



## Technical Education and Analysis for Community Hauling and Anaerobic Digesters **TEACH AD** Project Profile

### St. Cloud Nutrient, Energy and Water (NEW) Recovery Facility, St. Cloud Mn.

#### Net Zero Energy:

Net Zero Energy is defined as a facility that, by combining energy efficiency and renewable energy generation, consumes only as much energy on an annual basis as is produced onsite. Achieving net zero energy is a long term process that includes a vision, strategic and financial planning, patience and persistence, combined with a strong commitment. The

St. Cloud Nutrient, Energy and Water (NEW) Recovery Facility embarked on a net zero energy goal in 2014. Today, in 2023 the NEW Recovery Facility is recognized locally, nationally and internationally as a leader for innovative wastewater treatment and resource recovery strategies. The facility reached net zero energy in 2021 and continues to implement leading edge technologies that benefit their customers, the environment, and the region they serve.

#### Background:

The NEW Recovery Facility is owned and operated by the City of St. Cloud, Minnesota, providing Class A advanced wastewater treatment services to approximately 122,000 customers in six cities. The facility's rated capacity is 17.9 MGD with an average daily flow of 9.5 to 10 MGD. The fully treated (and disinfected utilizing ultraviolet light during recreation season) liquid effluent is discharged into the Mississippi River. Solids are drawn off and separated from the wastewater during both the primary and secondary treatment stages. The solids, known as sludge, are mixed together and dewatered. The liquid portion is returned to the beginning of the treatment process and the solids portion is pumped to the anaerobic digesters, where they are biologically processed into renewable energy (biogas) and nutrient rich biosolids which can be land applied as fertilizer.

#### Increased Biogas Production:

The existing digester complex at the NEW Recovery Facility consists of two primary digesters, a secondary digester, and a biosolids holding tank. The two primary mesophilic digesters operate between 96° and 98° F. When operating on municipal solids only, the digesters produced between 150,000 to 175,000 ft<sup>3</sup>/day of biogas. In 2014, the facility began successfully testing the blending of high strength liquid waste with the municipal solids, and feeding the combined feedstock into the digesters. Today,



Digester Complex with two CHP Units  
Source: St Cloud NEW Recovery Facility

up to 43% (approximately 26,000 gallons per day) of high strength liquids are being co-digested with the municipal solids. The co-digestion has resulted in daily biogas production of between 300,000 to 400,000 ft<sup>3</sup>/day. In 2018, a dome shaped biogas storage membrane system was installed that stores up to 49,000 ft<sup>3</sup> of biogas to supplement the daily production, enabling consistent feed to the biofuel generators. With the increase in biogas production came an increase in the volume of biosolids produced. In 2018, the NEW Recovery Facility installed the Lystek System, a resource recovery technology that reduced the volume of the biosolids by 75%, while upgrading the biosolids to a Class A product. In support of the co-digestion process, the NEW Recovery Facility repurposed two existing tanks that were retained when a new headworks facility was put in service in 2008, providing 45,000 gallon

#### HIGHLIGHTS

**LOCATION:** St. Cloud, Minnesota

**SECTOR:** Wastewater

**DIGESTER TYPE:** Two 60 ft. diameter, 572 k gallon mesophilic anaerobic digesters

**FEEDSTOCK:** Co-digesting municipal solids with high strength liquid waste from food sources

**BIOGAS YIELD:** Between 300,000 and 400,000 ft<sup>3</sup>/day

**Biogas Scrubbing:** Remove hydrogen sulfide, moisture and siloxanes

**CHP:** Two 633 kW CHP engines that operate on Biofuel

**RECOVERED HEAT:** Max of 4.4 M Btus/hr, 195° F hot water fed into central heating plant

**SOLAR ARRAYS:** Four solar arrays totaling 545 kW AC installed

**REVENUE STREAM:** Tipping fees for trucked in high strength liquid waste, sale of excess electricity back to local utility, sale of struvite pearls (nutrient harvesting of phosphorus from effluent)

storage capability for high strength liquid waste. The liquid waste is delivered daily by truck from nearby commercial businesses. The NEW Recovery Facility receives tipping fees to cover the costs of handling, processing and beneficially recycling the waste. The liquid waste is carefully checked for quality and consistency before being introduced to the digesters.

