

Vendor:
Heartland Renewable Energy, LLC
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Industry:
 Dairy/food waste

Project type:
 Co-Digester

Project goal:
 RNG production
 Food waste utilization
 Solid separation

Date of Case Study:
 August 27, 2016

Heartland Biogas Project – Level 1

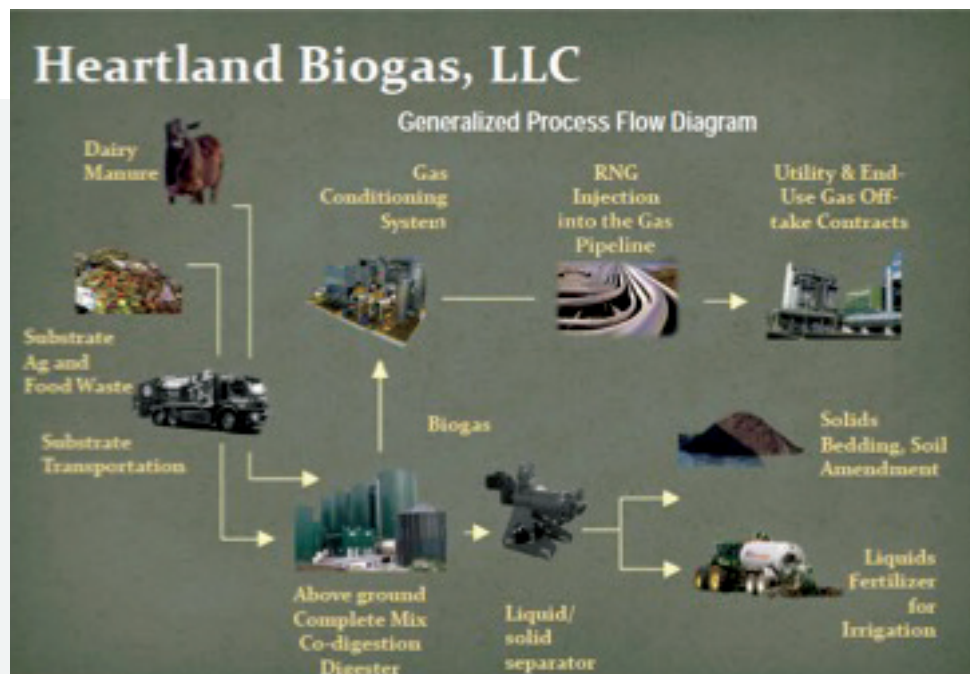
OVERVIEW

The Heartland Biogas Project is owned by EDF Renewable Energy, a wholly owned subsidiary of Électricité de France, a utility company based in France. HDR, Inc. was awarded a contract by Heartland Biogas for design, construction and startup of the biogas facility. The project was developed by AgEnergy USA. AgEnergy USA has retained an interest in the Project through a Net Profit Interest Structure. Construction started in August 2013 and full-scale operations achieved in 2015. The Renewable Natural Gas (RNG) facility, located in Weld County near LaSalle, Colorado, uses an integrated system of six complete mix anaerobic digesters to generate sufficient raw biogas to produce 4,700 MMBtu per day of high quality Renewable Natural Gas (RNG), making it the largest anaerobic digester facility in the United States.

The anaerobic digestion system converts a controlled mixture of 40% dairy cow manure and 60% food waste and other organic waste into raw biogas. The biogas is then processed into pipeline quality Renewable Natural Gas (RNG). The RNG is compressed on-site and injected into the Colorado Interstate Gas pipeline. Sacramento Municipal Utility District (SMUD) in California has a 20-year contract to purchase all of the RNG and associated environmental assets. SMUD uses the gas to produce 28 megawatts of electricity, enough to power 8,500 homes.

The \$100M Heartland Biogas project site is located fifty miles due north of the Denver International Airport on land that was formerly part of Shelton Dairy, the primary manure feedstock supplier to the digester. It is adjacent to the county’s largest grouping of fracking wells.

Flow Diagram



PROJECT OVERVIEW

The Heartland Digester produces Renewable Natural Gas through anaerobic digestion of a mixture of manure and food/organic waste. The facility receives approximately 400,000 gallons of feedstock daily including 180,000 gallons of manure from two local dairies and 200,000 -240,000 gallons of food/organic waste substrate DAF and FOG from local food processing plants, distribution centers, and city food waste collection programs.

