LOCAL GOVERNMENT CLIMATE AND ENERGY STRATEGY GUIDES

Energy Efficiency in Water and Wastewater Facilities

A Guide to Developing and Implementing Greenhouse Gas Reduction Programs

Energy Efficiency

U.S. ENVIRONMENTAL PROTECTION AGENCY
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EPA's Local Government Climate and Energy Strategy Series

The *Local Government Climate and Energy Strategy Series* provides a comprehensive, straightforward overview of greenhouse gas (GHG) emissions reduction strategies for local governments. Topics include energy efficiency, transportation, community planning and design, solid waste and materials management, and renewable energy. City, county, territorial, tribal, and regional government staff, and elected officials can use these guides to plan, implement, and evaluate their climate change mitigation and energy projects.

Each guide provides an overview of project benefits, policy mechanisms, investments, key stakeholders, and other implementation considerations. Examples and case studies highlighting achievable results from programs implemented in communities across the United States are incorporated throughout the guides.

While each guide stands on its own, the entire series contains many interrelated strategies that can be combined to create comprehensive, cost-effective programs that generate multiple benefits. For example, efforts to improve energy efficiency can be combined with transportation and community planning programs to reduce GHG emissions, decrease energy and transportation costs, improve air quality and public health, and enhance quality of life.

LOCAL GOVERNMENT CLIMATE AND ENERGY STRATEGY SERIES

All documents are available at: ***www.epa.gov/statelocalclimate/resources/strategy-guides.html***.

ENERGY EFFICIENCY

- Energy Efficiency in Local Government Operations
- Energy Efficiency in K–12 Schools
- Energy Efficiency in Affordable Housing
- Energy-Efficient Product Procurement
- Combined Heat and Power
- Energy Efficiency in Water and Wastewater Facilities

TRANSPORTATION

- Transportation Control Measures

COMMUNITY PLANNING AND DESIGN

- Smart Growth

SOLID WASTE AND MATERIALS MANAGEMENT

- Resource Conservation and Recovery

RENEWABLE ENERGY

- Green Power Procurement
- On-Site Renewable Energy Generation
- Landfill Gas Energy

Please note: All Web addresses in this document were working as of the time of publication, but links may break over time as sites are reorganized and content is moved.

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EXECUTIVE SUMMARY

Developing and Implementing Energy Efficiency Programs

Saving energy through energy efficiency improvements can cost less than generating, transmitting, and distributing energy from power plants, and provides multiple economic and environmental benefits. Energy savings can reduce operating costs for local governments, freeing up resources for additional investments in energy efficiency and other priorities. Energy efficiency can also help reduce air pollution and GHG emissions, improve energy security and independence, and create jobs.

Local governments can promote energy efficiency in their jurisdictions by improving the efficiency of municipal facilities and operations and encouraging energy efficiency improvements in their residential, commercial, and industrial sectors. The energy efficiency guides in this series describe the process of developing and implementing strategies, using real-world examples, for improving energy efficiency in local government operations (see the guides on local government operations, energy efficiency in K–12 schools, energy-efficient product procurement, and combined heat and power) as well as in the community.

Energy Efficiency in Water and Wastewater Facilities

This guide describes how water and wastewater facilities can lead by example and achieve multiple benefits by improving the energy efficiency of their new, existing, and renovated buildings and their day-to-day operations. It is designed to be used by facility managers, energy and environment staff, local government officials, and mayors and city councils.

Readers of the guide should come away with an understanding of options to improve the energy efficiency of water and wastewater facilities. Readers should also understand the steps and considerations involved in developing and implementing these energy efficiency improvements, as well as an awareness of expected investment and funding opportunities.

RELATED GUIDES IN THIS SERIES

- **Energy Efficiency:** *Energy Efficiency in Local Government Operations*

  Local governments can implement energy-saving measures in existing local government facilities, new and green buildings, and day-to-day operations. Efforts to improve energy efficiency in water and wastewater facilities can be combined with other energy-saving measures to create a comprehensive municipal energy efficiency strategy.

- **Community Planning and Design:** *Smart Growth*

  Smart Growth involves encouraging development that serves the economy, the community, and the environment. A community that adopts smart growth principles may develop policies that optimize the siting of water and wastewater treatment systems to reduce the energy needed to pump water to and from members of the community.

- **Energy Efficiency:** *Combined Heat and Power*

  Combined heat and power (CHP), also known as cogeneration, refers to the simultaneous production of electricity and thermal energy from a single fuel source. Wastewater facilities can install anaerobic digesters that generate methane, which can be burned in a CHP system on site to heat and power the facility.

- **Renewable Energy:** *Landfill Gas Energy*

  Landfill gas energy technologies capture methane from landfills to prevent it from being emitted to the atmosphere, reducing landfill methane emissions by 60–90%. The process of landfill gas recovery and use is similar to that of recovering methane from anaerobic digesters, and could be applied to water and wastewater treatment facilities situated near landfills.

- **Renewable Energy:** *On-Site Renewable Energy Generation*

  Local governments can implement on-site renewable energy generation by installing wind turbines, solar panels, and other renewable energy generating technologies. Water and wastewater facilities with adequate land or roof area could install on-site renewable energy generators, complementing their efforts to reduce GHG emissions through energy efficiency.

The guide describes the benefits of energy efficiency in water and wastewater facilities (Section 2); a step-by-step approach to improving energy efficiency in new and existing water and wastewater facilities (Section 3); key participants and their roles (Section 4); the policy mechanisms that facilities have used to support energy efficiency programs in their operations (Section 5); implementation strategies for effective programs (Section 6); investment and financing opportunities (Section 7); federal, state, and other programs that may be able to help water and wastewater facilities with information or financial and technical assistance (Section 8); and finally two case studies of water or wastewater facilities that have successfully improved energy efficiency in their operations (Section 9). Additional examples of successful implementation are provided throughout the guide.

Relationships to Other Guides in the Series

Local governments can use other guides in this series to develop robust climate and energy programs that incorporate complementary strategies. For example, local governments can combine efforts to improve energy efficiency in water and wastewater facilities with **energy efficiency in local government operations**, **smart growth** strategies, **combined heat and power** systems, **landfill gas energy**, and **on-site renewable energy generation** to help achieve additional economic, environmental, and social benefits.

See the box on page v for more information about these complementary strategies. Additional connections to related strategies are highlighted in the guide.

Energy Efficiency in Water and Wastewater Facilities

1. OVERVIEW

Energy use can account for as much as 10 percent of a local government's annual operating budget (U.S. DOE, 2005a). A significant amount of this municipal energy use occurs at water and wastewater treatment facilities. With pumps, motors, and other equipment operating 24 hours a day, seven days a week, water and wastewater facilities can be among the largest consumers of energy in a community—and thus among the largest contributors to the community's total GHG emissions. Nationally, the energy used by water and wastewater utilities accounts for 35 percent of typical U.S. municipal energy budgets (NYSERDA, 2008). Electricity use accounts for 25–40 percent of the operating budgets for wastewater utilities and approximately 80 percent of drinking water processing and distribution costs (NYSERDA, 2008). Drinking water and wastewater systems account for approximately 3–4 percent of energy use in the United States, resulting in the emissions of more than 45 million tons of GHGs annually (U.S. EPA, 2012b).

