



Finley Buttes Regional Landfill

4.8 MW Landfill Gas Combined Heat and Power Plant

Project Overview

The Finley Buttes Landfill Gas to Energy facility is located ten miles south of Boardman, Oregon at the Finley Buttes Regional Landfill (FBRL). The landfill, which began operations in 1991, is owned and operated by Waste Connections, Inc. (WCI), and receives over 500,000 tons of municipal solid waste annually. FBRL is the second largest landfill (1,800 acres) in the state of Oregon.

Currently, there are approximately 71 acres of municipal solid waste in-place with an average depth of ± 100 feet. The landfill gas (LFG) collection and control system is made up of 57 vertical extraction wells and a high-density polyethylene (HDPE) piping network to a blower/flare station. The blower station provides vacuum to the well field for LFG collection, and the flare is used for thermal destruction of the LFG.

The combined heat and power (CHP) plant draws methane gas from the wells to fuel three internal combustion engines that power electrical generators. As the engines burn methane to produce power, they also produce two sources of heat: Recaptured heat from the engines' water cooling system and heat from the exhaust stacks. This heat is used to send water at about 234°F to Cascade Specialties, an adjacent onion and garlic dehydration plant.

Quick Facts

TYPE OF INDUSTRY: Landfill Gas to Energy

LOCATION: Boardman, OR

TYPE OF SYSTEM: Landfill gas combined heat and power

PRIME MOVER: Caterpillar 1.6 MW 3520 Gen-set (3 gen-sets)

ELEC. GENERATING CAP: 4.8 MW

AVG. ELECTRIC LOAD: 4.8 MW

AVG. THERMAL LOAD: 100 therms/hr of 234°F heat

FUEL: Landfill gas/methane (from municipal solid waste)

USE OF THERMAL ENERGY: Heat for adjacent onion and garlic dehydration facility (Cascade Specialties, Inc.)

SYSTEM EFFICIENCY: ~ 70 – 80% (43% electricity)

CAPACITY FACTOR: ~ 59% (Based on production of 25⁺⁶ kWh/yr)

EMISSIONS OFFSET (tons/yr): CO₂e – 14,795; CO – 111.7; NO_x – 15.1; NMOC/VOC – 22.9 (see table on pg 3)

ENVIRONMENTAL BENEFITS: Helps meet Renewable Portfolio Standard (RPS) requirements for renewable energy and EPA's New Source Performance Standards (NSPS) requirements for greenhouse gas reductions

INSTALLED COST: \$9.7 million

SIMPLE PAYBACK: 4 years

OPERATION START: December 2007

Reasons for Installing CHP

By the late 1990s, Finley Buttes Landfill was in need of expansion. Until their expansion in 2004 the landfill owners were flaring the landfill gas. The expansion, however, put them in the "large" landfill category under EPA's landfill guidelines (NSPS and Emission Guideline Fact Sheet – 40 CFR 60), which meant that the landfill owners were now required to either install a gas collection system for controlling the emissions or prove that the landfill emits less than 50 Mg per year of non-methane organic compounds. WCI chose to install a gas collection system.

Controlling emissions involves drilling collection wells and routing the gas to a suitable energy recovery system or combustion device. Finley BioEnergy was formed through an agreement with WCI to manage the Finley Buttes LFG liability by utilizing the LFG as an asset.

Main components of the CHP landfill gas system

- Three 1.6 MW Caterpillar gen-sets, Model #3520C (with internal combustion engine). This model was chosen because it was designed to handle dirty gas and can burn low Btu gas.
- Three Cain exhaust heat recovery units, Model # HRSR-348D26SSS
- Three Ameridex flat plate heat exchangers, Model #X-55-83



Caterpillar gen-set



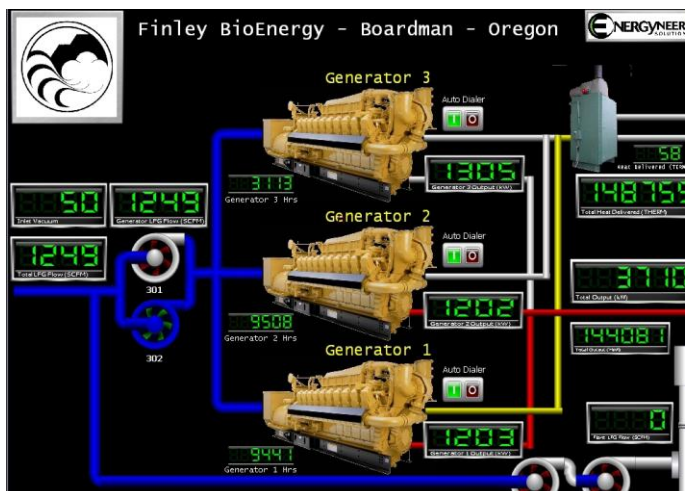
Cain exhaust heat recovery equipment

Fuel receiving system

- Gas is collected through 57 wells and transported through a 3–4 mile pipeline to the gen-set (approx. 5 psi)



Installing vertical well



Finley Bioenergy CHP system configuration

Latest generation gen-sets designed for landfill gas

Landfill energy projects have come a long way since the 1970s when it was a challenge to generate reliable electricity at a competitive cost. Reciprocating engines that were used to generate power proved vulnerable to contaminants inherent in landfill gas. Hydrogen sulfide and halides combine with water inside the engine to form weak acids that corrode components. Traces of siloxanes from products like detergents, shampoos and cosmetics create silicon dioxide deposits on spark plugs and cylinder components, diminishing engine efficiency.