Manure — Shelton Dairy, one of Heartland’s suppliers of cow manure, is a 3,000 head dairy adjacent to the project site that uses a combination of scrape, flush, and free-stall manure management techniques. The dairy recently built a new heifer facility that will house an additional 1,000-2,000 head, and that will increase the manure supplied to the project. Manure is also supplied by M&J Dairy that is eight miles North of the site. A total of 180,000 gallons per day of manure at 14% solids is delivered to the project. The manure does not include parlor water.

Food Waste — Currently, the Heartland project receives food waste and organic substrates from a 700-mile collection radius that stretches from Denver, Boulder, and Fort Morgan, CO and into Wyoming. This radius includes the Leprino cheese plant, a 5,000 head per day JBS beef processing plant in Greeley, CO and another similarly sized Cargill plant, three dog food plants (which send off-spec dog food), de-watered grease trap waste from local restaurants (20,000 – 30,000 gallons a day), and other organics. Heartland has a 20-year contract with A-1 Organics to collect, deliver and process organic waste. A-1

Organics owns and operates the on-site food waste processing center. If the Heartland digesters are down or at capacity the food waste is diverted to the Rattler Ridge 430 acre compost facility 10 miles from Heartland that provides back-up capacity.

The food waste received by the facility runs through a Ecoverse Tiger HS640 Food Depackager system, which is an initial processing step to remove all packaging and non-organic material (it can handle any packaging except glass). The system can process 20 tons per hour and currently only runs Monday through Friday one shift a day.

Primary Revenue Streams — The project relies on the sale of natural gas for about 80% of the project’s revenue and sales of compost for about 20% of the revenue. Heartland agreed to supply SMUD up to 7,000 decatherms/day of Renewable Natural Gas.

The production of 300-340 cubic yards/day of fiber is sold as a peat moss replacement to a processor. The fiber replaces the purchase of higher priced peat moss from Canada. This results in savings for both transportation costs and avoided GHG emissions from the mining of peat bogs. The fiber from Heartland has a slightly higher pH than naturally occurring peat moss, so the facility adjusts the pH using the acidic production water discharged from certain process equipment.

Water and Nutrients to Local Famers — The Heartland Digester is a dry climate digester which means the 400,000 gallons of micronutrient- and nitrogen-rich liquid soil amendment produced daily from the digestion and gas production process is a valuable resource to local farmers. Heartland built

Key Highlights:

- The anaerobic digestion system converts a controlled mixture of 40% dairy cow manure and 60% food waste and other organic waste into raw biogas.
- Uses an integrated system of six complete mix anaerobic digesters to generate sufficient raw biogas to produce 4,700 MMBtu per day of high quality Renewable Natural Gas.
- Largest anaerobic digester facility in the United States.



Figure 1. Heartland Biogas Project – Weld County, Colorado.



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a six mile pipeline to carry the water to farms for irrigation reuse. They have 42 M gallons of onsite water storage, 30 M gallons of offsite storage, and another 30 M gallons of storage under construction offsite. The additional storage is needed since the demand for water is variable and based on crop rotation needs and weather.

Six Thermophilic Digesters — At present, six digesters are operating at 129-130°F (131°F is optimal), which is in the thermophilic range.

A thermophilic digester design was selected to reduce retention time and increase throughput. The digesters are heated using natural gas from the pipeline (not the project RNG) at a cost of \$2 MMBtu. Electricity is supplied by Poudre Valley Rural Electric Cooperative, a member of Tri-State Generation and Transmission Cooperative in Denver. The Cooperative built 12 miles of electric distribution lines to provide the necessary power requirements of the Project.

Gas Cleaning — The facility uses three Greenlane Totara Plus wet scrubbers and a deoxo unit to remove excess oxygen from the gas. Once the gas is cleaned, it is run through one of three compressors to generate 4,700 MMBtu per day of pipeline quality compressed natural gas at 1000 psi.

Manure and Food Recipe — The digester uses a precise but changing recipe of food waste and cow manure to achieve optimal gas production. The facility has two 600,000-gallon substrate tanks to separately store the high fat and low fat food waste materials, which are filled directly from the food depackaging system. These tanks then feed two 20,000 gallon dosing tanks which blends the substrate with the manure in appropriate quantities. The mixture remains in the tanks for 10-12 hours, and pulses out periodically. The final mixture is then pumped into one of six 1.7 million gallon internally heated bioreactor tanks (30'x100') that use propeller mixers to facilitate the digestion process.