WATER USE EFFICIENCY

Water and wastewater utilities can also reduce energy use by promoting the efficient use of water, which reduces the amount of energy needed to treat and distribute water. In California, for example, urban water use accounts for 70% of the electricity associated with water supply and treatment (Elkind, 2011). Water use efficiency can also help avoid the need to develop new water supplies and infrastructure. This guide provides some information on approaches to improve water use efficiency (such as installing low-flow plumbing fixtures), but concentrates primarily on direct energy efficiency improvements in facilities.

More information on water use efficiency for water and wastewater utilities is available from:

- EPA's Water Efficiency Strategies page: ***http://water.epa.gov/infrastructure/sustain/wec_wp.cfm***
- EPA's WaterSense site: ***http://epa.gov/watersense/pubs/utilities.html***

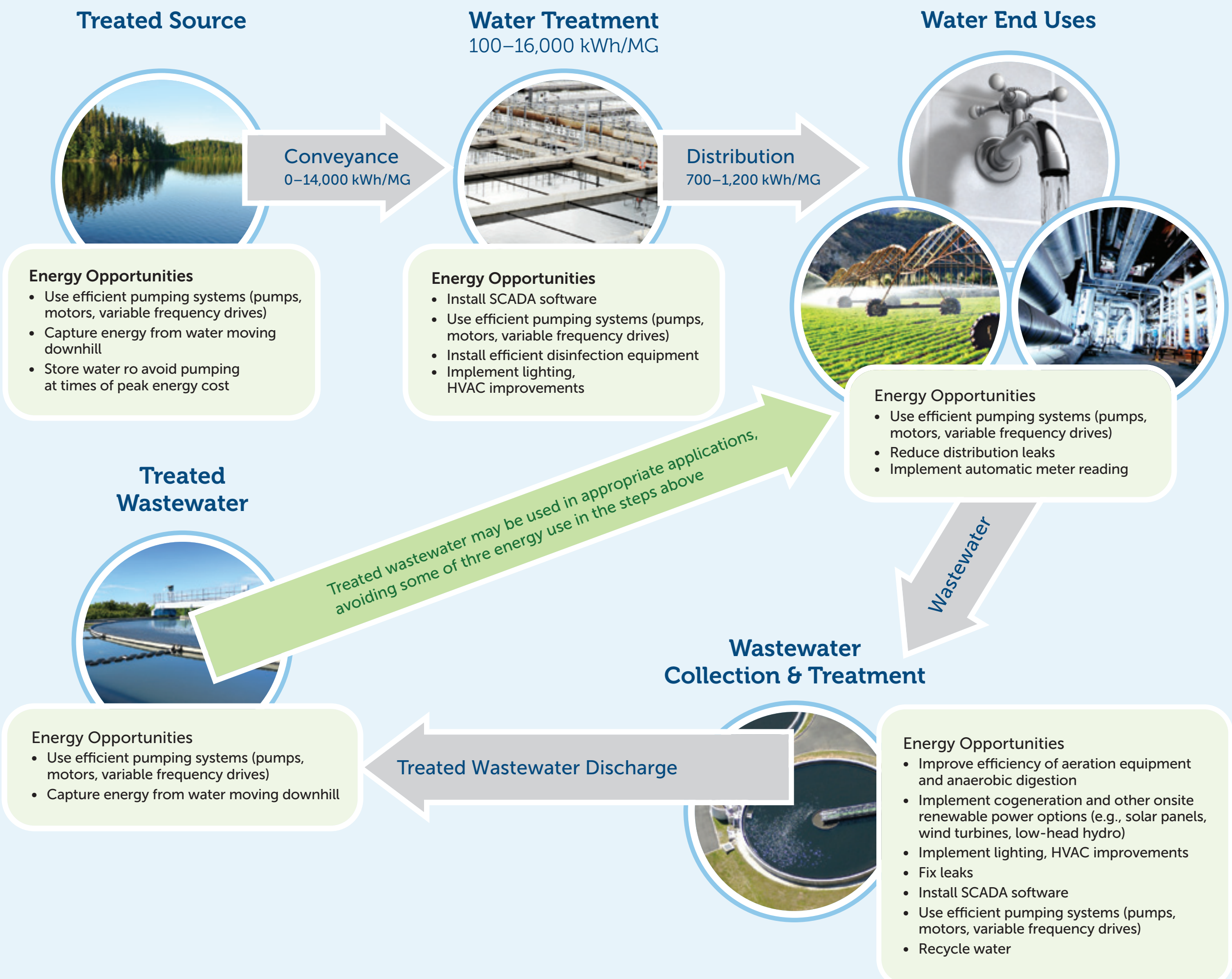
These economic and environmental costs can be reduced by improving the energy efficiency of water and wastewater facilities' equipment and operations, by promoting the efficient use of water (see text box on this page), and by capturing the energy in wastewater to generate electricity and heat. Improvements in energy efficiency allow the same work to be done with less energy; improvements in water use efficiency reduce demand for water, which in turn reduces the amount of energy required to treat and distribute water. Capturing the energy in wastewater by burning biogas from anaerobic digesters in a combined heat and power system allows wastewater facilities to produce some or all of their own electricity and space heating, turning them into "net zero" consumers of energy.

Local governments can also reduce energy use at water and wastewater facilities through measures such as water conservation, water loss prevention, stormwater reduction, and sewer system repairs to prevent groundwater infiltration. Measures to reduce water consumption, water loss, and wastewater lead to reductions in energy use, and result in savings associated with recovering and treating lower quantities of wastewater and treating and delivering lower quantities of water.

This guide focuses primarily on strategies for improving energy efficiency in water and wastewater facilities. Opportunities for improving energy efficiency in these facilities fall into three basic categories: 1) equipment upgrades, 2) operational modifications, and 3) modifications to facility buildings. Equipment upgrades focus on replacing items such as pumps and blowers with more efficient models. Operational modifications involve reducing the amount of energy required to perform specific functions, such as wastewater treatment. Operational modifications typically result in greater savings than equipment upgrades, and may not require capital investments (U.S. EPA, 2002). Modifications to buildings, such as installing energy-efficient lighting, windows, and heating and cooling equipment, reduce the amount of energy consumed by facility buildings themselves.

FIGURE 1. ENERGY INTENSITY OF EACH STAGE IN THE WATER USE CYCLE, WITH KEY OPPORTUNITIES FOR ENERGY EFFICIENCY, RENEWABLE ENERGY, AND WATER EFFICIENCY.

