PACIFIC

U.S. DOE

CHP Technical Assistance Partnerships

PROJECT PROFILE

East Bay Municipal Utility District

11-MW CHP System

Quick Facts

LOCATION: Oakland, California
MARKET SECTOR: Wastewater Treatment Facility (WWTF)
FACILITY SIZE: 65 million gallons per day
FACILITY PEAK LOAD: 10 megawatts (MW)
EQUIPMENT: 4.6-MW Solar Turbines Mercury 50™ gas turbine and 3 x 2.1-MW Enterprise engines
FUEL: Digester gas
USE OF THERMAL ENERGY: Digester heating
CHP TOTAL EFFICIENCY: 80%
ENVIRONMENTAL BENEFITS: Methane destruction reduces GHG emissions
TOTAL PROJECT COST: $19 million (includes turbine and related equipment modifications made in 2011)
ANNUAL ENERGY SAVINGS: $1.2 million
PAYBACK: 15 years
CHP IN OPERATION SINCE: 1985 (modified in 2011)

Site Description

The East Bay Municipal Utility District (EBMUD)'s wastewater treatment facility supplies wastewater treatment service for 650,000 customers in an 88 square-mile (228 km^2) area along the eastern shore of San Francisco Bay. Approximately 75 million gallons per day of wastewater is treated to meet stringent state and federal standards before recycling it or releasing it to the Bay. EBMUD has received many honors and awards for its efforts to protect public health and keep pollutants from reaching the Bay, and partners with residents and businesses to help them keep contaminants out of sewers and the Bay.

Reasons for CHP

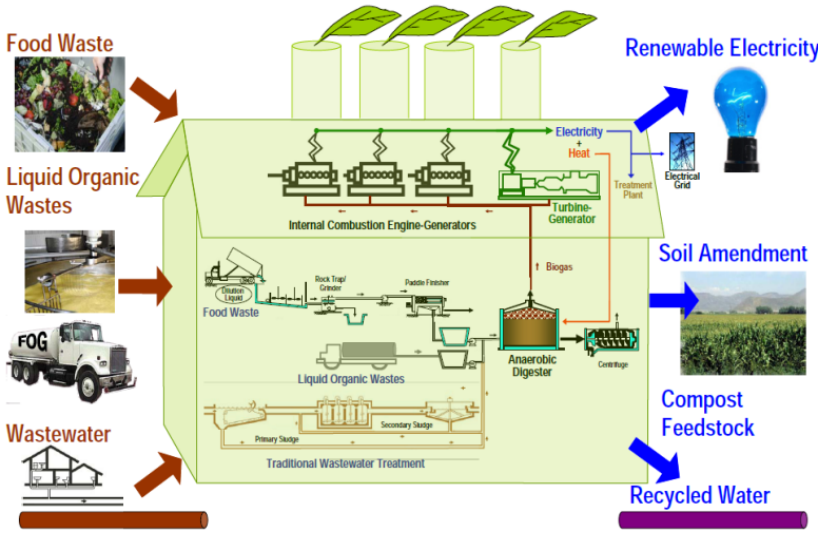
Since 1985, EBMUD has been generating electrical power in Oakland from digester gas using three 2.1-MW combustion engines manufactured by the former Enterprise Engine Machinery Company. The facility began accepting high-strength wastes in 2002 that are trucked in from food processing operations, including wastes from wineries, animal processing and food scraps. Digester gas production doubled and then exceeded the maximum engine gas feed rate. To avoid flaring excess digester gas, a 4.6-MW Solar Turbines gas turbine was added in 2011 to convert the gas to electricity. In doing so, EBMUD became the first wastewater treatment facility in North America to become a net energy producer, with excess electricity sold back to the grid.

CHP Equipment & Configuration

The 4.6-MW gas turbine is utilized as the lead equipment for electricity generation and kept at 100% capacity. Due to parasitic load elements like gas conditioning and compression, net electricity generation is 3.8 MW. In addition to the turbine, one or two of the older combustion engines are kept running depending on the amount of additional digester gas available. The overall system produces an average of 6 MW of renewable electricity, with a peak facility demand of 10 MW. All recoverable waste heat from the turbine and engines is captured and utilized to provide thermal heat to the digesters.

CHP Operation

Similar to many medium and large WWTF, EBMUD stabilizes wastewater solids in anaerobic digesters where bacteria convert the organic material into digester gas (65% methane and 35% carbon dioxide). The digester gas is then conditioned for moisture removal and treated in a gas cleanup skid for removal of siloxanes (originating mostly from personal care products) and other impurities before being compressed and used in the turbine. This process assures that the fuel will not damage the system. The cleanup system uses an activated carbon bed that has to be replaced periodically with new media. Digester gas is collected from each of the 11 active digesters on site.



All inputs of the power generation process at EBMUD.
ILLUSTRATION COURTESY OF EBMUD

In 2002, the facility began accepting high-strength organic waste known as FOG (fats, oils and grease) from outside facilities. Trucks pay lower tipping fees to EBMUD for receiving the waste than they would pay at landfills. FOG waste greatly enhances anaerobic digestion, increasing the amount of digester gas available. Prior to installation of the gas turbine, excess digester gas was flared. The system currently produces an average of 2,000 cubic feet per minute (CFM) of digester gas (1,200 CFM is consumed in the gas turbine and the remainder used in the older engines). By producing renewable electricity, the project generates renewable energy credits that can be sold to electric utilities, enhancing the value of the power delivered to the grid by about $0.02 - $0.04 per kWh. Due to a Monday-Friday schedule of high-strength waste truck deliveries, the gas production peaks midweek and drops off on weekends.

Lessons to Share

Accepting supplementary high-strength wastes is an option for EBMUD because the facility has surplus digester capacity when compared to the nominal wastewater intake of the plant. In addition to the contaminant removal required prior to digestion, EBMUD has developed management systems for high-strength waste acceptance including review, audit, tracking and billing functions. The facility now generates 110-140% of the plant's energy demands, presenting EBMUD with the unique opportunity to export surplus electricity. Because renewable energy generation varied with trucked waste deliveries, EBMUD sought a purchaser with flexible power delivery requirements. Ultimately, EBMUD entered into a PPA with the Port of Oakland, a neighboring municipal utility that is required to meet California's renewable energy purchase requirements. The smaller utility would allow for flexibility in the quality of power delivered, which was important to EBMUD's operations since the digester gas quantities fluctuate each week based on the high-strength waste deliveries.

> ***"EBMUD's achievement has implications on a national and global level. The wastewater treatment industry worldwide is in the midst of a major paradigm shift – instead of thinking of what we do as waste disposal, we are beginning to understand that wastewater treatment plants can be recyclers and, in fact, generators of valuable commodities like renewable energy, recycled water, compost, nutrient fertilizers and even biodiesel."***
>
> ***- Matt Bond, Water Environment Federation***

For More Information

U.S. DOE PACIFIC CHP TECHNICAL ASSISTANCE PARTNERSHIP
Gene Kogan, Director
858-633-8561
Gene.Kogan@energycenter.org

EAST BAY MUNICIPAL UTILITY DISTRICT (EBMUD)
John Hake, Engineer
510-287-1279
www.ebmud.com

More CHP Project Profiles:
www.pacificCHPTAP.org

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