Solids Separation — Once digestion is complete, the resulting digestate goes through primary solids separation consisting of two Centrysis Centrifuges. The solids (fiber) are removed by putting the digestate through a non-stop Centrysis centrifuge unit. The project has 60% excess centrifuge capacity to handle excess solids.

Class A Facility — The Heartland Biogas Facility is a Class A solid waste facility, which means they need to meet certain contamination prevention standards to maintain operational compliance. To minimize potential contamination from the bioreactors, the six reactors were built on top of a three-layer fused lining consisting of one 60 mil high-density polyethylene (HDPE) layer, a geo-netting (a latticed plastic netting that provides structure to the liner), and a second layer of 60 mil HDPE.

Employees — The facility has 23 full time employees, with 120-140 employees during peak construction. The project uses a host of external consultants to monitor the temperature and pH in the bioreactors and to test daily samples for proper chemical and biological make-up.

Phase I and II — The project is in its first phase of development. The Phase I project is designed to produce 4,700 MMBtu per day of renewable natural gas (4,700 decatherms/day). Phase II of the project will increase daily production to 7,000 MMBtu of RNG.

EDF Energy — The plant is EDF's first biogas digester in the United States. EDF invests about \$2 billion per year in the U.S. energy market, primarily in wind and solar projects. In 2015, EDF installed 7,700 MWs capacity of wind production.

MAIN PROJECT COMPONENTS

- **Substrate and manure off-loading and storage area**
 - Manure pit with dilution and mixing ability
 - Substrate tanks (two) with mixing ability
 - Dosing tanks for proper mixing of manure and substrate before injecting into digesters
- **Six complete mix digesters – 1.7 million gallons each**
 - Main area where methane (renewable natural gas) is produced
 - Raw biogas from anaerobic digesters is produced 24x7
 - The digesters were custom designed and constructed by HDR Engineering
- **Biogas upgrading system converts raw digester gas to pipeline quality gas**
 - Biogas cleaning uses a natural biological sulfur scrubber to remove hydrogen sulfide gas
 - A DeOxo Unit is used for final upgrading of the biogas for pipeline injection

Products:

- Biogas
- RNG
- Peat moss replacement
- Liquid fertilizer



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Figure 2. Eight to ten tanker truckloads daily deliver over 100,000 gallon of manure at 15% solids.

- **Solids separation system to process digester effluent**
 - Centrysis centrifuges are used to separate solids (fiber) from the digestate
 - The solids are composted to make a high value landscape solids material similar to peat moss
- **Covered Anaerobic Lagoon for finishing gas production**
 - The remaining liquid digestate is pumped to an 8.2 million gallon covered lagoon
 - Additional methane is captured under the cover over the lagoon and pumped to the biogas upgrading system
- **All remaining liquid digestate is pumped to two holding ponds and sold as liquid fertilizer**
 - South Lagoon: 28.3 million gallons
 - North Lagoon: 14.5 million gallons

Feedstock (Manure)

- **Dairy Cow Manure**
 - Source: Shelton Dairy and M&J Dairy
 - Volume: 180,000 gallons per day at 14% solids (does not include parlor water)

Feedstock (Food Waste)

- **Food Waste**
 - Food waste is collected from a 70-mile collection radius that stretches from Denver to Boulder and Fort Morgan and into Wyoming. The organics include grease trap waste, off-spec food, low solids (liquid) food, process waste from a meat packaging plant and a large Leprino cheese plant
 - Volume: 200,000 – 240,000 gallons per day at approximately 23% solids
 - Food depackaging is performed on-site as required using a Tiger HS 640 depackager



Figure 3. 200,000 gallons/day of food waste is processed.



Figure 4. A tiger HS 640 is used to de-package food.



Figure 5. Six complete mix digesters - 1.7 million gallons each.



Figure 6. Biogas cleaning and upgrading system.