Sources: California Energy Commission, 2005; U.S. EPA, 2010a; U.S. EPA, 2010b; Energy Center of Wisconsin, 2003



Notes:

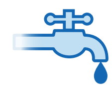
- Energy intensity is given in kilowatt-hours (kWh) per million gallons (MG).
- The energy efficiency opportunities shown are examples, not an exhaustive list.
- The ranges in energy intensity shown here are for California, whose water and wastewater sectors have higher energy intensities overall than the rest of the United States. However, the energy intensity of most U.S. water and wastewater utilities will likely fall within these ranges (U.S. DOE, 2006).
- The ranges in energy intensity at each stage in the cycle are related to differences in factors such as the water source (deep aquifers being the most energy-intensive to pump); the volume of water transported; the distances and topography between sources, treatment plants, and end users; the quality of the source water; the intended end uses; and the technologies used to treat water and wastewater.
- The energy use associated with transport of wastewater from end users to wastewater treatment facility is included under "Wastewater Collection and Treatment."
- For EPA's latest guidelines on water reuse, please see ***http://www.waterreuseguidelines.org/***.

Figure 1 shows typical ranges of energy use at each stage of the water use cycle, along with key opportunities for improving energy efficiency, conserving water, and using renewable energy. The processes of pumping and treatment are the largest consumers of energy in the water use cycle. In most cases, pumping is the largest source of energy use before, during, and after treatment of water. For wastewater, where energy-intensive technologies such as mechanical aerators, blowers, and diffusers are used to keep solids suspended and to provide oxygen for biological decomposition, treatment accounts for the largest share of energy use (California Energy Commission, 2005). Facility managers can perform energy audits or install monitoring devices that feed into their Supervisory Control and Data Acquisition (SCADA) system[1] to learn where energy is being used in their facility and identify opportunities for energy efficiency improvements.

The most effective way for communities to improve energy efficiency in their water and wastewater facilities is to use a systematic, portfolio-wide approach that considers all of the facilities within their jurisdiction. This approach allows communities to prioritize resources, benchmark and track performance across all facilities, and establish cross-facility energy management strategies. A portfolio-wide approach not only results in larger total reductions in energy costs and GHG emissions, but enables communities to offset the upfront costs of more substantial energy efficiency projects with the savings from other projects. Adopting a portfolio-wide approach can also help local governments generate greater momentum for energy efficiency programs, which can lead to sustained implementation and continued savings.

Before developing a portfolio-wide approach, local governments first need to understand the steps involved in identifying and implementing energy efficiency improvements at individual facilities. This guide is designed to help local governments understand how to work with municipal or privately owned water and wastewater utilities to identify energy efficiency opportunities. It provides information on how water and wastewater utilities have planned and implemented programs to improve energy efficiency in existing facilities and operations, as well as in the siting and design of new facilities (see the text box on page 5). It also includes information on the benefits of energy efficiency improvements in water and wastewater facilities, expected investments and funding opportunities, and case studies. Additional examples and information resources are provided in Section 10, *Additional Examples and Information Resources*.

Since this guide provides information and examples for both the water and wastewater sectors, the icons below are used to help readers quickly identify examples and resources that focus specifically on one type of facility:


Water facilities


Wastewater facilities

2. BENEFITS OF IMPROVING ENERGY EFFICIENCY IN WATER AND WASTEWATER FACILITIES

Improving energy efficiency in water and wastewater facilities can produce a range of environmental, economic, and other benefits, including:

- **Reduce air pollution and GHG emissions.** Improving energy efficiency in water and wastewater facilities can help reduce GHG emissions and criteria air pollutants by decreasing consumption of fossil fuel-based energy. Fossil fuel combustion for electricity generation accounts for approximately 40 percent of the nation's emissions of carbon dioxide (CO_2), a principal GHG. It also accounts for 67 percent and 23 percent of the nation's sulfur dioxide (SO_2) and nitrogen oxide (NO_x) emissions, respectively. These pollutants can lead to smog, acid rain, and airborne particulate matter that can cause respiratory problems for many people (U.S. EPA, 2011a; U.S. EPA, 2011b).[2]

[1] A SCADA system is a computer system used to monitor and control industrial, infrastructure, or facility-based processes.

[2] According to EPA, energy use in commercial and industrial facilities accounts for nearly 50 percent of all U.S. GHG emissions (U.S. EPA, 2011a).

The Green Bay, Wisconsin Metropolitan Sewerage District has two treatment plants that together serve more than 217,000 residents. One of the treatment plants installed new energy-efficient blowers in its first-stage aeration system, reducing electricity consumption by 50 percent and saving 2,144,000 kWh/year—enough energy to power 126 homes—and avoiding nearly 1,480 metric tons of CO_2 equivalent,[3] roughly the amount emitted annually by 290 cars (U.S. EPA, 2010a; U.S. EPA, 2011d; U.S. EPA, 2011f).

CHP FOR WASTEWATER FACILITIES

Wastewater facilities with an anaerobic digester can use biogas generated by the digester to produce heat, and in many cases electricity as well. As a rule of thumb, each million gallons per day of wastewater flow can generate enough biogas in an anaerobic digester to produce 26 kilowatts of electric capacity and 2.4 million Btu per day of thermal energy in a CHP system (U.S. EPA, 2011g).

Not all wastewater facilities use anaerobic digesters, so CHP is not an option for all wastewater plants. Furthermore, some facilities with anaerobic digesters must rely on supplemental sources to provide enough energy for electricity generation in their CHP system.

For more information on CHP in wastewater facilities, see *http://www.epa.gov/chp/documents/wwtf_opportunities.pdf*.

- **Reduce energy costs.** Local governments can achieve significant cost savings by increasing the efficiency of the pumps and aeration equipment at a water or wastewater treatment plant. A 10 percent reduction in the energy use of U.S. drinking water and wastewater systems would collectively save approximately $400 million and 5 billion kWh annually (U.S. EPA, 2011g). Facilities can also use other approaches to reduce energy costs, such as shifting energy use away from peak demand times to times when electricity is cheaper or (for wastewater plants) using CHP systems to generate their own electricity and heat from biogas.

[3] *Carbon dioxide equivalent is a measure used to compare the emissions from different GHGs based on their respective global warming potential (GWP). Carbon dioxide equivalents are commonly expressed as metric tons of carbon dioxide equivalent ($MTCO_2e$). The carbon dioxide equivalent for a gas is derived by multiplying the tons of the gas by the associated GWP. In other words, $MTCO_2e$ = (metric tons of a gas) * (GWP of the gas).*

With more than two-thirds of the up-front installation and maintenance costs covered by the State of Minnesota and a local utility, the Albert Lea Waste Water Treatment Plant in Albert Lea, Minnesota developed a 120-kW microturbine CHP system, which saves the plant about $100,000 in annual energy costs. About 70 percent of the savings resulted from reduced electricity and fuel purchases, and the remainder from reduced maintenance costs. The installation of the CHP system raised awareness at the plant about energy use in general, and led to a number of other energy efficiency improvements and additional cost savings (U.S. EPA, 2011f).

