Energy Management Initiative for Water & Wastewater Utilities – Summer 2011

City of Harrisonville

Serving Its Residents

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 such as 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 Harrisonville was among the participating communities.

About the City of Harrisonville

The City of Harrisonville provides both water and wastewater services to its community. The original wastewater treatment plant (WWTP) was constructed in 1971 to handle 1 million gallons per day (MGD) of wastewater. The WWTP consisted of two large package plants and a two-cell lagoon to polish the effluent. Extensive upgrades were made in 1987 which increased the plant's capacity to 3 MGD. The upgrades included conversion of the two package plants to aeration basins and the conversion of the two-cell lagoon into extraneous flow and sludge holding basins. Subsequently in 2004, an 18 MGD primary lift station was installed to keep sewage out of the collection system, ensuring no overflows or backups into basements. After the upgrades in 2004, the WWTP primarily consisted of a headworks facility that leads to one of two aeration basins. The effluent from the aeration basins was treated in a final clarifier before being discharged to a stream. The waste sludge was processed in an aerobic digester and subsequently disposed via land application.

When planning for equipment upgrades, energy consumption has always been a high priority for Steve Woodring, chief wastewater operator for the City of Harrisonville. However, the higher capital cost of replacing standard energy-consuming equipment with energy-efficient models was always an issue that needed to be dealt with. The City of Harrisonville strived to balance the capital cost of the projects with the possible energy savings. In the midst of the planning phases of a new round of upgrades, the City of Harrisonville was invited to participate in the MOWUP.

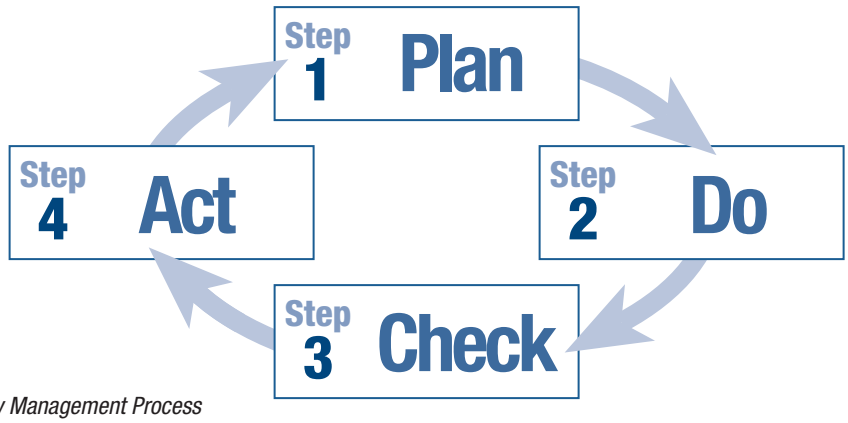
Developing an Energy Management Plan

The City of Harrisonville planned to serve their community by using quantitative analysis to determine which upgrades and replacement parts would save more money over the long run. During the first phase of the MOWUP Initiative, personnel visited the City of Harrisonville's water and wastewater treatment plants to perform an initial energy assessment. They also assisted the City of Harrisonville with the benchmarking process to determine how much energy had been used over the past 1½ years to establish a baseline for current energy usage.

Steve Woodring, Chief Wastewater Operator, overlooks the new clarifier skimmers as part of the 2010-2011 upgrades.

> ***"Some people just want to be green, but is it financially feasible to go green? What is the payback?"***
>
> **Steve Woodring,**
> **Chief Wastewater Operator**

Some of the construction planning occurred before the City of Harrisonville began working with the MOWUP. The four workshops in the MOWUP second phase provided Steve Woodring and Robert Weiss, chief water plant operator, with the opportunity to review their plans for energy-efficiency-related savings. Using the EMP developed as part of the workshops, they were able to make quantifiable connections between energy savings and initial cost. Subsequently, many projects were selected for implementation using an approach that achieved the lowest lifetime-equipment cost to their residents.



Energy Management Process

Building on Momentum

The current round of upgrades (2010-2011) will guarantee continuation of ammonia removal and reduce use of the extraneous flow basins. Using the extraneous flow basins requires extra pumping of wastewater resulting in higher pumping costs. Some of the new equipment (including the vortex grit chamber) will perform screening and grit removal more efficiently, a preventative maintenance measure that will result in saving operational money.

Another major upgrade was a new screening system for the headworks. The FlexRake screening mechanism was chosen for many of its design features, including the capability to handle large objects without jamming, as well as a self-cleaning mechanism that limits maintenance requirements and lowers energy use. The motor used for the self-cleaning mechanism of the screen has a power requirement of only ½ HP.

