



Colorado Pork

115-kW Renewable CHP Application

Site Description

Colorado Pork LLC is a concentrated animal feeding operation (CAFO) with 6,300 sows, located near the town of Lamar in southeastern Colorado. The site was constructed in 1999, and was built to be an energy- and water-efficient operation. Colorado Pork is an EPA AgStar partner, and also works closely with the Colorado Governor's Office of Energy Management and Conservation to field-test new waste management, biogas, and CHP processes.

Reasons for CHP

Energy bill savings was one of the key reasons for installing CHP. Colorado Pork installed energy efficiency measures at the same time as the CHP. Colorado Pork pays approx \$3,500 for electricity per month, while other local hog CAFOs of equivalent size pay \$10,000-\$11,000 per month. Demonstrating that anaerobic digestion could be used to meet Colorado's Amendment 14 odor and water quality regulations was another driver for the project.

More broadly, Colorado Pork had a desire to implement cutting-edge waste management technology at their facility. The anaerobic digester was the first installed in Colorado and one of only 30 in the U.S. at the time. The microturbine at Colorado Pork was the first in the world to run on biogas at a hog farm, and only the third in the world to run at any type of agricultural setting. The microturbine was mainly installed to evaluate its feasibility and economics, and compare it to the engine-based system.



The anaerobic digester at Colorado Pork

Quick Facts

EQUIPMENT: 500,000-gallon complete mix anaerobic digester, 85-kW Caterpillar engine with heat recovery, 30-kW Capstone microturbine with heat recovery

FUEL: Biogas produced from hog waste

COST OF DIGESTER: \$242,000

COST OF ENGINE & HEAT RECOVERY: \$146,000

TOTAL PROJECT COST: \$388,000

GRANT FROM EPA AGSTAR: \$75,000

ANNUAL ENERGY BILL SAVINGS: \$25,000-\$40,000

ANNUAL LAGOON CLEAN-OUT SAVINGS: \$10,000

SIMPLE PAYBACK: 6-9 years

HOG FARM SIZE: 6,300 sows, 18,000 to 20,000 gallons/day of manure

FACILITY LOAD: 100-196 kW

CHP IN OPERATION SINCE: 2000 (engine) and 2002 (microturbine)

FUTURE PLANS: 55-kW Stirling engine, bio-accelerant to increase biogas production

ENVIRONMENTAL BENEFITS: Reduced odor, pathogens, water pollution, methane emissions, and fossil fuel use

CHP System Equipment & Configuration

A CHP system designed by Martin Machinery, consisting of an 85-kW Caterpillar engine with a Thermal Finned Tube heat recovery unit, began operation in 2000. The engine is a natural gas design modified to run on biogas. The biogas going to the engine is not conditioned (i.e. no moisture or sulfur removal), so the engine lubrication oil is changed every 10 days as a precautionary measure.

A 30-kW Capstone microturbine came online in 2002 – the first microturbine to run on biogas at a hog farm, and only the third in the world to run at an agricultural setting. The microturbine system includes a CompAir HydroVane gas compressor to boost the pressure of the gas, and a heat recovery system from Cain Industries. To remove moisture from the biogas, it goes through a desiccant dryer (prior to the compressor) and then a water knock-out canister and refrigerated dryer (after the compressor and before the microturbine).

Additional facts:

- If neither the engine or turbine are operating, or if too much gas builds up under the digester hood, the biogas is automatically diverted to a flare.
- Recovered heat from both the engine and microturbine is used to maintain the digester temperature at about 100°F, via a hot water loop circulated through the digester waste. No supplemental heat is needed for the digester.
- Both the engine and microturbine systems are grid-paralleled, but do not export power. On rare occasions when the power generated exceeds farm demand, a reverse power relay (required by the utility) throttles down the engine.
- The facility has a backup generator to supplement the CHP system in the event of a grid power failure.



The CHP system at Colorado Pork: Capstone microturbine (far left), Caterpillar engine (far right) and balance of plant

CHP Operation

The site doesn't have enough biogas production to run both systems at full capacity. Typically, the engine is run at 60 kW and then switched to run on natural gas overnight, to avoid reducing biogas pressure and collapsing the digester cover. The microturbine is set to run continuously, typically producing 22 to 24 kW (minus the small parasitic load of the compressor).

The farm's electric load is between 100 and 196 kW, so the remainder of the electricity is provided by Southeast Colorado Power Association, a rural electric cooperative.

The CHP equipment was oversized (in relation to the amount of available biogas) because the farm thought it would receive additional waste from a nearby farm, which didn't work out. Future increases in biogas production rates and potential agreement with the local utility to export power may result in higher electrical power generated. The excess heat could then be used to meet space heating and domestic hot water needs at the farm, offsetting natural gas purchases.

For More Information

For a video on this installation, visit http://www.state.co.us/oemc/programs/agriculture/hog_wastes/video.htm

For detailed reports on this installation, visit:

<http://www.sri-rtp.com/CO-Pork-VR-turbine-final.pdf>

<http://www.sri-rtp.com/CO-Pork-VR-engine-final.pdf>

http://www.state.co.us/oemc/biomass/reports/1186%20Final%20Report%20v1.5_August%2025%202003.pdf

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More Case Studies: www.intermountainCHP.org/casestudies

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