- **Support economic growth through job creation and market development.** Investing in energy efficiency can stimulate the local economy and spur development of energy efficiency service markets. The energy efficiency services sector accounted for an estimated 830,000 jobs in 2010, and the number of jobs was growing by 3 percent annually (ACEEE, 2012). Most of these jobs are performed locally by workers from relatively small local companies because they typically involve installation or maintenance of equipment (ACEEE, 2012; Lawrence Berkeley Laboratory, 2010). Furthermore, facilities that reduce their energy costs through efficiency upgrades can spend those savings elsewhere, often contributing to the local economy (Lawrence Berkeley Laboratory, 2010).

- **Demonstrate leadership.** Investing in energy efficiency epitomizes responsible government stewardship of tax dollars and sets an example for others to follow. By implementing energy efficiency and water efficiency projects at water and wastewater facilities, a local government can demonstrate not only the dollars saved, but the environmental co-benefits that are obtained from reducing energy and water use. Installing energy-efficient products (e.g., more efficient pumps), water-efficient products (e.g., WaterSense products), and renewable energy technologies (e.g., solar panels) may facilitate broader adoption of these technologies and strategies by the private sector—particularly when communities publicize the economic and environmental benefits of their actions.

In an initiative led by the city's current mayor when he was alderman, a group of residents and city staff led an initiative in 2008 to develop a plan to make the City of Franklin, Tennessee, more environmentally sustainable. This group created the city's 2009 Sustainability Community Action Plan, which called for reductions in energy use and GHG emissions, and directed Franklin's utilities to become more involved in energy efficiency audits. As part of its effort to meet the action plan's energy goals, Franklin participated in the Tennessee Water and Wastewater Utilities Partnership, co-sponsored by EPA Region 4. The partnership helped Franklin's water department identify and implement opportunities to reduce energy costs by more than $194,000 per year—a 13 percent reduction—through changes in operations and installing energy-efficient lighting. The improvements have avoided more than 1,280 metric tons of GHG emissions, equivalent to the annual emissions from powering 125 homes (City of Franklin, 2009, 2012).

- **Improve energy and water security.** Improving energy efficiency at a water or wastewater treatment facility reduces electricity demand, avoiding the risk of brownouts or blackouts during high energy demand periods and helping to avoid the need to build new power plants. Water efficiency strategies reduce the risk of water shortages, helping to ensure a reliable and continuous water supply.

The East Bay Municipal Utility District (EBMUD), which provides drinking water to 1.3 million customers and handles wastewater for 650,000 customers in the San Francisco Bay Area, transformed itself from an energy consumer to a net energy producer. By 2008 the district had brought its GHG emissions back to their 2000 level and then reduced them by an additional 24 percent the following year, all while insulating itself from energy price fluctuations and supply uncertainties (EBMUD, 2010). EMBUD started its energy transformation by cutting its energy use requirements to the point where its facilities now use 82 percent less energy than the California average for delivering 1 million gallons of drinking water from source to tap. It accomplished these improvements through design features, such as delivering drinking water via downhill pipes rather than using electric pumps, and through energy efficiency upgrades such as installing microturbine CHP units. EBMUD's remaining energy needs are met by renewable energy systems, including hydropower, solar, and biogas. Excess power produced by the renewables provides a source of income through sales of electricity into the grid (EBMUD, 2012).

- **Extend the life of infrastructure/equipment.** Energy-efficient equipment often has a longer service life and requires less maintenance than older, less efficient technologies (U.S. EPA Region 9, 2012a). Efforts to improve water efficiency or promote water conservation can also extend the life of existing infrastructure due to lower demand, and can avoid the need for costly future expansions.

SITING AND DESIGN CONSIDERATIONS FOR NEW WATER AND WASTEWATER FACILITIES

While this guide focuses mainly on energy efficiency improvements in existing facilities, energy use can also play an important role in decisions about siting and designing new water and wastewater facilities.

Distance and topography are important factors to consider in siting: by reducing conveyance distances where possible and using gravity rather than pumps, water and wastewater utilities can reduce energy costs. New facilities can also be designed from the ground up to be more energy efficient and to use efficient equipment.

Wastewater utilities may be able to achieve additional savings by decentralizing new treatment facilities. Small, local treatment facilities reduce the energy costs of conveyance and make treated wastewater available for local reuse. Decentralized wastewater facilities are being implemented at the scales of individual buildings, neighborhoods, and entire watersheds. For example, the Solaire high-rise apartment building in New York City has its own wastewater plant in the basement and collects stormwater from its roof. The stormwater and treated wastewater are used for cooling the building, flushing toilets, and irrigation (Decentralized Water Resources Collaborative, 2012).

For more information on decentralized wastewater treatment, see *www.decentralizedwater.org*.

- **Protect public health.** Improvements in energy efficiency at water and wastewater facilities can reduce air and water pollution from the power plants that supply electricity to those facilities, resulting in cleaner air and human health benefits (U.S. EPA Region 9, 2012b). Equipment upgrades may also allow facilities to increase their capacity for treating water or wastewater or improve the performance of treatment processes, reducing the potential impacts of sea level rise, treatment failures, and risk of waterborne illness.

Millbrae, California implemented a program to divert inedible kitchen grease from the city's wastewater system, where it could clog sewer lines and cause releases of raw sewage into the environment, posing risks to public health. Waste haulers collect the grease daily from area restaurants and deliver it to the wastewater treatment facility, where it is processed in digester tanks to create biogas. Before the program was implemented, the grease ended up in area landfills where its decomposition produced methane emissions. The treatment plant's digester system produces enough biogas to generate about 1.7 million kWh of electricity annually, meeting roughly 80 percent of the plant's power needs (Renewable Energy World, 2006).

3. PLANNING AND IMPLEMENTATION APPROACHES

This section describes a seven-step process that water or wastewater facilities can follow to develop, implement, and sustain energy efficiency programs (see Figure 2). This approach can help local water and wastewater facilities achieve the range of benefits described in Section 2, *Benefits of Improving Energy Efficiency in Water and Wastewater Facilities*.

The steps in this process are consistent with the Plan-Do-Check-Act management systems approach, which is a circular evolving process that focuses on continual improvement over time. This approach is described in the ENERGY STAR® *Guidelines for Energy Management* (U.S. EPA, 2011e). EPA's Office of Water has expanded the plan-do-check-act approach to a seven-step process. The steps are outlined in *Ensuring a Sustainable Future: An Energy Management Guidebook for Water and Wastewater Utilities* (U.S. EPA, 2008), which serves as the primary source for the guidance presented below. Several EPA Regions are currently working with water and wastewater facilities to help them implement energy management programs based on the *Ensuring a Sustainable Future* guidebook's approach. Similarly, local governments can work with their water and wastewater facilities to apply these steps.

EPA's *Planning for Sustainability Handbook for Water and Wastewater Utilities* describes key steps for integrating sustainability considerations, including energy efficiency, into a utility's planning process. The handbook is available at: ***http://water.epa.gov/infrastructure/sustain/upload/EPA-s-Planning-for-Sustainability-Handbook.pdf***. EPA has also developed tools that can help with the planning process, including the Energy Management Self-Assessment Tool for Water and Wastewater Utilities, available at: ***http://www.epa.gov/region9/waterinfrastructure/howto.html***.

