Energy Management Initiative for Water & Wastewater Utilities – Summer 2011

City of Columbia

Keeping Energy in Mind

Overview

One of the most effective ways for cities to reduce their costs and improve environmental performance is to improve energy efficiency. In U.S. cities, an estimated 30 to 40 percent of municipal energy use and associated operating budgets are spent treating water and wastewater. Rising energy costs add to the other challenges that water utilities are facing that include the need to expand services, meet more stringent regulations, and replace aging infrastructure. Because most of the energy used to pump and treat water in the Midwest comes from coal-fired power plants, significant quantities of air pollutants are also emitted as a result. Energy conservation can be a mechanism to improve both air and water quality as well as save money.

In May 2009, the U.S. Environmental Protection Agency (EPA) invited 12 Missouri communities to participate in an Energy Management Initiative for Water and Wastewater Utilities, a pilot program led by the Missouri Water Utilities Partnership (MOWUP). Partners included the Missouri Department of Natural Resources, the Missouri University of Science & Technology, Siemens Industry, Inc. (Siemens) and EPA Region 7. Seven communities chose to participate in the pilot program which included developing an Energy Management Plan (EMP), implementing an energy efficiency project, maintaining data and sharing results. The City of Columbia was among the participating communities.

About the City of Columbia

The City of Columbia, with a population of 110,000, is located north of the state capital, Jefferson City, and is approximately midway between Kansas City and St. Louis on Interstate 70. The City of Columbia's Water & Light Department processes an average of 12 million gallons per day (MGD) at its drinking water plant. The city's wastewater is managed by a separate department, the Public Works Department, at the Columbia Regional Wastewater Treatment Plant (WWTP), a facility with a design capacity of 25.4 MGD. The city's wastewater is treated using a complete-mix activated sludge process.

City of Columbia wastewater treatment plant

Prior to participating in the MOWUP Initiative, the City of Columbia had committed to several climate and conservation goals including: the Mayor and Council's Climate Protection Resolution of July 2006, Conservation Best Practices, and the Integrated Resources Plan. When invited to participate in the MOWUP Initiative, Columbia chose three leaders: Assistant City Manager Paula Hertwig-Hopkins, Water Plant Superintendent Barry Kirchhoff, and Environmental Services Manager Steve Hunt. These personnel participated in the assessments and workshops. The city believed that the selected personnel's involvement would allow them to pursue these climate/conservation goals and identify new opportunities to save energy.

Energy Management Plan Development

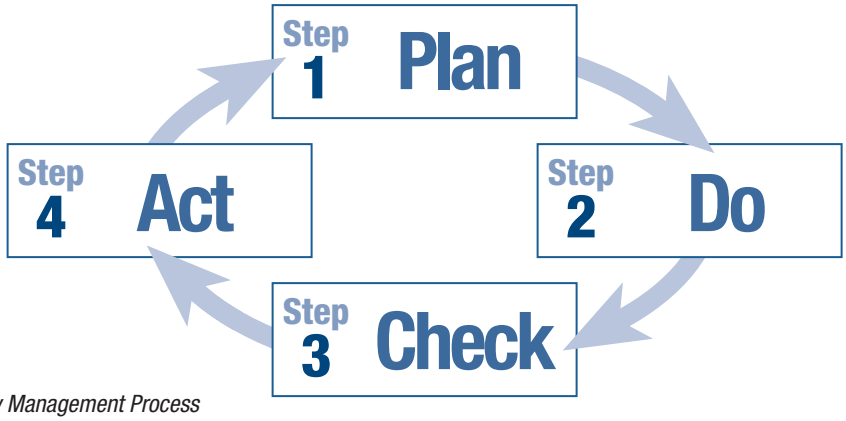
The MOWUP provided a series of workshops to walk participants through the guidebook, "Ensuring a Sustainable Future: An Energy Management Guidebook for Wastewater and Water Utilities." Workshop participants were assigned homework to encourage them to work together and choose goals that fit their community. Ms. Hertwig-Hopkins took the lead for the City of Columbia's team to develop the EMP identifying suitable options that could be used by both the water and wastewater plants to meet the city's energy-efficiency objectives.

> ***"The biggest benefit of the workshop was confirmation that what we're doing … is as energy efficient as it could be."***
>
> **Steve Hunt, PE**
> **Environmental Services Manager**

Building on Momentum

The Environmental Services Division of the Public Works Department had already been designing an upgrade to treat increased flow and remove ammonia when the MOWUP began. Although these upgrades are estimated to require more energy, the construction plans utilized the information gained through MOWUP workshops to keep new energy requirements at a minimum. Also, the MOWUP personnel volunteered to review the construction plans drafted by a consulting firm for the city.

The WWTP was initially built in 1983 and consisted of two primary clarifiers, two aeration basins, and two final clarifiers, followed by methane digesters, gravity thickeners, and a sludge holding basin. In the 1990s, wetland treatment units were added and increased the capacity of the plant by 7 MGD. Construction began on the addition of two more trains (primary clarifiers,



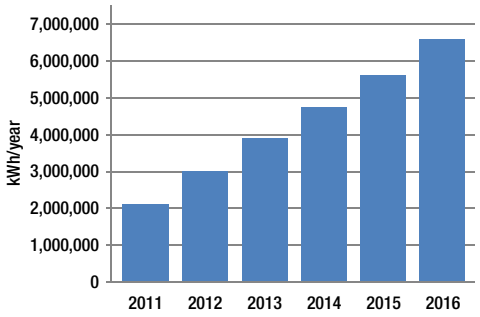
Energy Management Process

aeration basins, and secondary clarifiers) in February 2010, in order to expand the capacity of the plant to accommodate an additional 4 MGD and ammonia removal by September 2012.

