



# Crave Brothers Farm

## 633 kW Biogas CHP System

### Project Overview

In April 2009, Crave Brothers Farm, located in Waterloo, Wisconsin, began the operation of a 633 kilowatt combined heat and power (CHP) system operating on anaerobic digester gas supplied by a Clear Horizons digester from cow manure. At the core of the CHP system is a single GE Jenbacher engine generator with exhaust heat recovery equipment. The excess electricity generated by the CHP system is sold directly to We Energies. The recovered heat from the engine generator is used to maintain the temperature of the anaerobic digesters as well as provide heating and hot water for the farm's buildings. The total project cost of the CHP system was \$1.2 million.

### Background

An anaerobic digester was originally installed, owned, operated, and maintained at Crave Brothers Farm by Clear Horizons LLC, headquartered out of Milwaukee, Wisconsin beginning in 2007. It was installed to assist in the reduction of animal waste problems associated with manure disposal on farms, odor reduction, and the potential revenue benefit resulting from expanding the farm's milking operation, without the need of expanding land. Without more land to spread the increased manure, the farm would not have been able to add to their existing herd. By partnering with Clear Horizons, the capital that would have been spent for more land or expanding the digester system could be used toward additional cattle and barns.

In 2007, Clear Horizons completed the first phase of the two phase project consisting of one digester and a 230kW engine CHP system. This system processed manure from the farm's 750 Holstein cows as well as cheese whey from the adjoining cheese plant. Following early operations of the system, Clear Horizons realized they had more biogas to utilize than was initially anticipated. With the opportunity for expansion, Clear Horizons embarked on the second phase of the anaerobic digester project in 2009 as the farm increased their herd to 1,600 head of livestock and installed an additional anaerobic digester, thereby doubling the biogas output of the plant. The existing 230 kW engine was replaced with a 633kW GE Jenbacher engine generator set to accommodate the additional biogas production.

### Quick Facts

**LOCATION:** Waterloo, Wisconsin  
**MARKET SECTOR:** Agriculture & Food Processing  
**FACILITY SIZE:** 1,600 head of livestock  
**CHP GENERATING CAPACITY:** 633 kilowatts  
**EQUIPMENT:** GE Jenbacher JMC312  
**FUEL:** Anaerobic Digester Biogas (~55% CH<sub>4</sub>)  
**HEAT RECOVERY SOURCE:** Oil, Jacket, Intercooler, Exhaust  
**HEAT RECOVERY Rate:** 2,530 MMBtu/hr hot water  
**CHP TOTAL EFFICIENCY:** 82.7 %  
 (elec ~ 38.1%, thermal ~ 44.6%)  
**TOTAL PROJECT COST:** \$1.2 Million  
**YEARLY ENERGY SAVINGS:** \$250K to \$300K  
**BEGAN OPERATION:** 2009  
**RUN TIME:** 8,760 hrs/yr



**Crave Brothers Farm**

PHOTO COURTESY OF CRAVE BROTHERS FARM

Prior to the CHP system installations, the waste produced on the farm was stored in an open lagoon. This system released harmful methane gas into the atmosphere. Today, the anaerobic digester prevents this release of harmful greenhouse gas emissions, equivalent to 7,125 tons of carbon dioxide annually.

## The Waste to Energy Processes

Each day Crave Brothers Farm produces 50,000 gallons of animal waste from the livestock and whey from the cheese plant operations. All of this waste is pumped into the two, 750,000 gallon digester tanks, without any pretreatment.

Additionally, approximately 15,000 gallons of substrates are added into the mix per week. Among the used substrates are FOGs (fats, oils, and greases). The waste is mixed and heated to 100°F to aid in the digestion process. From the digestion process, an anaerobic digester gas (biogas) is produced for use in the CHP genset, which produces clean electricity sold to the local utility. The engine is run continuously throughout the year. By providing the utility with electricity generated from a clean, renewable resource, Clear Horizons and Crave Brothers Farm displace the fossil fuel used to generate electricity by the utility power plants, and therefore displace harmful greenhouse gas emissions. The electricity they produce is enough to power 550 Wisconsin homes annually.



**Crave Brothers Farm's Digester Tank**  
PHOTO COURTESY OF ENERGY RESOURCES CENTER

The electric generation process produces heat that would be wasted if not for the heat recovery system included with system application. The recovered heat is purchased by Crave Brothers Farm from Clear Horizons to supplement the farm's hot water production as well as

for heating the office, shop, special needs barn, parlor and nursery. The heat is also utilized by the digesters, to maintain the required operating temperature at 100°F.

## Partnership between Crave Brothers Farm and Clear Horizons

Crave Brothers Farm and Clear Horizons hold a 10 year contract for this partnership. Clear Horizons LLC installed, owns and operates the biogas-to-energy system located at Crave Brothers Farm. The anaerobic digester/ CHP system was paid for by Clear Horizons and they own the rights to the carbon credits and byproducts produced by the digesters, including the, solids and the generated electricity produced by the CHP system. Crave Brothers Farm buys back the solids for cattle bedding, and

the heat captured by the CHP heat recovery system to provide useful heat to the farm

processes. The farm retains the liquid effluent for a nutrient rich land fertilizer. Clear Horizons sells the generated electricity to the local utility and sells a portion of the solids that is not utilized by Crave Brothers Farms as a potting mix to area landscapers.

*"One of the main reasons we went with the CHP system is because it was a containerized package - completely engineered from incoming gas lines to exhaust heat recovery."*

*- Karl Crave, Clear Horizons LLC*



**Bedding Byproduct Storage**  
PHOTO COURTESY OF ENERGY RESOURCES CENTER

## For More Information

### U.S. DOE MIDWEST CHP TECHNICAL ASSISTANCE PARTNERSHIP

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The Midwest CHP TAP is a U.S. DOE sponsored program managed by the Energy Resources Center located at the University of Illinois of Chicago.