Harnessing Energy from Wastewater

November 2021

WLSSD's Combined Heat and Power Energy System

Along with clean water, Western Lake Superior Sanitary District's (WLSSD) wastewater treatment facility can produce clean, renewable energy. Biogas, a methane-rich byproduct of the treatment process, can be used to create electricity and heat.

WLSSD's Combined Heat and Power energy project will allow WLSSD to use the biogas currently produced at its regional wastewater plant to generate about half of the electricity needed to power the treatment plant.

WLSSD also plans to reclaim additional wastes to increase biogas production. Investing in just a handful of projects, WLSSD can cut electricity purchases in half or more—moving WLSSD toward its goal of energy neutrality.

WLSSD's Vision: Energy Self-Sufficiency

WLSSD envisions an energy neutral future by generating 100% of the electricity needed to operate its large regional wastewater treatment plant. The unpredictable nature of energy costs remains WLSSD's biggest challenge in its efforts to stabilize rates for area residents and employers. Every day, WLSSD currently produces enough biogas to generate more than 50% of the electricity needed to operate the treatment plant. WLSSD is currently able to use a portion of this gas for heating, but unused gas is flared off and wasted. WLSSD's plan to produce and use energy on site by fully using this existing, renewable resource will allow WLSSD to control costs, stabilize rates , and improve WLSSD's reliability and resiliency.

Install engine generators, $14.9 million
Increase gas production with the addition of reclaimed high strength wastes, $5.694 million
Heat exchanger and heating and ventilation modifications, $4 million

At a Glance:

Western Lake Superior Sanitary District Combined Heat & Power Project

Project Timeline:

2018-2021: Improve electrical distribution
2021-2022: Pre-generator infrastructure (mist elimination)
2022-2023: Install generators & equipment
2025-2026: Increase gas production using reclaimed high-strength wastes
2026-2027: Increased heat recovery and improve plant heating/ventilation system

Total Remaining Project Cost:

$26.5 million

Technologies:

Modular boiler system with

- 3 boilers that operate on biogas or natural gas
- 6 boilers that operate on natural gas or fuel oil

Gas conditioning for siloxane, moisture and H_2S removal

Engine generators

Market Value of biogas currently produced:

About $2,000 daily (based on 2021 natural gas pricing)

Expected Results:

Reduce WLSSD electricity purchases by 50-100%

Annual projected savings of $842,500 –$1.69 million*

Annual reduction of ~8-22 million kWh electricity used*

Reduced emissions (see back page for details)

*based on 2021 electricity rates/ 2021 electricity usage

Wastewater Treatment is Energy Intensive

Similar to many wastewater facilities, purchased electricity has become the largest non-payroll cost in WLSSD's wastewater operations, driving tough budgetary decisions and increased rates to customers. At about $3 million annually, electricity accounts for about 30% of wastewater treatment plant operating costs.

WLSSD Electricity by the Numbers

- **$2.76 million** in 2021 annual electricity costs
- Nearly **a third** of treatment plant operating costs
- **73.5% increase in electricity rates** since 2006
- **22,004,700 kWh** used annually in the treatment plant
- By **investing in combined heat and power,** WLSSD can cut electricity purchases **in half** or more.

Electricity rates continue to rise—about 5-9% each year. The local electric utility has requested an aggressive increase of nearly 18% for 2022. WLSSD has reduced its electricity use by 34% since 2008, but rapidly increasing rates have not only wiped out any cost savings, but WLSSD's electricity bill is 14% more than it was in 2008.

A Strategic Investment in Efficiency

WLSSD is uniquely positioned to serve the region by providing both wastewater treatment and cogeneration of renewable energy with the use of engine generators. Engine generators are the longest standing form of biogas utilization for electricity production, dating back into the 1970s.

WLSSD already produces the methane-rich biogas needed to generate about 35% of its power needs. After removing contaminants, WLSSD will utilize this renewable resource that would otherwise be wasted.

Overall, engine generator installations are 75-85% efficient for energy recovery; a large portion of the heat from the generators can be captured and used. Engine generators can also handle small fluctuations in biogas production. Biogas can also be stored to dampen peak gas production conditions.

