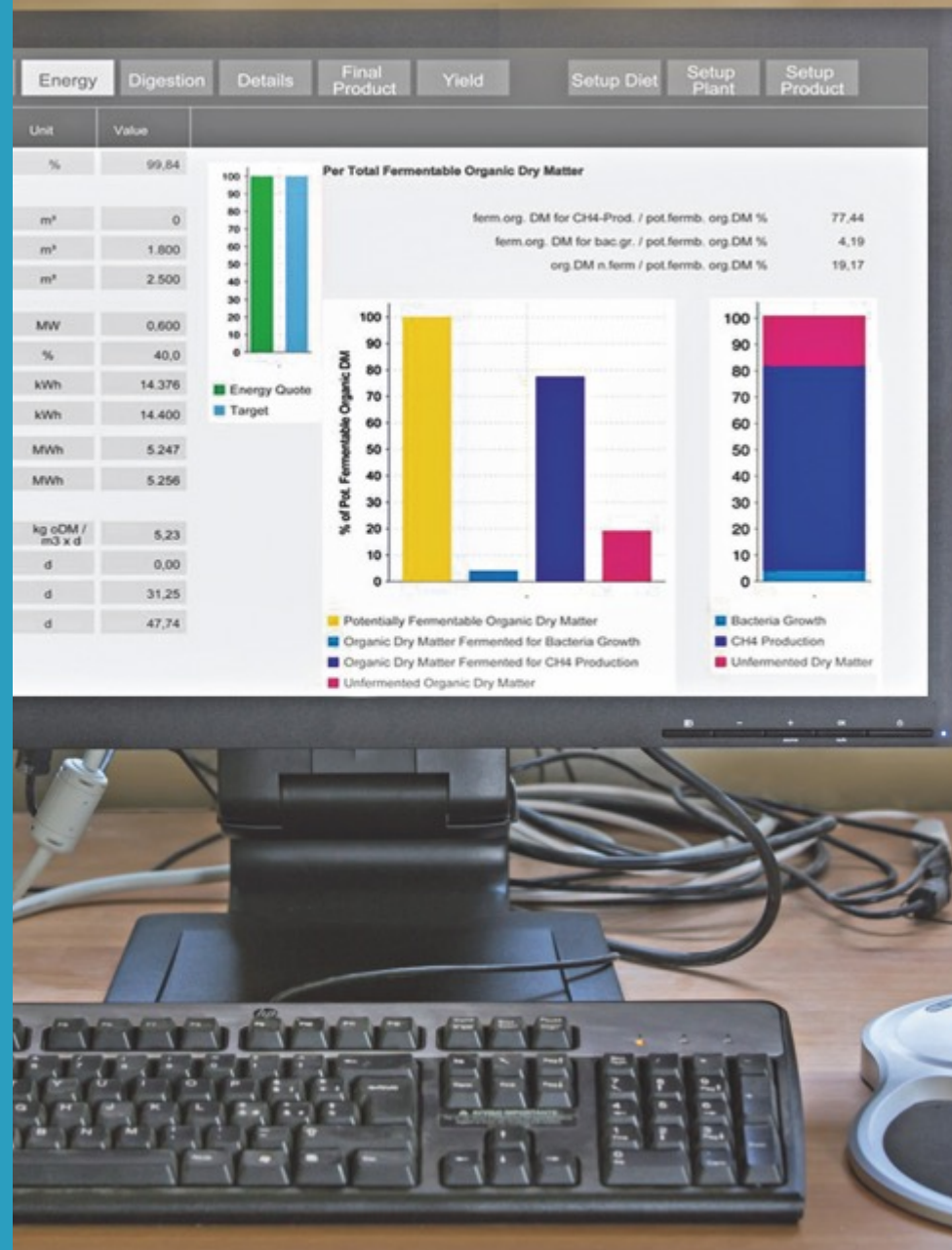
To help Perdue Farms become more environmentally friendly, Bioenergy DevCo plans to build what could be the first large-scale facility on Delmarva that converts poultry manure into energy.

"We're taking their organic material from their plants and making it to better products including renewable natural gas and compost," said Kreloff.

They will use what is called an anaerobic digester at a particular area of the site, where 100,000 tons of manure and other materials will be treated over the course of a year, without emitting nasty odors.

