Case Study

EnergyTrust of Oregon, Inc.

Biopower: City of Gresham Wastewater Services

Guy Graham, Gresham's wastewater services division manager, stands by the fuel treatment section of the city's new combined heat and power system. The system helps the city turn a byproduct of sewage treatment into energy.

Gresham turns waste into clean power

Since installing a 395-kW combined heat and power (CHP) system in 2005, the 20 million gallon-per-day Gresham Wastewater Treatment Plant produces over half of its power needs and also provides useful process heat. The fuel that powers this system is a byproduct of anaerobic digestion—a sewage treatment process in which biological action breaks down sewage solids into nonreactive organic compounds and a combustible gas. The anaerobic digester gas is about 60% methane and 40% carbon dioxide, with trace amounts of hydrogen sulfide.

According to Guy Graham, Gresham's wastewater services division manager, "The project demonstrates the City of Gresham's commitment toward implementing sustainable business practices by creating a clean energy resource from a waste product."

Planning for the new system grew out of a 2003 evaluation of the facility's digester gas production and utilization that was part of an overall facility master plan. A key issue at that time was the poor availability of an existing 250-kW CHP system. Frequent outages, caused largely by fuel contamination issues, were exacerbated by a lack of local service. Replacement parts and service technicians came from out of the state, adding a number of days to any repair. Even when running, the former system used gas inefficiently. In addition, the facility flared 41% of its digester gas, and the city wanted to eliminate this wasteful practice. One of the options suggested by the facility master plan was to retire the existing system, which was nearing the end of its useful life, and install a new, larger, more efficient CHP system.

PROJECT OVERVIEW

Project Description

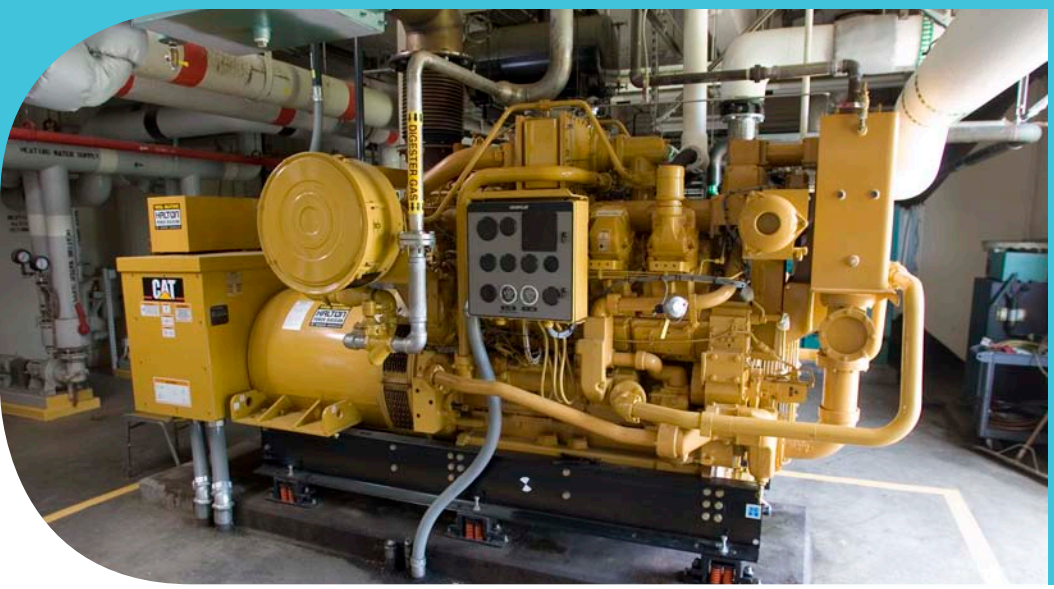
- *A 395-kW combined heat and power system powered by the plant's digester gas*
- *Online in November 2005*

Project Team

- *City of Gresham Wastewater Services*
- *Energy Trust of Oregon*
- *Oregon Department of Energy*
- *California Power Partners*
- *Portland General Electric*

Project Benefits

- *Generates clean, renewable power*
- *Provides process heat for the plant's digesters and space heat for the facility's administrative building*
- *Reduces facility energy costs by $18,000–$20,000 per month*
- *Enhances reliability by providing facility power during utility outages*
- *Reduces the need for power generation from fossil fuel, and associated environmental impacts*



California Power Partners designed and built the system which features a Caterpillar engine designed specifically to utilize low-pressure digester gas. The system recovers heat from the engine and uses it to maintain the temperature of the facility's two digesters and provide additional heat for the administration building.