WLSSD's Energy Transformation is Underway

- 21 years of successful biogas production in our $30 million, 4-million gallon anaerobic digestion facility along with thermal improvements to improve facility heating. WLSSD uses only about half of its digester capacity.
- Successfully using biogas to meet 8% of WLSSD energy needs
- Reduced electrical use by 34% with operational efficiencies and modernization
- $11.2 million heating conversion and gas conditioning upgrades in 2015
- $3.9 million investment in 2018-19 to upgrade electrical distribution to facilitate electricity generation
- $16.2 million energy-efficient oxygen production facility in 2019
- $3.9 million invested in pre-generator infrastructure and gas conditioning in 2021

WLSSD's Path to Energy Self-Sufficiency

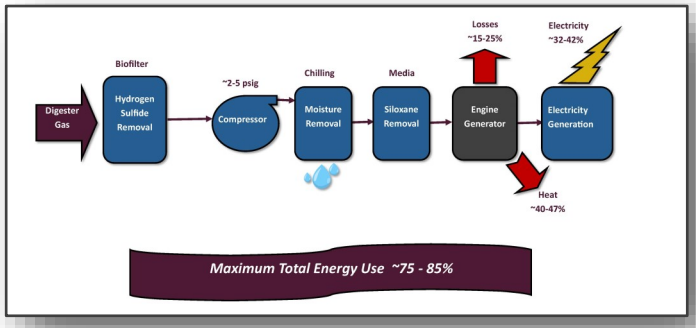
WLSSD will become energy neutral with three planned projects—reducing variability in operating costs, and improving the environmental footprint of the campus. Investing in combined heat and power, WLSSD can cut electricity purchases in half or more.

Engine Generators: 2022-2023

Install engine generators that use biogas to generate electricity. Using the biogas currently produced during wastewater treatment, WLSSD will meet more than 50% of its power needs. **Estimated cost $14.9 million.**

High Strength Waste Addition

WLSSD will increase biogas production and electricity generation by adding high strength wastes such as fats, oils and grease and food waste into WLSSD's anaerobic digester. With the increased biogas, WLSSD will generate electricity to meet up to 100% of treatment plant needs. **Estimated cost: $5.694 million**



Heat Recovery

WLSSD will recapture the substantial heat produced by the generators for use in the treatment process and for building heat, reducing the need for purchased natural gas. Components of this project will reduce the wastewater treatment plant's electricity consumption and improve system reliability with improvements to the digester heat exchangers and plant heating and ventilation systems. **Estimated cost $4 million.**

Harnessing Energy from Wastewater Yields Great Benefits

- Maximizes the use of existing infrastructure
- Generation of reliable, cost-effective renewable energy
- Reduces emissions
- Stabilizes rates for residents and businesses
- Uses an existing energy resource that is currently wasted

Potential Annual Emissions Reductions Resulting from WLSSD's Engine Generator Project	
CO_2	11,665,376 pounds
NO	6,424 pounds
SO_2	2,976 pounds
Mercury	15,138 mg

Based on Minnesota Power 2021 Environmental Cost Disclosure, WLSSD average gas production 2016-Q1-2021, and WLSSD 2021 projected electrical usage.

WLSSD—A Comprehensive Solution to Regional Problems

Western Lake Superior Sanitary District is a special purpose unit of government created by the Minnesota Legislature in 1971 to address serious environmental pollution problems in the lower St. Louis River basin. WLSSD is responsible for the effective and economical treatment of wastewater and management of solid waste for a 530-square-mile region in northeastern Minnesota, providing services to 16 communities and four large industrial facilities. The dual role of managing wastewater and solid waste for the region makes it possible for WLSSD to offer collaborative solutions to the challenges posed by waste in our society. WLSSD programs have been recognized nationally for innovation and effectiveness while preserving and protecting the unique natural characteristics of the region.

Contacts

Marianne Bohren	WLSSD Executive Director	218.740.4805	Marianne.bohren@wlssd.com
Karen Anderson	Director of Community Relations	218.740.4776	Karen.anderson@wlssd.com
Carrie Clement	Manager of Operations and Maintenance	218.740.4782	Carrie.clement@wlssd.com