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Biogas Production and Cleaning

• Biogas Production

- The project generates sufficient raw biogas to produce 4,700 MMBtu of RNG
- A state-of-the-art biogas upgrading system converts raw biogas gas to pipeline quality RNG
- The clean biogas is compressed and injected into the Colorado Interstate Gas pipeline

Solid Byproducts

• Solids Production and Usage

- 340+ cubic yards produced per day is composted on site
- Marketed by a third party as a high end soil amendment

Liquid Byproducts

• Digestate

- 217,000 gallons per day of liquid digestate fertilizer (nitrogen and phosphorus)
- Stored in lagoons that provide up to six months of storage
- Marketed and used as a fertilizer for local crops

On-Site Water Usage

• Dilution Water

- Recycled effluent: 165,000 gallons per day
- Fresh water use: 50,000 gallons per day

• Recycled Water is pumped into manure receiving pits for mixing and dilution

• Recycled water is pumped into food waste receiving tanks for dilution, chopping and mixing

• Manure and Substrate are mixed together as appropriate for digestion in dosing tanks

• Manure and Food Waste slurries and water are pumped to the dosing tank to supply the six digester tanks using a formula to maximize gas production

Environmental Attributes

• Ecosystem Benefits

- Prevents methane emissions from landfilling waste and dairy lagoon storage of manure
- Displaces fossil fuel use from electricity generation
- Displaces fossil fuel used from fertilizer application (digestate and solids are used for soil amendment)
- GHG offsets: 64,000 metric tonnes CO₂ equivalent captured as methane in digesters

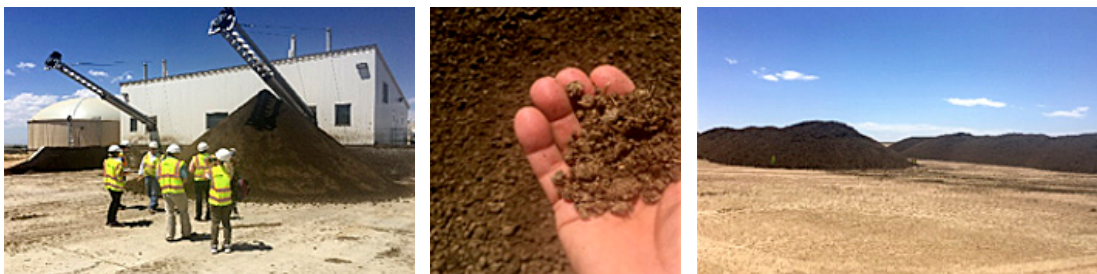


Figure 7. 340 cubic yards per day of peat moss replacement. Compost is produced and sold regionally.



Figure 8. One of two liquid byproducts holding ponds. Total on-site capacity 42.8 M gallons.



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- **Beneficial Byproducts**
 - Produces a valuable solids by-product
 - Produces a valuable liquid digestate used for fertilizer/irrigation
 - Reduces runoff problems from stockpiling food wastes and manure at the dairies
 - Reduces odors and destroys pathogens
- **Energy Production**
 - The renewable natural biogas will produce 20 MWs of power
- **Nutrients**
 - Recycles N and P to soils in the region of the facility
 - Digestate introduces healthy microbes to soils which improves soil quality and plant growth
 - Reduces organic solids content of waste and COD strength in byproducts by 80%

Heartland Biogas Project–Level 1 Project by the Numbers

Location type	Dairy
Herd size	Currently 3,000, will add another 1,000-2,000 head Also handles 200,000-240,000 gallons of local food waste
Type of digester system	Complete mix digesters
Digester capacity	Six digesters, 1,700,000 gallons each
Manure collection method	Combination of scraping, flushing and free-stall manure management techniques
Biogas production	4,700 MMBtu of RNG
Installed electrical generation (kW)	NA, SMUD uses the biogas to generate electricity
Ownership (farmer-owned, third party, cooperative)	EDF Renewable Energy
Digester designer	Design — HDR, Inc. Development — AgEnergy USA
Date operational	2015
Engine brand	NA
Solids use (manure, organic waste)	Manure and organic food waste
Final Products	Biogas, RNG, peat moss replacement, liquid fertilizer

For more information about Heartland Renewable Energy, LLC, or to join our mailing list, email info@newtrientllc.com.

Newtrient’s mission is to help all dairy farmers reduce the environmental footprint of manure while enhancing their economic opportunities and their social license to operate. The information contained in this case study was developed with the cooperation of the organizations involved and Newtrient has endeavoured to make sure it is accurate and complete as possible.



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