"It's basically a cow's stomach on an industrial scale the same microbes that are in a cow's stomach

CASE STUDIES: EUROPE





SOUTH MILFORD

United Kingdom

SOUTH MILFORD

GENERAL INFORMATION

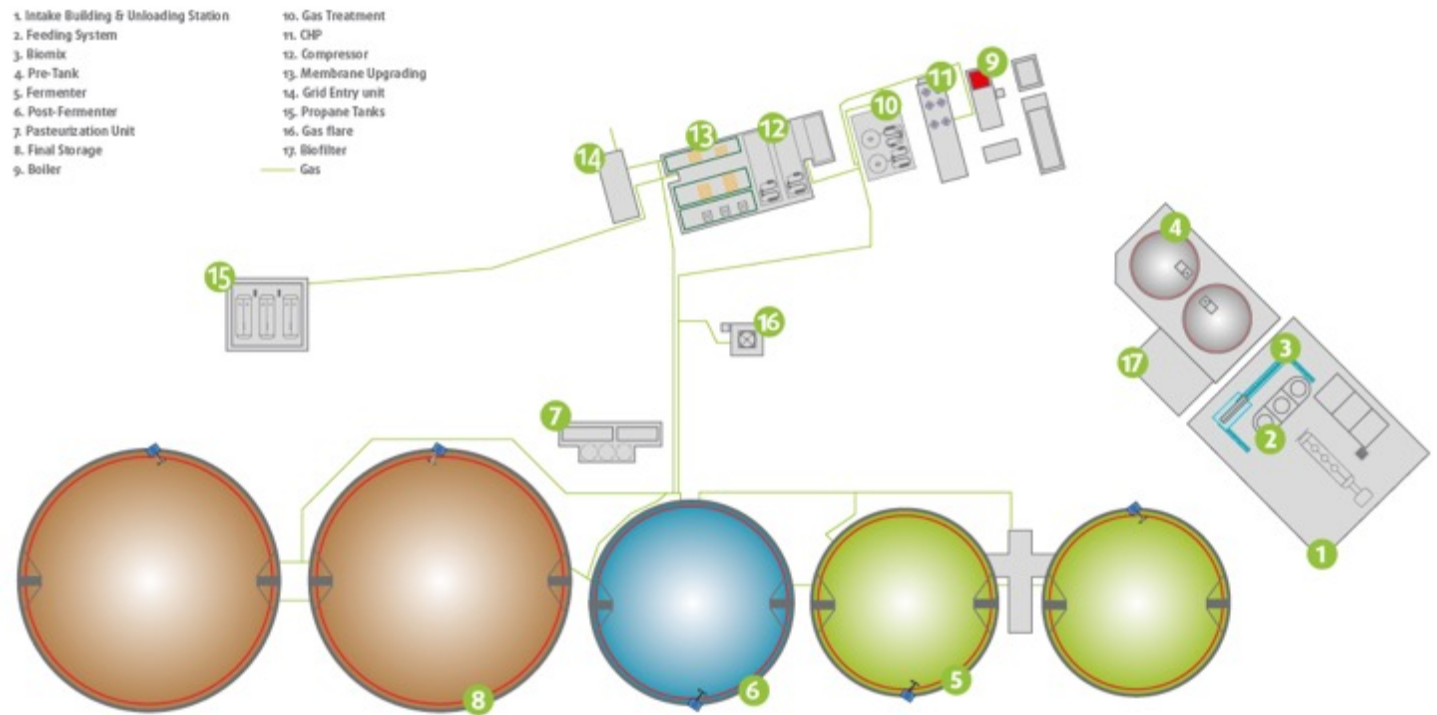
- Start Up: 2016
- Type of Raw Material: 100% organic waste and industrial food processing leftovers
 - 40,000-60,000 t/y liquid food waste
 - 10,000-20,000 t/y solid food waste
 - 10,000 – 20,000 t/y green waste
- Utilization of Biogas
 - Production of Electricity
 - Upgrading for gas grid injection
- Plant Size: 500 kWe – 7,538,000 Sm³/y Biogas
- Heat Utilization: Fermenters heating, upgrading unit, pasteurization
- Utilization of Digestate: Production of 50,000 t/a unpasteurized liquid

Note: All units are Metric.