#### Onsite Electric Generation:

The NEW Recovery Facility has installed and is operating two 633 kW engine driven combined heat and power (CHP) units (total of 1.26 MW) and four solar arrays totaling 545 kW. The CHP units operate on the biogas produced by the anaerobic digesters. Before being injected into the CHP engines, the biogas is cleaned on site, removing hydrogen sulfide (H<sub>2</sub>S), moisture and siloxanes. The renewable onsite generation assets are connected to the local electric grid, which is owned and operated by Xcel Energy. Due to electric feeder issues associated with the local grid, Xcel Energy limits the amount of onsite power connected to their grid at any one time to 872 kW (7,600,000 kWh/yr). Since the annual electric demand of the facility is 6,600,000 kWh/yr, the NEW Recovery Facility operates the onsite generating assets as a mini grid, keeping the output of the assets as close to the 872kW limit as possible. The normal operation calls for one CHP unit to operate at full capacity 24/7, while the second CHP unit operates only at night and on days when the weather restricts production from the solar arrays. Any excess electricity generated during the year is net metered back to the local utility.

*“Each successful project brings us closer to the full utilization of all the energy and complete recovery of all the nutrients found in the waste streams we process. This benefits our facility, our customers and the environment”*  
**Emma Larson**  
**Assistant Public Utilities Director**

The thermal output of each CHP unit operating at full capacity is 2.2 MBtus/hr in the form of 195° F hot water. The hot water is fed into the facility’s central heating plant where it preheats the water to the existing boilers. For approximately 6 to 8 months of the year, the thermal output of the CHP units provides 100% of the facility’s heat requirements (both process heat including keeping the digesters at proper temperature and satisfying facility heating demand). The thermal output of the CHP units has resulted in significant fuel savings for the NEW Recovery Facility. Natural gas purchases for the existing boilers has been reduced by 42%.

#### Community Benefits:

- ✓ The co-digestion program has offered local haulers and businesses with a cost-effective option to dispose waste products that can be beneficially reused.
- ✓ The local utility generated power now serves as a backup to the onsite generated renewable power (CHP and solar arrays), providing added plant operation reliability.
- ✓ By displacing grid power and reducing natural gas consumption through the effective use of onsite produced biogas, the NEW Recovery Facility is removing over 8.5 million pounds of CO<sub>2</sub> annually from the atmosphere.

#### Lessons Learned:

- ✓ Ensuring proper quality, mixing, and feed rates of the high strength liquid waste being injected into the digesters is crucial to maximizing biogas production and avoiding digester upsets.
- ✓ Partnerships with local waste haulers and businesses has ensured an adequate daily supply of high-quality liquid waste for the co-digestion process.
- ✓ Partnership with the local utility (Xcel Energy) is essential to ensure smooth installation and operation of the onsite renewable generation technologies (CHP and solar arrays).

#### Additional Technology Efforts:

Although the NEW Recovery Facility has met its goal of net zero energy, they continue to test additional technologies and strategies to expand their commitment to nutrient, energy and water recovery. There are several pilot projects that are either ongoing or in advanced planning stages:

- ✓ Collect organic food wastes from schools, hospitals, etc., diverting them from landfills, and co-digesting the food waste in the facility digesters. Initial results look very promising.
- ✓ The NEW Recovery Facility is presently implementing a \$1.09 million grant issued to the City of St Cloud by the MN Legislative-Citizen Commission on Minnesota Resources (LCCMR) through the Environmental and Natural Resources Trust Fund. The funds are being used to develop and demonstrate the ability to produce Renewable Natural Gas (RNG) from biogas produced onsite through the digesters as well as Green Hydrogen and Green Oxygen through electrolysis of water, for use in supplementing current energy sources as well as reducing the oxygen demand for the aeration process.

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#### For More Information

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