



Budd Inlet Wastewater Treatment Plant

335 kW Biogas CHP/District Energy System

Site Description

The Budd Inlet Treatment Plant, located in downtown Olympia is part of the LOTT Clean Water Alliance (www.lottcleanwater.org).

As a result of the 1995-1999 long-range planning process, the LOTT Wastewater Alliance was incorporated as a non-profit organization in April, 2000 and includes the cities of Lacey, Olympia, Tumwater, and Thurston County Washington. Effective July 1, 2001 the LOTT Clean Water Alliance became a full stand-alone entity. The treatment plant installed a 335 kW CHP system that became operational in late 2009. The system provides power for the pumps, heat for the digesters and sludge process, and cooling for the biogas and CHP equipment. It also provides hot water for heating two buildings (LOTT Regional Services Center and Hands-On Children's Museum), making it a small district energy system as well.

Reasons for CHP

- Eliminate the biogas flare –reduction of emissions;
- A reciprocating engine CHP system had a better cost savings than other alternatives considered, such as fuel cells and microturbines and;
- A system was needed that could provide both heat for the digesters and two buildings, and power for the treatment plant.

Quick Facts

LOCATION: Olympia, Washington

MARKET SECTOR: Municipalities – Wastewater Treatment

FACILITY SIZE: 11.5 million gallon wastewater flow

FACILITY PEAK LOAD: 2 megawatts (MW)

EQUIPMENT: GE Jenbacher reciprocating engine

FUEL: Biomethane, natural gas

USE OF THERMAL ENERGY: District heating, digester and sludge treatment

CHP TOTAL EFFICIENCY: ~78.5%

ENVIRONMENTAL BENEFITS: Reduction of 1,800 metric tons of CO₂e/year and 1,600 lbs/year of sulfur dioxide

TOTAL PROJECT COST: \$2.48 million

YEARLY ENERGY SAVINGS: \$150,000-\$180,000 (~ 2 million kWh)

CHP IN OPERATION SINCE: 2009

PAYBACK: 5 years (after grants and rebates)
- Not realized due to genset failure.



Digesters at Budd Inlet Treatment Plant

Photo courtesy of LOTT Cleanwater Alliance

CHP Equipment & Configuration



335 kW GE Jenbacher Reciprocating engine

PHOTO: COURTESY OF LOTT ALLIANCE

- 335 kW GE Jenbacher reciprocating internal combustion (I/C) engine, Model #JMS208
- New Brunswick (NB) plate heat exchangers, Model #193786
- Two Raypak 1.5 MMBth natural gas boilers, Model #300173
- Two CalTower biogas scrubbers
- AccuChiller (Trane) 7.5 tons (based on 12,000 BTU/hr/ton), Model #SQ2A0804
- A “pony” boiler (4.3 MBth) added in 2015 is expected to eliminate biogas flaring and dependency on natural gas to supplement thermal needs

The 335 kW CHP system provides 10 to 15% of the wastewater treatment plant’s power needs. Although the generated power is connected to the Puget Sound Energy (PSE) grid, no power actually goes to the grid –all power produced is used on site to power the pumps. Plans are in progress to expand power generating capability in conjunction with increasing demands for additional wastewater treatment due to population growth and expansion of central sanitary sewer systems throughout in the service area (individual septic system retirement).

CHP Operation

The treatment plant and CHP systems operate 24/7/365. Wet gas collected from the digesters is directed through a gas conditioning system starting with the hydrogen sulfide (H₂S) scrubbers, where H₂S is removed. The gas is directed to the siloxane skid, where pressure is raised to about 2.5 to 3 pounds per square inch (psi), and then routed through two heat exchangers for cooling and subsequent moisture removal. Gas moves through siloxane scrubbers to remove silicone compounds that may damage the engine. After conditioning, the gas enters the engine where it is combusted, providing shaft power to drive the generator. Burned gas is exhausted through a muffler/heat exchanger for the treatment plant’s high-heat loop. Waste heat is also recovered from the engine cooling jacket heat exchanger and is transferred to the plant’s high-heat loop (about 160°F) to heat the digesters. Each of the three active digesters – one million gallons each – need to be heated to about 98°F. Another heat exchanger recovers low-temperature heat from the engine manifold and transfers it into the plant’s low-heat loop (about 85°F). There it is used to cool equipment, such as the service air compressors, secondary blowers, and centrifuge, and provide heat to the LOTT Regional Services Center and Hands-On Children’s Museum.

The existing boiler system is not large enough to utilize all biogas produced nor meet all winter thermal demands. The planned addition of a smaller “pony” boiler will allow the treatment plant to meet additional winter-time thermal demands through the use of biogas generated and is expected to allow the facility to remove its dependence on natural gas, except for maintenance down time. The additional boiler is expected to allow the treatment facility to eliminate almost all biogas flaring year round.

In mid-2013 there was a reciprocating engine seizure; one of the cylinder pistons seized. The event was post-warranty and in advance of a typical 5-6 year overhaul in a reciprocating engine under 24/7 operation. Although replacing parts was less complicated than a more traditional reciprocating engine (each cylinder is in it a separate block assembly), shipping time from Austria caused significant repair delays.

“What I like about this project is it keeps employees thinking about how to conserve and efficiently use resources.”
Ben McConkey Public Facilities Coordinator LOTT Alliance

“A CHP reciprocating engine operating 95% of the time over 5 years is like running a car engine at 50 MPH for 1.9 million hours. Plan overhauls accordingly”
Ben McConkey Public Facilities Coordinator LOTT Alliance

Economics

As a municipality-owned utility, the LOTT Alliance was able to take advantage of an Energy Savings Performance Contract with the Washington State Department of Enterprise Services (DES). This type of contract provided a way to use utility savings to pay for some or all project costs. Guaranteed energy savings, determined by the Energy Service Company (ESCO), were also used to help with project financing; shortfalls in savings were guaranteed to be paid by the ESCO to the facility owner. As part of the contract, the client also received a guaranteed maximum project cost, guaranteed equipment performance, and open book pricing for project costs.

The partnership between LOTT Alliance, TRANE (the ESCO), and the Enterprise Services Energy Program, was the most cost-effective process for completing the energy upgrades. The DES Energy Program provided direct access to prequalified ESCOs. This means LOTT did not have to publish an RFP, develop a contract with an ESCO, negotiate scope and cost of the project, or review invoices, all of which represented a significant investment in time and expense. ESCO energy engineers helped LOTT administrators with project development and then managed the work through to completion.

Puget Sound Energy's Conservation Grant of \$1,708,575 paid for 70% of covered expenses (excluding "soft" costs), which also reduced the costs to LOTT and significantly reduced the projected payback period (equipment failure notwithstanding).

TOTAL PROJECT COST: \$2,481,509

CHP system only; includes engineering, design, and construction management.

- \$1,708,575 – PSE Conservation Grant (70% of covered expenses)
- \$126,212 – Washington Sales Tax Rebate
- \$646,722 – Net cost to LOTT Alliance after grant and tax rebate

Lessons To Share

- Get operations staff (with long-term responsibility for the system) involved from the beginning with the design, building, and start-up of the system to increase their knowledge in operating it and how to resolve potential issues. This reduces the operational learning curve costs.
- Project leads should research all of the "Lessons Learned" from other similar projects to be ahead of the game and tour similar facilities with CHP systems.
- Working directly with local utilities throughout the planning and implementation processes may provide funding opportunities as the project advances

For More Information

U.S. DOE NORTHWEST CHP Technical Assistance Partnership

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More CHP Project Profiles:

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

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LOTT CLEAN WATER ALLIANCE

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