SOUTH MILFORD

Plant Layout





RIDGE ROAD

United Kingdom

RIDGE ROAD

GENERAL INFORMATION

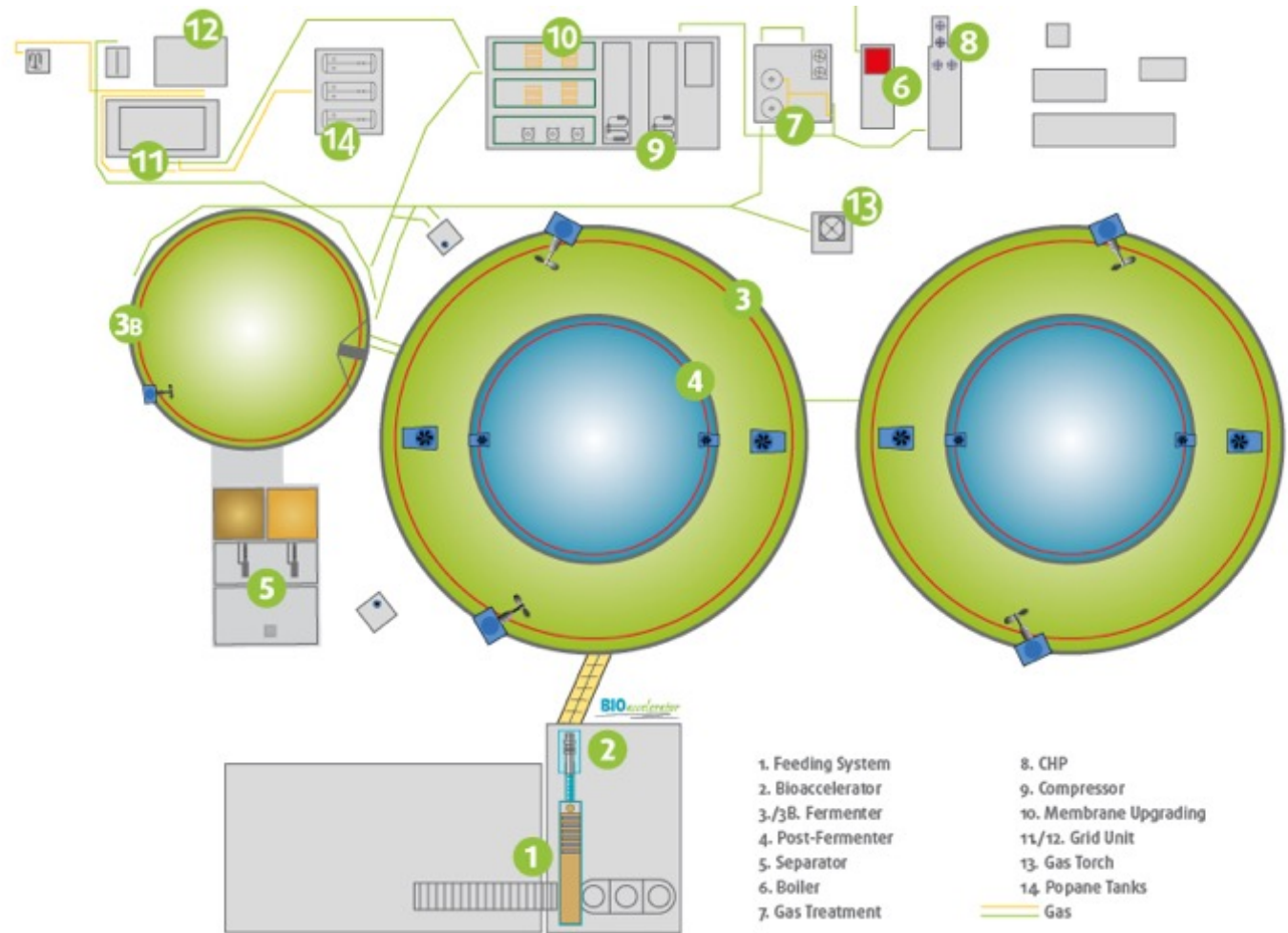
- Start Up: 2016
- Type of Raw Material (total input 53,000 t/y):
 - 20,400 t/y poultry litter
 - 7,548 t/y Rye silage
 - 16,900 t/y sugar beet pulp (silage)
 - 7,500 t/y sugar beet (silage)
 - 51,000 Water
 - 25,500 Recycle
- Utilization of Biogas:
 - Production of electricity
 - Gas grid injection
- Plant Size: 360 kWe – 5,200,000 Sm³/y
- Heat Utilization: Fermenters heating & upgrading unit
- Production of Digestate: 43,000 t/y

Note: All units are Metric.



RIDGE ROAD

Plant Layout





THANK YOU!