



Joseph Gallo Farms Dairy

700 kW reciprocating CHP System

Site Description

Joseph Gallo Farms, founded in 1979, accommodates 16,000 dairy cows across five dairies in Merced County.

Project Profile

About 5,000 of the cows are at the Cottonwood Dairy. Each cow produces about 120 lbs (54 kg) of liquid and solid waste per day, which can result in serious environmental problems. Authorities are struggling with the air and water pollution consequences and are searching for solutions. One can be the installation of an anaerobic digester to produce biogas from manure and allow electricity generation. In 2004 a 44,225,000 gallon (167,400 m³) lagoon digester with 7 acre surface area (28,000 m²) in combination with a 300-kW Caterpillar 3412 reciprocating engine were installed at the Cottonwood site.

The digester produces up to 300,000 cubic feet/day (8,500 m³/d), but only 130,000 cubic feet/day (3,700 m³/d) are used by the 300-kW Caterpillar engine. To avoid flaring or releasing the remaining fuel to the atmosphere, Josephs Gallo Farms installed a second, 400-kW reciprocating engine in February 2006. With these two engines the system produces 5.6 GWh electricity onsite every year. Furthermore, the Cottonwood dairy also houses a cheese plant that processes around 900,000 lbs (408,000 kg) milk per day. Methane production is accelerated by the addition of warm plant clean up water to the digester.

The new 700-kW CHP system, which also uses waste heat for the cheese plant, can offset 55% of the utility-provided electricity (the peak load of the dairy is around 1.6 MW). The exhaust waste heat is used to produce steam for pasteurizing and sterilizing. Additionally, heat from the engine jacket coolant may be used in the future to preheat air for whey drier.

The dairy operates the entire digester system on its own at a maintenance cost of roughly \$150,000 per year. This includes H₂S scrubber materials replacement, weekly electrical equipment and pump motor checks, as well as major engine overhauls every 16,000 hours. Furthermore, the dairy has to change the engine oil every 500 hours and has to perform engine tune ups every 1,000 hours.

Quick Facts

LOCATION: Atwater, California
MARKET SECTOR: Dairy Farm Development
TOTAL PROJECT COST: \$3.2 Million (including the 400 kW upgrade in February 2006)
PAYBACK PERIOD: 3 to 4 years (without incentives)
MONTHLY ENERGY BILL SAVINGS: Varies depending on price of gas
EQUIPMENT: 300kW Caterpillar 3412 and 400 kW Caterpillar G399 reciprocating engine generators
FUEL: Digester gas (methane)
USE OF THERMAL ENERGY: Process steam for cheese making and heat for digester
FACILITY SIZE: 7 Acres
FACILITY PEAK LOAD: 2 MW
FACILITY AVERAGE LOAD: 1.3 MW
CHP IN OPERATION SINCE: 2007

Costs & Financial Incentives

Unlike traditional lagoons that emit methane directly into the atmosphere, digesters capture these emissions. This is very important because of the high methane content of the released gas. Methane is about 20 times more potent as a greenhouse gas than CO₂.

“Steep construction and maintenance costs along with bureaucratic hurdles and conflicts with utility providers have prevented many interested dairies from building biogas operations.” *Mike Marsh, CEO of Modesto-based Western United Dairymen*

Originally, the total project cost was projected at \$1,290,000. However, because of higher than expected costs for the manure collection, manure separation, and gas treatment systems, and for the grid interconnection, the final project costs were \$2,700,000 (without the later 400 kW upgrade). To mitigate these costs the farm received a buy-down grant of \$600,000 from the California Dairy Power Production Program (DPPP) as well as \$238,000 from the CA Self-Generation Incentive Program. Joseph Gallo Farms has also applied for a \$400,000 grant for the new 400 kW engine. The purpose

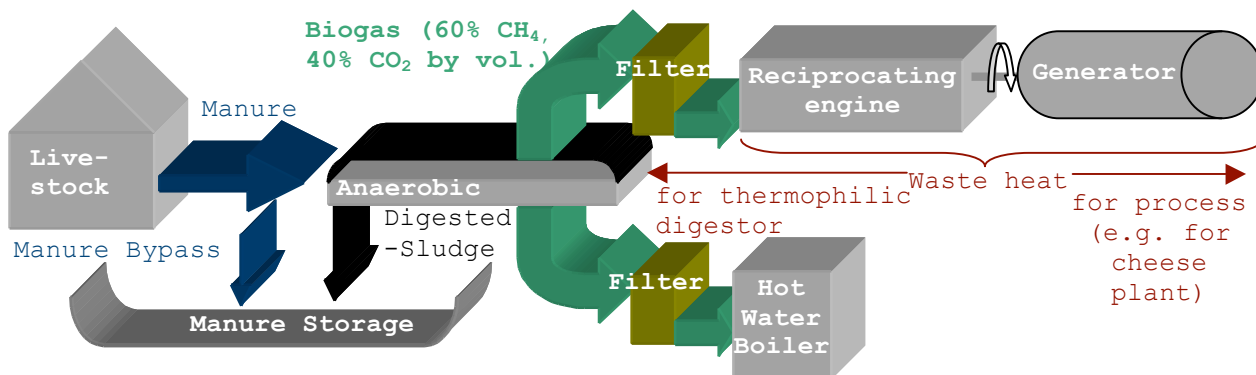
of the DPPP program was to stimulate the installation of biologically-based anaerobic digesters for gasification and biogas electricity generation. This program – which expired in March 2004 – contained two types of grants: a) an investment subsidy, which covered up to 50% of the system capital costs, and b) a production incentive of 5.7 cents per kWh of electricity produced.

Schematic of an Anaerobic Digester System (e.g. Dairy)



- Pictures left:**
- 1- 400 kW reciprocating engine
 - 2- The 7 acre digester cover

Biogas roughly consists of 60% methane (CH₄) and 40% carbon dioxide (CO₂) and is produced by bacteria in the absence of oxygen in a covered, impermeable anaerobic digester. Almost any organic material can be processed in this manner, e.g. leftover food, waste paper, grass, etc. Two major processes are available: a) *mesophilic*, which takes place at ambient temperatures between 68°F (20°C) and 104°F (40°C) and b) *accelerated thermophilic*, which needs waste heat to increase the process heat up to 158°F (70°C). With such an anaerobic digester, a lactating dairy cow can generate enough biogas to generate approximately 2.5 kWh electricity every day. However, very important for a well-functioning system is the H₂S scrubber (filter). This reduces the corrosive hydrogen sulfide content in the biogas, which would otherwise reduce the engine lifetime.



For More Information

Joseph Gallo Farms:

<http://www.josephfarms.com/>

DDP: <http://www.wurdco.com/index.htm>

Self-Generation Incentive Program:

www.pge.com/suppliers_purchasing/new_generator/incentive/index.html

Methane (Biogas) from Anaerobic Digesters:

http://web.archive.org/web/20041124201613/www.eere.energy.gov/consumerinfo/factsheets/a_b5.html?print

Additional Pacific Projects Profiles:

<http://www.pacificcleanenergy.org/>

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U.S. DOE Pacific Region Clean Energy Application Center

Tim Lipman

2150 Allston Way, Suite 280

Berkeley, CA 94704

510-642-4501

telipman@berkeley.edu