MISSOURI WATER UTILITIES PARTNERSHIP

EPA Region 7, the Missouri Department of Natural Resources, the Missouri University of Science and Technology, and the Siemens Corporation partnered together to create the Missouri Water Utilities Partnership (MOWUP). Through a series of workshops, MOWUP has helped eight communities to:

- track their energy use,
- prioritize energy-saving opportunities,
- identify funding options,
- develop communication networks,
- evaluate renewable energy options, and
- develop near- and long-term plans for energy management.

One of the lessons learned from the initiative was the importance of collaboration and learning from one another. Each water utility is unique and faces different challenges.

The communities are projected to reduce their electricity use by more than 8 million kWh per year and avoid 5,500 metric tons of CO_2 equivalent annually—roughly the same amount emitted per year by 1,000 passenger cars.

More information about one of the communities involved in the partnership can be found in Section 9, *Case Studies*.

Source: U.S. EPA, 2011c

FIGURE 2. STEPS FOR DESIGNING, IMPLEMENTING, AND SUSTAINING ENERGY EFFICIENCY IMPROVEMENTS IN WATER AND WASTEWATER FACILITIES

Plan	***Step 1. Get Ready*** ▪ Establish the facility's energy policy and overall energy improvement goals ▪ Secure and maintain management commitment, involvement and visibility ▪ Choose an energy "fenceline" ▪ Establish energy improvement program leadership ▪ Secure and maintain employee and management buy-in ***Step 2. Assess Current Energy Baseline Status*** ▪ Establish a baseline and benchmark facilities ▪ Perform an energy audit ▪ Identify activities and operations that consume the most energy or are inefficient ***Step 3. Establish an Energy Vision and Priorities for Improvement*** ▪ Identify, evaluate, and prioritize potential energy improvement projects and activities ***Step 4. Identify Energy Objectives and Targets*** ▪ Establish energy objectives and targets for priority improvement areas ▪ Define performance indicators
Do	***Step 5. Implement Energy Improvement Programs and Build a Management System to Support Them*** ▪ Develop action plans to implement energy improvements ▪ Get top management's commitment and approval ▪ Develop management system "operating controls" to support energy improvements ▪ Begin implementation once approvals and systems are in place
Check	***Step 6. Monitor and Measure Results of the Energy Improvement Management Program*** ▪ Review what the facility currently monitors and measures to track energy use ▪ Determine what else the facility needs to monitor and measure its priority energy improvement operations ▪ Develop a plan for maintaining the efficiency of energy equipment ▪ Review the facility's progress toward energy targets ▪ Take corrective action or make adjustment when the facility is not progressing toward its energy goals ▪ Monitor/reassess compliance status
Act	***Step 7. Maintain the Energy Improvement Program*** ▪ Continually align energy goals with business/operation goals ▪ Apply lessons learned ▪ Expand involvement of management and staff ▪ Communicate success

Based on U.S. EPA, 2008.

Plan

Step 1: Get Ready

Before a water/wastewater facility can implement an energy management program and sustain it successfully over time, the facility must take the time to establish a strong foundation.

- **Establish the facility's energy policy and overall energy improvement goals.** An organization's energy policy is a statement defining its intentions and principles for energy management. Signed by top managers and communicated to all employees, the energy policy provides a framework for action and setting specific energy improvement goals and milestones.

Determining goals for energy improvements in the beginning is important for measuring success after the project, and for ensuring that the project stays on track. These goals can be quantitative (e.g., reduce overall energy use by 25 percent in three years) or qualitative (e.g., implement a community education program, setting an example for other facilities). Facilities may want to develop a mix of quantitative and qualitative goals to cover a range of quantifiable and non-quantifiable actions. Whenever possible, these goals can be developed as part of the facility's ongoing planning processes.

These goals can be ambitious but realistic. A facility can review case studies and examples—such as those provided in Section 10, *Additional Examples and Information Resources*—to see what similar facilities have been able to achieve through certain energy improvements. Water and wastewater facilities can often achieve a 20 to 30 percent reduction in energy use through energy efficiency upgrades and operational measures (U.S. EPA, 2010a). Setting goals around or above achievements by past projects is generally reasonable.

Along with establishing goals for energy efficiency improvements, a facility may consider adding goals to meet the energy requirements of any actions it takes to adapt to the risks of future climate change. EPA has developed an adaptive response framework that can help facilities identify and adjust to the potential impacts of climate change on water supplies and wastewater treatment. See the text box below on climate change adaptation and water utilities for more information.

CLIMATE CHANGE ADAPTATION AND WATER UTILITIES

Climate change poses many challenges to water and wastewater utilities through impacts such as extreme weather events, sea level rise, shifting precipitation and runoff patterns, and temperature changes. EPA's Climate Ready Water Utilities (CRWU) program (***http://water.epa.gov/infrastructure/watersecurity/climate/***) provides resources to help the water sector adapt to a changing climate by promoting a clear understanding of climate science and adaptation options.

CRWU has developed a climate ready adaptive response framework that water and wastewater facilities can use to prepare for the impacts of climate change. The framework allows facilities to maintain their readiness through an approach that recognizes the diversity of conditions facing a facility and uncertainty regarding the nature, timing, and magnitude of local climate impacts. The framework involves an iterative, continual, and adaptive process, as illustrated below. Although mainly focused on climate adaptation, mitigation of greenhouse gases and energy management is a key aspect of the adaptive response framework. Additional information on the adaptive response framework can be found at: ***http://water.epa.gov/infrastructure/watersecurity/climate/upload/epa817f12009.pdf***.

Source: U.S. EPA 2012d

CRWU has also developed tools and other resources for water and wastewater facilities, including:

- An online searchable database of freely available resources, available at: ***http://www.epa.gov/safewater/watersecurity/climate/toolbox.html***.
- The *Climate Resilience Evaluation and Awareness Tool* (CREAT), which helps drinking water and wastewater facility owners and operators understand the impacts of climate change, assess potential risks to their utilities, and evaluate adaptation options. CREAT 2.0 contains energy management resources and allows a user to consider the energy requirements for adaptation options, available at: ***http://water.epa.gov/infrastructure/watersecurity/climate/creat.cfm***.
- An *Adaptation Strategies Guide for Water Utilities* to help drinking water and wastewater utilities gain a better understanding of what climate change-related impacts they may face in their region and what adaptation strategies can be used to prepare their system for those impacts. This guide also includes information on how drinking water and wastewater utilities can approach sustainable practices, specifically green infrastructure and energy management activities. It is available at: ***http://water.epa.gov/infrastructure/watersecurity/climate/upload/epa817k11003.pdf***.
- *Preparing for Extreme Events: Workshop Planner for the Water Sector*, which contains all of the materials a drinking water or wastewater utility would need to plan a customized workshop that focuses on planning for more frequent extreme events. The materials on the Workshop Planner encourage utilities to work with their local communities and include them in the planning process, available at: ***http://water.epa.gov/infrastructure/watersecurity/climate/upload/epa817f13001.pdf***.

