MID-ATLANTIC

CHP Technical Assistance Partnerships

PROJECT PROFILE

D.C. Water Blue Plains AWTP

14-MW CHP System

Site Description

Blue Plains Advanced Wastewater Treatment Plant, Washington, DC
SOURCE: DC WATER

The District of Columbia Water & Sewer Authority's (D.C. Water) Blue Plains Advanced Wastewater Treatment Plant (AWTP) is the largest plant of its kind in the world. On an average day, the facility treats close to 370 million gallons of wastewater and has the ability to treat over 1 billion gallons a day at peak flow. Wastewater flows in from the District of Columbia and from Montgomery and Prince George's Counties in Maryland and Fairfax and Loudoun counties in Virginia. The plant opened as a primary treatment facility in 1937. Since that time, new processes and technologies have been added to provide advanced wastewater treatment.[1] The Blue Plains facility now uses both primary and secondary treatment as well as denitrification, multimedia filtration, and chlorination/dichlorination during the treatment process.

Quick Facts

LOCATION: Washington, DC
MARKET SECTOR: Waste Water Treatment
FACILITY SIZE: 370 million gallons per day
FACILITY PEAK LOAD: THP < 14 MW megawatts (MW)
EQUIPMENT: 3 x 4,667 kW Recuperative Combustion Turbines
FUEL: Digester Gas
USE OF THERMAL ENERGY: Steam for THP process heating
CHP ANNUAL TOTAL EFFICIENCY: 70%
ENVIRONMENTAL BENEFITS: Reduces greenhouse gas emissions by 130,000 to 160,000 metric tons of CO_2 per year.
CONTRACT ENERGY SAVINGS: Energy service agreement with guaranteed savings during the contract term.
CHP IN OPERATION SINCE: 2015
RESILIENCE: The CHP plant operates in island mode and is not connected to the grid.

Reasons for CHP

DC Water wanted to reduce biosolids[2], GHG emissions and save energy. The plant entered into an agreement with Pepco Energy Services who designed a system with a complete thermal hydrolysis process (THP) and a combined heat & power system (CHP) in order to generate operating savings. The CHP onsite power production reduces the facility's greenhouse gas emissions by about 40 percent and provides steam to the THP. The THP reduces biosolids volume and thus hauling requirements. DC Water received a guaranteed rate of return for the CHP system at the outset of the project.

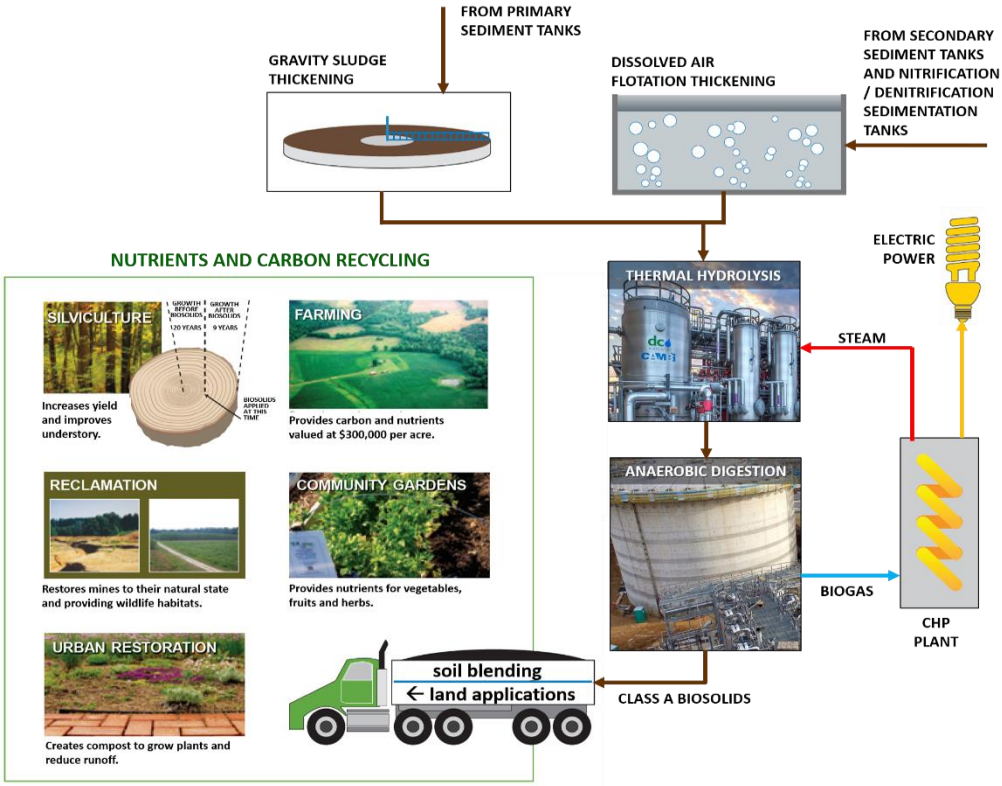
[1] Complete thermal hydrolysis process (THP) including CHP system highlighted in red in Blue Plains photo shown above.
[2] Previous lime stabilization sludge treatment produced class B biosolids used for agricultural fertilizer; the THP system produces more versatile class A biosolids.