Less obvious upgrades include new automated valves with meters on incoming flow which will automatically divert flow between the plant and the extraneous flow basin, based on the predetermined flow rate desired through the plant. Three of the motor control centers which distribute the power throughout the plant have also received an upgrade. The electrical system has been checked and several parts replaced. Return sludge pumps and waste sludge pumps were replaced. Fine air diffusers were installed initially or as replacements for coarse diffusers in the aeration basins.

During the MOWUP workshops, the City of Harrisonville also realized that the ongoing WWTP upgrades that increase the design capacity would likely increase the electricity usage. Using historical data, they set a baseline using EPA's ENERGY STAR® Portfolio Manager and projected that many of the upgrades will increase the energy efficiency while offsetting the increased energy use. Therefore, the city's goal within their current EMP is to achieve no net increase in electricity use compared to the 2009 baseline when the ongoing projects are completed (estimated to be Summer 2011).

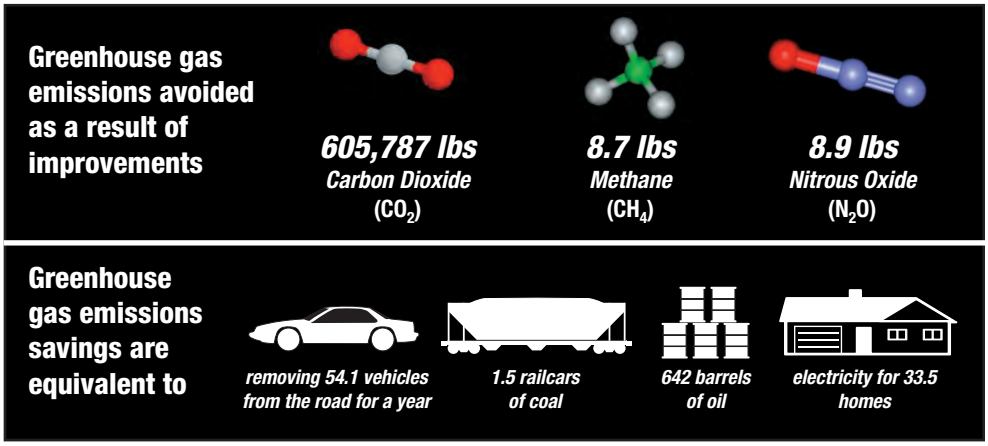
Financing

The planning for this project had begun several years before the City of Harrisonville joined the MOWUP program. The 2010-2011 upgrade projects were funded with $4.3 million of the State Revolving Loan Fund, a $3 million American Recovery and Reinvestment Act (ARRA) grant, and $170,200 of local user fees – a total expenditure of $7.5 million. After all of the upgrades are completed, the City of Harrisonville will be in compliance with lower ammonia limits, have capacity to handle larger flows, be able to capture peak flows during wet weather, and subsequently treat the stored water over several days following a rain event – all while achieving a lower energy cost per MGD of effluent treated.

Next Steps

As part of the MOWUP Initiative, each community was asked to identify and implement a project that was expected to improve energy efficiency by at least 15%. To achieve this, the City of Harrisonville is now in the process of planning to replace blowers in the WWTP which supply air to the aeration basins. At the current operating capacity, the city has determined that it can annually save approximately 279,198 kWh of electricity by replacing the old blowers with new energy-efficient turbo blower models. The initial cost of this project is estimated to be $405,279. At an electricity cost of $0.0973 per kWh, the annual energy-related savings are $27,166. This computes to a payback period of roughly 14.9 years, not accounting for interest rates, increased operating capacity, and changes in electricity cost.

Possible annual greenhouse gas reductions based on future blower replacement project planned by the City of Harrisonville. They were calculated using EPA's eGRID web converter (http://cfpub.epa.gov/egridweb/ghg.cfm).



1971
Original plant; 2 large package plants, grit channel; primary and tertiary cell of a two-cell lagoon to polish effluent

2004
Installed 18 MGD primary lift station

2012/2013
Replacement blowers for aeration tank

1970s | 1980s | 1990s | 2000s | 2010s

1987
Added headworks: rotating bar screen/grinder, aerated grit basin, grit classifier; package plants converted to aeration basins; added two final clarifiers and one aerobic digester; two-cell lagoon converted to extraneous flow and sludge holding basins; four new motor control centers (MCC)

2010/2011
Aerated grit basin was changed to a vortex grit removal basin; one new aeration basin and one new aerobic digester (fine bubble diffusers and dome covered); two new clarifier drives and skimmers; one main MCC was converted to two new MCCs; three existing MCCs had wiring refurbished; new lab, office, training room, and break room, all with efficient lighting

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 Woodring
Chief Wastewater Operator
300 E. Pearl Street
P.O. Box 367
Harrisonville, MO 64701
(816) 380-8960
swoodring@ci.harrisonville.mo.us

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.