



Essex Junction WWTF

60 kW CHP Application

Project Profile

combined heat & power in wastewater treatment



The MicoGen heat recovery system

Quick Facts

Location:

Essex Junction, Vermont

Installation Date:

October 2003

CHP Equipment:

Two 30-kW dual-fuel Capstone C-30
Micro-turbines
MicoGen MG2C2 heat Recovery system

Type of Fuel:

Self-generated methane gas; natural gas

Winter and Summer Heat Recovery Application:

Heating of anaerobic digester (process)

System Efficiency:

> 80%

Annual Energy Savings:

412,000 kWh per year (36%)

Project Cost:

\$303,000

Simple Payback:

7 years

Project Overview

Until 2003, the Essex Junction wastewater treatment facility used half the waste methane gas produced by its anaerobic digester to fire the boiler that heated the digester. (Anaerobic digestion stabilizes wastewater sludge, reduces sludge volume, and eliminates pathogens.) The remaining waste methane gas was flared, because methane is a greenhouse gas that is 20 times as effective at trapping heat as carbon dioxide, the gas produced when methane is burned.

Although facility officials had been interested in combined heat and power since 1992, high initial costs failed to satisfy the requirement of the facility's governing board, that all projects have a simple payback of no more than seven years. Furthermore, it was unclear whether sufficient digester temperatures could be maintained when methane was used to fire a CHP system. The system was also required to emit no more pollutants than flaring methane did.

In order to satisfy the payback period requirement, the facility was able to obtain additional funding from Efficiency Vermont, The Biomass Energy Resource Center, NativeEnergy and the U.S. Department of Energy. While the local utility was supportive of the project, it was unable to offer financial support.

Essex Junction used Northern Power to design its system, which uses micro-turbines that can run on either methane or natural gas. The fuel system runs the two fuels in parallel, but methane gas is the priority fuel. Natural gas can be added, in continuously variable blends, through a mixing control valve.

"Northern Power Systems has developed a customized a control system that has worked very well and reliably for us," said James L. Jutras, Director Public Works/Wastewater Treatment.



Dual alternating CompAir V07G compressors

Challenges

After the CHP system was installed, the power factor has dropped from 96 to 87. An investigation revealed that because the CHP system produces only real – rather than reactive - power, it changes the dynamics of the site grid. Plant officials are still studying the problem, Jutras said.

Also, because the digester methane gas is saturated with water, maintenance on the methane compressors has proven to be more difficult and costly than anticipated. The facility is upgrading its equipment, to maximize moisture removal. Officials hope this will significantly reduce the potential for further moisture problems.

Benefits

- Saves \$37,000 in electricity costs (36% per year)
- Prevents power plant carbon dioxide emissions of 600,000 pounds
- Uses nearly 100% of its waste methane, a renewable fuel, compared to 50% before
- Demonstrated the viability of methane-fired cogeneration at a small facility
- Relieved transmission & distribution constraints on the grid

Energy Overview

The facility pays an average price of electricity per kilowatt-hour of approximately 10 cents to the local utility. Before cogeneration, electric use was 1.1 million kWh per year and cost approximately \$100,000. That cost has dropped by \$37,000, or about 36 percent.

The facility produces an average of 30,300 cubic feet of methane per day, with a typical energy content of 520 BTU per cubic foot. Although it was initially envisioned that two 30 kW micro turbines would operate an average of 40 total hours per day, methane generation since startup in October of 2003 has been sufficient to run the micro turbines for 48 total hours each day. The extra eight hours represent more than 80,000 kWh of electricity per year.

On-peak demand has dropped from the range of 134-235 kW to the range of 110-215 kW; off-peak demand from 130-226 kW to 94-226 kW; average use from 93,000 kWh to 61,000 kWh.

Awards

The Essex Junction CHP installation was awarded a 2003 Vermont Governor's Award for Environmental Excellence and Pollution Prevention. Projects are chosen for their innovative approach, economic efficiency, and their ability to serve as a model for others.

While methane-based cogeneration is more common at large wastewater facilities, it is not considered cost-effective for small facilities like Essex Junction, whose daily average flow is 2 million gallons per day. It is estimated that between 5% and 15% of the nation's 16,000 wastewater facilities could implement similar projects.

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“The Essex Junction CHP installation is proof that small scale CHP retrofits are viable and cost effective.”

James L. Jutras,
Director, Public Works/
Wastewater Treatment,
Village of Essex Junction