In 2009, the City of St. Peters, Missouri established a goal of reducing energy use by 10 percent at its wastewater facility. The city set its goal under the Energy Management Initiative for Water and Wastewater Utilities, a pilot program led by the Missouri Water Utilities Partnership. As a result of this program, the city implemented upgrades such as a new SCADA system, variable frequency drives, and new mixing equipment. The facility surpassed its 10 percent energy-savings goal in 2010, avoiding GHG emissions of nearly 550 metric tons of CO_2 equivalent—about as much as the amount emitted annually by 114 cars (U.S. EPA Region 7, 2011a).

- **Secure and maintain management commitment, involvement, and visibility.** The most compelling argument in favor of energy efficiency improvements is that they represent an opportunity to free up resources that would otherwise be spent on energy costs, allowing water and wastewater facilities to use those resources to make other needed improvements. Communicating these benefits to the appropriate managers and obtaining their commitment from the beginning is crucial. Whether it is the local/county water board, the mayor of the town/city, or the facility management, the key decision makers when it comes to purchasing, budget, and operations are important players in achieving a successful program. Keeping management updated with the progress is also important to the long-term sustainability of the plan.
- **Choose an energy "fenceline" (i.**e., the part of the facility and its operations that you want to focus on). See the text box below. Choosing the right energy fenceline is important to success. Usually the plant operators will have a good idea of where improvements need to be made and where issues exist such as high maintenance costs or inefficiency.

ENERGY FENCELINE

The energy "fenceline" is the scope of operations where the energy improvement goals will be focused and implemented. It is important to think about which operations or areas of the facility have the most outdated equipment, where the energy use is highest, and how expensive it would be to upgrade. Examples of energy fencelines include the operation as a whole, biosolids management, or aeration equipment.

- **Identify staff (or a champion) to lead the facility's energy management program.** The leadership for the energy management program will be the person or team responsible for program implementation. The leader or leadership team will meet with management to communicate successes, as well as any barriers or other challenges that the project encounters. Similarly, the energy team will be management's contact for information on the program. The energy team will be involved in establishing deadlines, delegating tasks, and evaluating the project at various stages. See the text box below.

ESTABLISH ENERGY MANAGEMENT LEADERSHIP

Energy management leadership can consist of one motivated person who champions an energy management program in smaller water/wastewater facilities or a few people that have led the efforts at a larger facility. One leader may need to begin the program and eventually gain support from others to establish a team. While a large team is not necessary to ensure success, a team of people from different areas within the facility can encourage employee buy-in, help secure management support, and can provide an avenue for creative input from a diverse group of employees.

The City of Columbus, Georgia, decided to reduce operating costs by improving energy efficiency at the municipally owned Columbus Water Works. It took the leadership of the facility's president and senior vice president of operations to switch to an energy-efficient operation. Using a team approach, senior leaders encouraged operators, team leaders, and other staff members to propose plans to increase efficiency. Managers and team leaders also have biannual seminars on energy efficiency. The results from this approach have been impressive. Columbus Water Works has re-engineered and fully automated its entire plant. The facility retrofitted older equipment, installed adjustable speed drives, and automated speed controls for pumps. It has made significant investments in energy-efficient motors, with one project alone saving the facility $250,000 in energy costs (a 25 percent reduction). The motor retrofit project had less than a 1-year payback period and received the Governor of Georgia's Award for Pollution Prevention (Alliance to Save Energy, 2011).

- **Secure and maintain employee and/or management buy-in.** It is important to have all members of the facility operations involved and supporting the energy management program. Employees will be the ones executing the plan, and it will be easier if they are convinced from the start that energy efficiency is important to the facility.

Step 2: Assess Current Energy Baseline Status

Developing a current energy baseline helps a facility assess its current energy use and provides a level for comparison with future improvements. Facilities can also use their energy baseline to determine whether their energy management goals are reasonable: a facility that is already highly energy efficient will need to spend more to further improve its energy efficiency by a given percentage than a facility that has ample room for improvement.

- **Establish a baseline and benchmark facilities.** The energy team can use a tool such as EPA's ENERGY STAR energy measurement and tracking tool, Portfolio Manager™, to track energy use and costs and to measure improvements over a baseline. Portfolio Manager, which includes a benchmarking component specific to wastewater facilities, converts all types of energy to a common unit and provides a GHG emissions estimate for each facility. In addition, wastewater treatment plants that meet certain criteria can receive an ENERGY STAR performance score from 1 to 100. This score offers managers the ability to compare the energy use of their plants with that of other similar plants nationwide. For information on Portfolio Manager and free training opportunities, visit: ***http://www.energystar.gov/waterwastewater***.

  EPA also offers the Energy Use Assessment Tool, which was designed for small- and mid-sized water and wastewater plants. The tool allows water/wastewater facilities to conduct a utility bill analysis (looking at energy consumption over time compared with volume treated) to determine baseline energy consumption and cost (in total and broken down to the process level and equipment level). In addition, the tool highlights areas of inefficiency that facilities may find useful in identifying and prioritizing energy improvement projects. To download the tool, visit: ***http://water.epa.gov/infrastructure/sustain/energy_use.cfm***.

- **Perform an energy audit.** Performing an energy audit is the next step toward developing a successful energy management program. An energy audit helps the facility target the most inefficient aspects of its operations. Some facilities may opt to perform a comprehensive site energy audit based on an analysis of utility bills and equipment metering data. Others may start with a general walk-through audit that identifies high-priority areas to study in greater depth. Depending on the degree to which equipment and processes are metered, a more detailed follow-up audit can focus on one type of equipment or one operation within the facility. The level of disaggregation in the analysis may depend on the level of detail that the facility is able to gather from its electric utility bill. The audit may be performed by the electric utility or a third party, such as an independent energy services company. Some electrical utilities offer free audits to their customers to help them reduce their energy use. Information on plant energy audits and a directory of third-party service providers who can help with audits is available at: ***http://www.energystar.gov/index.cfm?c=industry.bus_industry_plant_energy_auditing***. If the facility has already performed energy audits in the past, it can revisit and evaluate its previous audits to look for potential energy-saving opportunities.

California energy company Pacific Gas & Electric (PG&E) provides energy audits to industrial, agricultural, and large commercial clients to help identify energy-saving actions. PG&E performed an energy audit for the Dublin San Ramon Services District (DSRSD), a San Francisco-area drinking water and wastewater utility, to help make a planned expansion more energy efficient. The 11.5 million-gallon-per-day (MGD) facility needed to expand to 17 MGD, and decided to include a sand filtration recycled water treatment plant and distribution facilities to provide water for irrigation of parks, school grounds, golf courses, and roadway medians. Not only did PG&E perform an energy audit for DSRSD, but also provided the water and wastewater utility with $67,000 in incentives to help offset the additional $2.2 million that was incurred to build a more efficient plant. The total estimated savings for DSRSD was 2,232,000 kWh, or $290,000 annually (PG&E 2009).