A preliminary study undertaken by R&W Engineering, provided Gresham with an evaluation of gas availability and CHP system configuration requirements. With this information in hand, the city began a formal solicitation process in spring 2004.

The city took the unusual step of initiating a Design-Build procurement, instead of the traditional Design-Bid-Build approach typically used by municipalities for public works projects. A Design-Bid-Build process separates the design and construction phases of a project into two competitive elements, with one contractor designing the facility and another building it. This approach is intended to prevent a single contractor from over-designing a project in order to reap the benefits on the construction end. Gresham sought a different approach. According to Clint Moshofsky, the Gresham project manager, "we wanted to be sure that we had an integrated package with strong local parts and service availability. In a Design-Bid-Build, you could design with specific equipment in mind, but end up with something else in the bid process. The only way you can be certain that you get an integrated system with the components you want is to do a Design-Build." Gresham's city manager and city attorney concurred, and Gresham City Council passed a resolution specifically supporting the Design-Build approach.

In late 2004, California Power Partners (CalPWR) was selected from among a number of competitors to implement the project. CalPWR has completed 10 similar biopower projects and brought an experienced team of engineers to the project. The contract was structured into three phases: preliminary design, detailed design, and construction. The Gresham project team set go/no-go decision points at the end of the first two phases in case the project failed to meet required performance and cost goals. The project went smoothly, however. Construction started in April 2005, and the entire system was completed on budget and operating by November 2005.

The key to system reliability is a new fuel treatment train that removes moisture and impurities in the methane gas that could damage or upset the operation of the power system.

PROJECT COST SUMMARY

Consulting Services	R&W Engineering	$14,000
Design-Build Services	California Power Partners	$1,105,094
Permits & Inspection	Gresham Building Department	$24,009
Substation Relay Upgrade	Portland General Electric	$11,768
Internal Engr. & Admin.	Gresham Dept. of Env. Services	$197,443
TOTAL PROJECT COST		**$1,352,274**
Energy Trust Incentive		$82,379
BETC Pass-through		$287,801
NET PROJECT COST		**$982,094**
Annual Energy Savings (First-year estimate)		$202,782
Average Annual System Maintenance (First-year estimate)		$36,500
NET ANNUAL COST SAVINGS		**$166,282**
Project payback without incentives		8.1 years
Project payback with BETC and Energy Trust Incentives		5.9 years

Gresham applied for an Energy Trust incentive as part of the Biopower program. Gresham's team was guided by a dedicated Energy Trust contact, Adam Serchuk, biopower program manager. The entire incentive process was completed in a little over four months. The Energy Trust incentive removed the above-market costs of the project so the city could meet its investment goal of a seven-year payback. In exchange for the incentive payment, Energy Trust retains the rights to the project's environmental attributes ("green tags"). Energy Trust then holds these attributes in trust for ratepayers of the participating electric utility. In the case of Gresham, the electric utility was Portland General Electric.

In addition, the State of Oregon offers the Business Energy Tax Credit to projects that use a renewable fuel such as digester gas. The Business Energy Tax Credit program offers a 35% credit on state income taxes for eligible energy investments. As a municipality, Gresham does not pay state income taxes, but the Business Energy Tax Credit rules allow cities and other nonprofit organizations to find a taxable pass-through partner. Gresham received a 25.5% lump-sum payment from its pass-through partner, Costco. In turn, Costco takes the 35% tax credit in annual increments over five years. Gresham received a preliminary determination from Oregon Department of Energy based on the design cost estimate and a final commitment upon project completion. Without these incentives, it is unlikely that Gresham would have proceeded with the project.