CHP Equipment and Configuration

Three – 4,667 kW Solar Mercury 50 Gensets
SOURCE: DC WATER

The THP plant[3] at Blue Plains (process schematic below) is designed to pressure cook biosolids leftover from the wastewater treatment process and to generate up to 14 megawatts of power and thermal energy. The facility—also capable of processing scraps, fat, and grease—includes four anaerobic digesters, four Cambi treatment trains, a pre-dewatering centrifuge building, a CHP facility, a gas treatment facility, flares, and gas storage. The THP process requires 47,500 lbm/hr of 175 psi steam from the CHP plant.

The three Solar Turbines Mercury 50 Combustion Turbines (CTs) produce electrical power and deliver that energy to the Blue Plains AWTP thru 13.8 kV paralleling switchgear. Each CT has a maximum output of 4,667 kW, for a total system capacity of 14 MW. Since there are very few operating scenarios that would allow the CHP system to produce more power than the demand on site, the project does not include an interconnection with the power grid. One CT produces enough unfired exhaust heat to produce 14,000 lbm/hr of steam without a duct burner and 35,000 lbm/hr with a duct burner. With three units operating with the duct burners fully fired, the total steam production of 105,000 lbm/hr provides flexibility in setting the systems to meet the steam demand and maximizing the power produced by the CTs. An auxiliary backup digester gas/natural gas boiler provides steam during startup and other potential process upsets that would result in minimal digester gas production. Four 450 hp rotary screw compressors deliver 200 psig gas to the CTs. A gas blending system is located upstream of the compressors to supplement the digester gas with up to 30% natural gas.



Blue Plains AWTP THP Schematic
SOURCE: DC WATER

Energy Service Agreement

The project was delivered in a design-build-operate contract arrangement with Pepco Energy Services (PES) as the prime contractor who will operate the facility for a period of 15 years. Black & Veatch, working as a subcontractor to PES, was the engineer of record for the CHP plant. The operations contract includes a series of performance guarantees that stipulate the amount of steam and electricity to be produced under a wide range of operational parameters, including digester gas quality, ambient temperatures, and operational hours of the equipment.

For More Information

U.S. DOE MID-ATLANTIC CHP TECHNICAL ASSISTANCE PARTNERSHIP (CHP TAP)
www.machptap.org

U.S. DOE Packaged CHP Systems eCatalog:
chp.ecatalog.ornl.gov
Date Produced: 2020

[3] The partial THP is shown, in the top photo on this page, where the three CT generators (wrapped in blue plastic to protect them during shipping and construction) can be seen set in place in the CHP plant, which was being constructed around them in 2014. The Blue Plains THP process schematic is above on the right.