EXAMPLES OF ENERGY EFFICIENCY IMPROVEMENTS

The examples below represent illustrate a few of the many actions that water and wastewater facilities can take to improve energy efficiency and reduce energy costs. For more examples, see U.S. EPA (2010a).

Water Facilities

- **Promote water efficiency and conservation, detect and fix distribution leaks.** Reducing demand for water and fixing leaks in the distribution system can reduce the amount of water that needs to be treated and distributed. Note that water conservation can ultimately reduce wastewater treatment needs as well.

Wastewater Facilities

- **Improve efficiency of aeration equipment.** Aeration systems in wastewater plants typically account for about half of a wastewater treatment plant's energy use. The use of improved system controls, energy-efficient blowers, and energy-efficient diffuser technologies can reduce costs in this area.
- **Move toward net zero energy.** Biogas recovered from sludge digesters can be burned to produce electricity and heat buildings at the facility.

Both Water and Wastewater Facilities

- **Improve pumping efficiency.** Ensuring that pumps are sized appropriately and installing variable frequency drives, whose speed varies to match flow conditions, can reduce energy costs.
- **Improve efficiency of HVAC/lighting.** Retrofits of HVAC and lighting systems can have high initial costs, but are generally cost-effective over the life of the investment. Efficient HVAC systems can reduce energy use by 10–40%.
- **Improve efficiency of operations.** Installing Supervisory Control and Data Acquisition (SCADA) software can increase the efficiency of process monitoring and operating control.

Source: U.S. EPA 2010a

- **Identify activities and operations that consume the most energy or are inefficient.** The energy team and facility operators can use information from the energy audit to identify the most energy-intensive and/or inefficient activities and operations in the facility. This step may require comparisons with the rated efficiency listed on equipment nameplates, or comparisons with similar models of equipment to get an idea of typical energy consumption.

Depending on who is involved in the facility's leadership, different members of the operation could be brought together to identify where efficiency improvements may be appropriate. The plant operators usually have the best understanding of equipment performance. Building managers may have ideas about ways to improve efficiency of lighting, HVAC, or other aspects of the building itself.

The energy team can develop an inventory to identify the operations and pieces of equipment in the facility consuming the most energy. The inventory can include the equipment names, nameplate horsepower (if applicable), hours of operation per year, measured power consumption, and total kilowatt-hours of electrical consumption per year, and age (if applicable). The team can gather and store this information using EPA's Energy Use Assessment Tool (available at: *http://water.epa.gov/infrastructure/sustain/energy_use.cfm*). In some cases, this information may already have been stored in a maintenance management system or may have been collected by the auditors.

TECHNOLOGIES FOR WATER AND WASTEWATER UTILITIES

EPA's Technology Fact Sheets for Wastewater provide information on a range of technologies—including tools for energy management—that could be implemented at a wastewater treatment facility. These fact sheets include information on treatment processes (e.g., disinfection, biological treatment) and wastewater equipment (e.g., pipes, disinfection equipment). They also include information about the cost of implementation and maintenance of the technology that can be useful in the planning process. The fact sheets are available at: ***http://water.epa.gov/scitech/wastetech/mtbfact.cfm***.

For more information on energy efficiency and conservation technologies for water and wastewater facilities, see:

- *Evaluation of Energy Conservation Measures for Wastewater Treatment* (U.S EPA, 2010a).
- *Energy Efficiency in the Water Industry: A Compendium of Best Practices and Case Studies* (Water Research Foundation, 2011).

At Goose Creek Sewage Treatment Plant in West Chester, Pennsylvania, a 2010 energy audit showed that treatment equipment (such as aerators, blowers, and pumps) accounts for approximately 95 percent of the facility's electricity consumption. To identify possible energy conservation and efficiency opportunities, the facility developed an inventory of its major equipment. The inventory includes descriptions and quantity of equipment, nameplate horsepower, estimates of run hours, and calculations of kWh/yr. The inventory revealed that blowers account for 57 percent of the total energy use of all treatment equipment at the plant (U.S. EPA Region 3, 2011).

Step 3: Establish an Energy Vision and Priorities for Improvement

This step involves identifying and establishing priorities for the facility's energy efficiency improvements.

- **Based on results of energy assessments and audits, identify, evaluate, and prioritize potential energy improvement projects and activities.** The energy team can make a list of all of the projects that could be implemented to increase energy efficiency. These projects may involve operational changes (e.g., shifting to greater use of off-peak electricity) or equipment upgrades (e.g., replacing a pump). Employees who work in areas within the energy fenceline will be a good source for project ideas, as they are most familiar with the daily operations and the equipment. See the text box on page 11 for examples of energy efficiency improvements.

KEY DEFINITIONS

- **Goal:** A quantitative or qualitative result that a facility has decided to achieve.
  Example: Reduce facility energy use by 25%.
- **Objective:** A shorter-term step that a facility needs to complete in order to ultimately achieve its goal.
  Example: Create an energy management team.
- **Target:** A measurable performance requirement associated with a goal or objective.
  Example: Reduce facility energy use by 25% from 2011 levels by 2015.

Once the possible projects have been identified, the next step is to prioritize which projects can be implemented. The energy team can develop a set of criteria that will be used to evaluate the projects against each other, considering factors such as payback period and up-front cost of implementation. In general, the team can prioritize "low hanging fruit" opportunities in the most energy-intensive processes in the operation of water or wastewater facilities, focusing on actions that provide the greatest reduction of energy at the lowest cost (U.S. EPA, 2010a). This approach will favor making improvements in energy efficiency before pursuing options for on-site renewable energy. Energy efficiency improvements will also help reduce a facility's overall energy requirements, potentially reducing the capacity required from renewable sources if the facility is aiming to be a "net zero" consumer of energy. Examples of criteria that could be used in priority ranking include:

- Capital costs
- Operation and maintenance costs
- Potential for energy reduction
- Maintenance required
- Existing need for equipment upgrade
- Return on investment
- Regulatory requirement
- Ease of implementation

After the list of criteria is established, the energy team can evaluate each project under each of the criteria. Projects that score the highest can receive priority. See Appendix H on page 105 of EPA's *Ensuring a Sustainable Future* guidebook for an example ranking table, available at: ***http://water.epa.gov/infrastructure/sustain/upload/Final-Energy-Management-Guidebook.pdf***.

Step 4: Identify Energy Objectives and Targets

- **Establish energy objectives and targets for priority improvement areas.** Specific objectives and targets can be identified for each of the projects that have been prioritized. These targets can be ambitious but realistic, and measurable.

- **Define performance indicators.** Performance indicators are quantifiable measurements that the facility will need to take or obtain to measure progress toward facility targets. Indicators may be developed from the electricity bill, natural gas bill, or internally generated reports, and need to be easily accessible.

