



CHP
TECHNICAL ASSISTANCE
PARTNERSHIPS

Des Moines Wastewater Reclamation Authority

4.6 MW CHP System

Quick Facts

LOCATION: Des Moines, Iowa

MARKET SECTOR: Wastewater Treatment

FACILITY SIZE: 134 MGD

CHP GENERATING CAPACITY: 4.6 MW

CHP HEAT RECOVERY RATE:

>25,000 MMBtu per year

CHP PRIME MOVERS:

3 Superior Reciprocating Engines @ 600 kW
(installed 1992)

2 Jenbacher Reciprocating Engines @ 1,400 kW
(installed 2015)

CHP SYSTEM EFFICIENCY: 65–70% in the winter
[when heating is used for buildings] and 40% in
the summer.

CHP FUEL: Biogas

*Following Data is available for the
initial 1.8 MW CHP System (installed 1992):*

TOTAL PROJECT COST: \$1,873,432

ENERGY SAVINGS: \$358,000 in 2014

SIMPLE PAYBACK: 4.8 years

Project Overview

The Des Moines Wastewater Reclamation Authority (WRA) is composed of 17 communities, counties, and townships and is the largest wastewater treatment facility in Iowa. The WRA processes sewer waste from the Des Moines metro region in addition to high strength waste from waste haulers.

The WRA has successfully been running combined heat and power (CHP) since 1992. The CHP concept began in 1987 when the WRA received a Clean Water grant from the U.S. Environmental Protection Agency (EPA) to install three 600 kW Superior reciprocating engines with heat recovery. Although these engines have dual fuel capability for operating on either digester biogas or natural gas, these units primarily run on digester biogas.

In 2014, over 25,000 MMBtu of heat was recovered from the engine jackets and exhaust gases. This waste heat is used to heat the digesters and to provide heating for three buildings. The three engines run upwards of 7,500 hours per year providing a base load electric supply for the site.

The Reclamation Process / Anaerobic Digestion

The wastewater reclamation plant can process up to 134 million gallons per day (MGD) and up to 200 MGD during wet weather flows and uses anaerobic digesters to treat the sludge.

All wastewater treatment/reclamation plants produce organic sludge that requires further treatment to render it harmless prior to its disposal. The anaerobic digestion process breaks down the organic waste contained in the sludge in a controlled oxygen free environment. This process produces several outputs, a sludge that is ready for land application by local farmers, a liquid high in nutrient content (mainly nitrogen) that must be further treated, and a biogas that contains 64% methane that can be utilized for energy related projects.

The WRA operates a total of six digesters. The five primary digesters have a capacity of over 3 million gallons of waste while the secondary



Superior 600 kW Engine. Source Iowa Environmental Council

digester can hold a maximum of 2.6 million gallons. The digesters today produce 1.6 million cu ft/day of biogas.

The gas is stored in either the storage sphere or dome. The biogas sphere can hold over 141,000 cu ft at 45 psi while the dome provides storage up to 450,000 cu ft. The WRA maintains an inventory of 500,000 cubic feet of biogas at all times to ensure fuel supply in case of an outage. The three superior engines consume 10,000 cu ft/day of biogas. In addition to the gas consumed onsite by the engines, the WRA sends biogas across the street to the Cargill facility that is used for process needs. In 2010 the WRA sold 117 million cubic feet to Cargill.

In the 1990s the WRA became engaged in a high strength waste receiving program that now comprises 40% of the plant organic loading. The site has a 140,000 gallon tank used to hold the 40–50 hauled loads per day. This waste comes from all across Iowa and as far away as Illinois, Ohio, Wisconsin and even Mississippi. The WRA currently receives between \$0.015–\$0.029 / gal of received waste as a tipping fee. This potent waste, in the form of fats, oils, and greases (FOGs) allows the WRA to create up to 27 cubic feet of biogas per pound of volatile solids destroyed. The additional biogas enabled the WRA to explore additional uses of the increased volume of biogas and the future expansion of their CHP system.

CHP Heat Recovery Integration and CHP Maintenance

The treatment system consists of 5 primary and 1 secondary digesters each of 115 ft diameter and 15 ft depth. Plate type heat exchangers are utilized to transfer the thermal energy recovered from the engine's exhaust and jacket water to the system that provides heating for the buildings and digesters. The digesters require a temperature of 90–100 degrees Fahrenheit to maintain proper operation. Hydraulic detention time is approximately 20–25 days after which biosolid waste is brought to local farmers to be used as fertilizer. Maintenance for the CHP engines is minimal with oil changes occurring every 2,800 hours of operation and large overhauls/rebuilds occurring approximately every 30,000 hours of operation.

Recent Facility and CHP Expansion

In 2010 construction began on a Combined Sewer Solids Separation Facility to handle sewage overflow during larger rain events. The WRA used this expansion as an opportunity to purchase additional CHP engine units.

Due to the success of the existing CHP system and the increased output of biogas from the hauled waste program, the WRA added four new 1.4 MW Jenbacher engines in January 2015. These engines are turbo charged, lean burn, and significantly more efficient than the older Superior engines. Two of the new engines are intended to run primarily on digester gas and will operate 24/7 and incorporate heat recovery. The other two engines will run solely on natural gas and are intended for backup and peaking without heat recovery. Once final testing is completed by Fall 2015, the upgraded CHP system will have an overall output of 4.6 MW.



*New 1.4 MW Jenbacher Engine.
Source: Iowa Environmental Council*

The new engines were paid for from Iowa's Clean Water State Revolving Fund (SRF), a loan program that funds wastewater treatment, sewer rehabilitation, and storm water quality improvements, as well as non-point source projects. The SRF provided construction and planning and design loans for the CSSSF at an interest rate of 1.75%.

For More Information

U.S. DOE MIDWEST CHP TECHNICAL ASSISTANCE PARTNERSHIP (CHP TAP)

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The Midwest CHP TAP is a U.S. DOE sponsored program managed by the Energy Resources Center located at the University of Illinois of Chicago.