To address these issues, the U.S. Department of Energy's Advanced Reciprocating Engine Systems (ARES) program launched an intense national effort to increase gas-fueled reciprocating engine efficiency. The latest-generation gas engines are now capable of 43 percent mechanical efficiency. Maintenance costs are 40 percent lower per kWh than for traditional landfill gas engines.

Landfill gas versions are designed to resist corrosion and to deliver the maximum performance from low-Btu fuels. Changes include the use of non-corrosive metals in strategic wear areas, elevated jacket water temperatures to prevent condensation of caustics, enhanced crankcase ventilation to remove caustics from the system, and modifications to enhance fuel flow and enable full-rated power production on low and variable-Btu gases.

This model for the landfill industry is a 20-cylinder unit. There are two configurations: a 60 Hz model that operates at 1200 rpm, delivers 1600 kW of capacity, and produces between 0.5 and 1.0 g/bhp-hr NO_x) and a 50 Hz model (that operates at 1500 rpm, delivers 1950 kW, and produces between 250 and 500 mg/Nm³ NO_x). Both are capable of meeting existing *or expected* future landfill NO_x emission regulations *anywhere* in the world.

(Source: White Paper presented at SWANA's 27th Landfill Gas Symposium, March 22-25, 2004, Michael Devine)

Environmental Profile

- Reduced greenhouse gas emissions
- Increased renewable energy to the grid
- Energy-efficient technology (CHP)

ON-SITE EMISSIONS FROM THE 3 GEN-SETS (tons/yr) (Source test results, pg. 10, OR Dept. of Environmental Quality, Title 5 Operating Permit, Review Report)				
	CO	CO₂e	NO_x	NMOC/VOC (propane)
Based on 5207 hrs/yr of full-load operation (capacity factor = 59%) Note: flare emissions info. unknown	111.7		15.1	22.9
EMISSIONS OFFSET				
Electricity (to the grid) (based on a typical natural gas combined cycle plant, with a heat rate of 7200 Btus/kWh, that Finley Bioenergy would replace)		10,525		
Natural gas (reduction of 25-30% by Cascade Specialties for onion dehydration facility, from 1000 MMBtus/day to 700 MMBtus/day)		4270		

Unique Attributes of the Project

- Overcame utility barriers: location was between two different interconnection points
- New use of technology: interface and heat transfer media (glycol/water solution)
- Learned about daily scheduling of power and transmission
- CHP wheeling

Project Benefits

- Revenue from electricity sold to PacifiCorp and thermal heat sold to Cascade Specialties
- Beneficial use of landfill gas
- Potential sale of green tags and carbon credits
- Energy savings to Cascade Specialties, Inc. (purchaser of the supplemental heat) Cascade has reduced their natural gas usage by 25 – 30% (from 1000 MMBtus/day to 700) during their eight-month season.

Financial Analysis

Total installed cost: \$9.7 million

Payback period: 4 years

Project capital

- 70% loan
- Owner/partners (Finley Bioenergy)
- Tax-free Oregon State Bonds

Financial incentives

- Tax credits
- Renewable Energy Certificates (RECs)
- Oregon Business Energy Tax Credits (BETC)

Revenue streams

- Sales of heat and electricity
 - Finley BioEnergy sells 25 million kWh/yr. (contracted for 27 million kWh/yr.) to utility (PacifiCorp)

Power Purchase Agreement (PPA)

Length of PPA: 15 yrs (2007 – 2022)

Power Purchase Contract electric rate:

Peak = \$.71/kWh

Non-peak = \$.65/kWh

- Finley BioEnergy sells approximately 45,000 therms/mo. to Cascade Specialties during their 8-mo. processing season

Collaborative Business Arrangement

The project was a successful collaboration between several organizations:

- Waste Connections, Inc. (WCI) manages the Finley Buttes landfill gas liability (LFG) by utilizing the LFG as an asset.
- PacifiCorp handled the interconnection (power is wheeled through Umatilla Electric Coop to Boardman BPA, then to Troutdale, Oregon to the BPA/PacifiCorp station).
- ENERGYneering Solutions, Inc. assisted in initial design of the CHP system.
- Cascade Specialties, Inc. purchases the heat from Finley Bioenergy.

Partner Profiles

WCI

Integrated solid waste service company. WCI provides solid waste collection, transfer, disposal, and recycling services in mostly secondary markets.

PacifiCorp

Investor-owned utility based in Portland, Oregon. PacifiCorp is one of the West's leading utilities, serving approximately 1.7 million customers in six western states. Its generating plants have a net capacity of 9,286 megawatts. PacifiCorp has 15,700 miles of transmission line, 61,085 miles of distribution line, and more than 900 substations and 68 generating plants across the West.

ENERGYneering Solutions, Inc.

Designer of turn-key gas-to-energy systems

Cascade Specialties, Inc.

Produces dehydrated onion and garlic products

Lessons to Share

- It took two years to learn how to recover heat from both the jacket water and exhaust stack, as well as how to automate it to perform reliably.
- Information about financing coordination and options and tax credits is available from Oregon Department of Energy.
- Utility barriers: The project was held up because the plant is located between two separate interconnection points (Umatilla Electric Coop and PacifiCorp). This meant two different pricing structures (how power would be delivered and who would accept it).

For More Information

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