CHP System

The City of Gresham's CHP system consists of the following major components:

- ***A fuel treatment system that removes moisture and contaminants from the digester gas.*** *The system consists of a chiller to condense moisture, a packed bed reactor for the removal of hydrogen sulfide, and two packed bed reactors for the removal of siloxanes—a class of increasingly common consumer product chemicals that create harmful deposits on combustion equipment. Inadequate approaches to gas cleaning have shortened the life and limited the effectiveness of many wastewater treatment plant energy projects, and the Gresham team was determined to avoid that mistake. Gresham's fuel treatment system is designed to maximize the performance and availability of the engine and to lengthen maintenance intervals between oil changes and overhauls.*
- ***An eight-cylinder Caterpillar engine-generator package (G3508) that uses the digester gas fuel to produce 395-kW.*** *The system is specifically designed to utilize low-pressure, medium-Btu digester gas. The Caterpillar engine was chosen for its proven track record and strong local parts and service availability.*
- ***A heat recovery system that produces 180° F water from the engine coolant and exhaust.*** *The hot water heats the plant's two digesters to 91° F. Heating the digesters is required to maintain the bacteria's biological reaction rate. During cold weather, some of the hot water is used to heat the facility's administration building.*
- ***A sophisticated control system that allows multiple operating modes, depending on system conditions and facility loads.*** *Under normal operating conditions the unit can meet two-thirds or more of the facility's 600-kW peak load. During a power outage, the system can manually be switched to back-up mode in order to keep critical components of the facility on line.*

In addition to reducing costs for the Gresham Wastewater Treatment Plant, the CHP system benefits all Oregonians through increased energy efficiency, reduced reliance on fossil fuels, and reduction of greenhouse gas emissions and other air pollutants. Gresham was able to turn these benefits into financial value for citizens by means of a financial incentive from Energy Trust and a Business Energy Tax Credit from the Oregon Department of Energy. Together, these incentive programs reduced the investment cost for Gresham by $370,200, a 27% reduction.

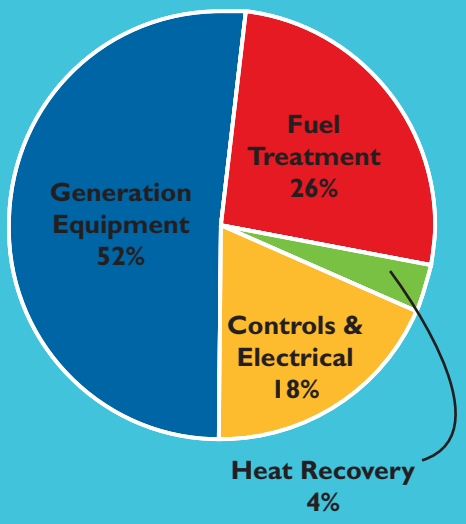
There were some minor initial start-up problems integrating the CHP control system with the overall facility supervisory control and data acquisition system. After sorting out these issues, the system has achieved a 98% availability. Power cost savings of $18,000–$20,000 per month during the first year of operation are meeting and sometimes exceeding original estimates. The system operates at full capacity when facility demand requires it. Flaring of digester gas has been reduced to practically zero. In addition, a secondary benefit is emerging. Gresham expects to be able to extend oil change intervals and engine overhaul periods as a result of the treatment system that cleans up the fuel, reducing oil contamination and engine deposits.

The original facility boiler, operating now when the CHP system is down for maintenance or repair, uses gas from the fuel treatment train rather than the raw digester gas it consumed previously. This change is expected to reduce the need for frequent fuel valve replacements.

Gresham is planning to install new gas flow meters in order to track digester gas production and engine performance more accurately. The city also intends to measure gas flow downstream of the fuel treatment train. If gas production at the Gresham Wastewater Treatment Plant were to increase in the future, the city would be interested in adding capacity.

The project won a 2006 Award of Excellence from the League of Oregon Cities.

MAJOR EQUIPMENT COSTS



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Do you have an idea for a solar electric (photovoltaic), solar water heating, small wind, hydro, biopower or geothermal project? Energy Trust may be able to provide funding for these.

To find out more, call 1-866-ENTRUST or visit our website at energytrust.org.

Energy Trust of Oregon, Inc., is an independent nonprofit organization dedicated to energy efficiency and renewable energy development. Our mission is to change how Oregonians produce and use energy by investing in efficient technologies and renewable resources that develop new sources of clean energy, help Oregonians lower their energy costs, stimulate the economy, and protect the environment. Energy Trust serves Oregon customers of Portland General Electric, Pacific Power, NW Natural, Avista and Cascade Natural Gas.

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