The city expects to see a significant increase in energy as the new treatment processes are brought online. However, using their EMP, they set a goal for 2013 to increase onsite power generation by 50% using the 2009 baseline. Currently, the WWTP has one aging engine generator which can produce 240 kW off the methane created by the digesters. It is being replaced with two 375 kW engine generators which produce electricity that is fed back into the plant. Heat generated from the methane is also used to power boilers which help to heat the buildings and keep the digesters warm during cold Missouri winters.

Financing

The upgrades were financed by a $3 million American Recovery and Reinvestment Act (ARRA) grant as well as a $54 million combination ARRA loan and State Revolving Fund (SRF) loan. Although the city initially looked at SRF loans and municipal bonds as the only source of funding, they discovered the ARRA grant and chose to apply. This put them in the pool for ARRA loans as well as the SRF loan. The City of Columbia is looking forward to serving its residents more sustainably and with better services when these projects are completed.



Projected energy generation is expected to reach peak capacity in 2016.

Next Steps

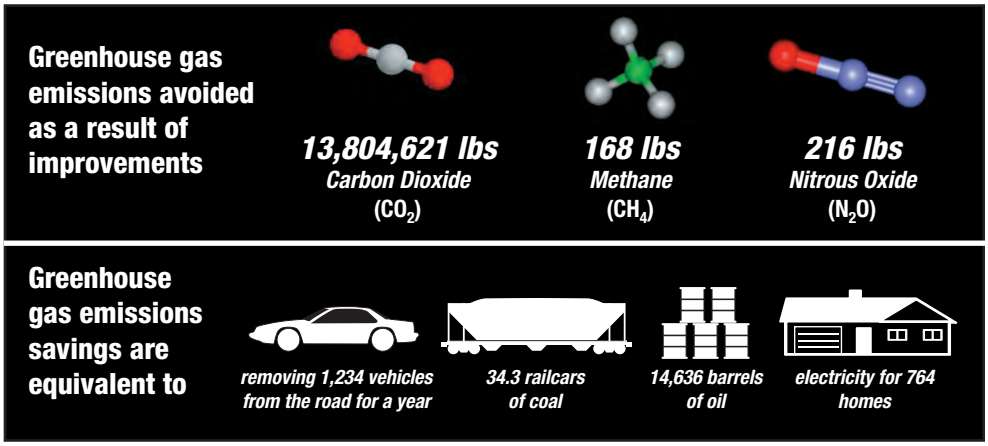
At the time the city joined the MOWUP Initiative, the design process had just begun for the water plant to increase its capacity. The skills taught at the MOWUP workshops were used to better understand their current system and design upgrades. The tools provided at the MOWUP workshop allowed the city to benchmark energy use, audit current energy use, propose changes, and evaluate the savings from proposed changes. To determine the current level of energy use, the city utilized EPA's ENERGY STAR® Portfolio Manager. This free online tool was used to complete a motor inventory, lighting survey, and identify places for more pump efficiency. The benchmarked information, along with the EMP, was utilized during the design phase of the water treatment plant. In addition, the City of Columbia's Water and Light Department plans to evaluate savings from the proposed changes after construction.

Old (at right) and New Model Generators

Annual greenhouse gas reductions resulting from the reduced electricity demand from the grid (based on peak output power generation) by the City of Columbia. They were calculated using EPA's eGRID web converter (http://cfpub.epa.gov/egridweb/ghg.cfm).

"Everybody's aware of electricity costs, but the MOWUP brought it to the forefront that we should focus on these costs as we move into the design phase."

Barry Kirchhoff,
Water Treatment Plant Superintendent



1983
13 MGD WWTP built; primary clarifiers, contact stabilization aeration, and final clarifiers

1999
4th wetland treatment unit constructed (21.6 to 25.4 MGD)

1980s | **1990s** | **2000s** | **2010s**

1993
3 wetland units constructed (13 MGD to 21.6 MGD)

2010 - 2012
2 new primary clarifiers, 2 aeration basins, 2 final clarifiers (25.4 to 29.4 MGD and ammonia removal); one 240 kW engine generator replaced with two 375 kW engine generators

Contacts

Kerry Herndon
Sustainable Infrastructure Program Manager
U.S. Environmental Protection Agency
Water, Wetlands and Pesticides Division
901 N. 5th Street
Kansas City, Kansas 66101
(913) 551-7286
fax (913) 551-7863
herndon.kerry@epa.gov

Ruben B. McCullers
U.S. Environmental Protection Agency
Resource Conservation and Pollution Prevention Section
901 N. 5th Street
Kansas City, Kansas 66101
(913) 551-7455
mccullers.ruben@epa.gov

Steve Hunt, PE
Environmental Services Manager
701 E. Broadway
P.O. Box 6015
Columbia, MO 65205
(573) 874-7264
sshunt@gocolumbiamo.com

Author Ms. Samantha Markus works for the Shaw Group and is pursuing a Masters Program in Environmental Engineering at the Missouri University of Science and Technology (S&T). She can be reached via email at slm437@mst.edu.