POSSIBLE OBJECTIVES FOR ENERGY EFFICIENCY PROJECTS

- Reduce energy costs.
- Reduce peak energy demand.
- Reduce GHG emissions.
- Improve reliability.
- Reduce reliance on fossil fuels.
- Achieve net zero energy consumption through energy efficiency and on-site renewable energy generation.

Using performance indicators such as electricity consumption or energy cost per gallon of water or wastewater treated gives the energy intensity of the process instead of the total energy consumed. This allows the facility to compare its performance against that of other facilities, and to compare the different processes of the path of treatment. ENERGY STAR's Portfolio Manager tool, described on page 10, facilitates this comparison and allows wastewater plants to benchmark their energy consumption.

Examples of performance indicators include:

- Electricity consumption per unit of time or gallon of water or wastewater treated
- Natural gas consumption per unit of time or gallon of water or wastewater treated
- Peak electricity demand
- Energy cost per unit of time or gallon of water or wastewater treated

Do

Step 5: Implement Energy Improvement Programs and Build a Management System to Support Them

Now that the water or wastewater facility has decided which improvements will be made, along with the targets and objectives for those improvements, it must prepare for implementation and build a management and operations structure that can ensure the program's long-term success.

- **Develop action plans to implement energy improvements.** Creating a formal action plan outlining responsibilities and a timeline will help to keep the implementation on track and ensure that all participants are aware of their role in the implementation. Tasks such as replacing blowers and pumps or installing a new disinfection system may be complex and involve multiple stages that need to be laid out. Facilities can follow these steps:

1. List the tasks that need to be performed.
2. Assign responsibilities for who will perform these tasks.
3. Establish deadlines for these tasks. Remember to keep these deadlines realistic but consistent with the overall goal timeline.
4. Estimate staff time and cost (e.g., equipment, labor, other services) for implementation. Approve these costs with managers (even if they have already approved them).
5. Coordinate with state regulatory agencies to determine if changes in equipment or operations require any regulatory review.

- **Get senior level management's commitment and approval.** Managers can ensure that the energy management program aligns with other goals for the facility and that the capital costs and staff time are reasonable and feasible.
- **Develop management system "operating controls" to support energy improvements.** Operating controls are documents that specify the way to execute a certain activity or operation. These controls need to be established before implementation.

Operating controls include:

- ***Training***: Evaluate current training to determine if energy management training can be incorporated into an existing training program to reduce burden.

- ***Communication***: Evaluate internal and external communications to determine where communication of the energy policy and energy goals can be directed within the facility (e.g., employees, managers) and outside of the facility (e.g., local citizens, energy advisory groups, local officials).

- ***Controlling documents and managing records***: Review and evaluate the current document control and records procedures. Ensure that the procedures are updated to account for changes to the energy management program.

- ***Work instructions or Standard Operating Procedures and operations/equipment manuals for energy improvements***: Operating controls outline the procedures for maintenance, calibration, and operation of or piece of equipment or process. Operating controls may or may not need to be updated to include the most recent energy improvements that the facility will implement. The facility can review the current operating controls and update or draft new ones. Additionally, it can review the maintenance and calibration requirements to be sure that these are consistent. After requirements have been developed and checked for completeness, the energy leaders can communicate the operating controls to staff, discuss the effectiveness of the procedures with staff, and make changes accordingly.

Swatara Township, Pennsylvania, decided to include energy efficiency among the standard selection criteria that it uses when selecting new treatment processes at its wastewater facility. In 2005, the facility responded to stricter nutrient discharge limits by evaluating several alternatives to its current treatment process. Energy use ended up being the differentiating feature among the processes evaluated, leading the facility to decide to upgrade its aeration process. In its decision, the facility factored in the impact of future energy prices in Pennsylvania, which are expected to nearly double the cost of power over the life of the plant. By reducing its energy needs now, the facility's efficiency improvements will result in even greater cost savings in the future as energy prices increase (Whittier et al., 2011).

- **Begin implementation once approvals and systems are in place.** Once key managers and staff have the information they need, understand their tasks and responsibilities, and have a clear vision of the program's goals and objectives, they will be prepared to implement energy efficiency improvements in their facilities.

Check

Step 6: Monitor and Measure Results of the Energy Improvement Management Program

- **Review what the facility currently monitors and measures to track energy use.** The purpose of this step is to review and compile what was already collected in Step 2 when performing the energy audit. The facility can gather all of this information into one centralized location and review to make sure the information is accurate.

- **Determine what else the facility needs to monitor and measure its priority energy improvement activities.** Next, the water or wastewater facility can evaluate progress toward its energy targets. If there are data that need to be obtained, where and how will the facility obtain them? This step may require going back to review the energy objectives and targets.

COMPREHENSIVE ASSET MANAGEMENT FOR WATER AND WASTEWATER UTILITIES

Comprehensive asset management is a process by which water and wastewater utilities obtain detailed information on the age and condition of their capital assets, determine maintenance needs, assess risks, and set priorities for maintenance and replacement. Asset management can also be used to identify opportunities for improving energy efficiency.

EPA's Check Up Program for Small Systems (CUPSS) tool is a free asset management tool for water and wastewater utilities. Utilities can use CUPSS to develop a record of their assets, a schedule of required tasks, an understanding of their financial situation, and a tailored asset management plan. For more information, please visit: ***http://water.epa.gov/infrastructure/drinkingwater/pws/cupss/index.cfm***.

- **Develop a plan for maintaining the energy efficiency of equipment.** Maintaining any energy-using equipment that has been installed is vital to the continued success of an energy program. The maintenance schedule for each piece of equipment or system needs to be noted, considering the following questions:

  - Who is responsible for maintenance? Does the vendor provide maintenance?
  - How often does maintenance need to be performed? What are the actions for maintenance?
  - If the facility is performing the maintenance, are all of the necessary resources available (e.g., fuel, spare parts, filters, etc.)?
  - Will outside contractors need to be brought in to perform maintenance?
  - Is the performance evaluated with the maintenance?
  - Where are the records kept for the maintenance and performance evaluations?

  Determining the answer to these questions is important to maintaining the program and the operation. Large equipment typically has high repair costs that may be prevented through regular maintenance.

- **Review the facility's progress toward energy targets.** Develop a plan for regular review of progress toward the facility's energy targets. This may include conducting periodic energy audits or simply reviewing energy data over time. Energy managers can use EPA's ENERGY STAR Portfolio Manager tool and/or EPA's Energy Use Assessment Tool (both described in Step 2) to review energy data over time.

The City of Joplin, Missouri uses EPA's ENERGY STAR Portfolio Manager to track energy use and consumption patterns at its wastewater treatment facility by entering monthly energy data gathered from electric utility bills. The city is using this information to optimize new systems and guide planning for future investments. During the first three months of 2011, upgraded equipment installed at the facility reduced overall energy demand by 5.8 percent compared to the same period during the previous year (EPA Region 7, 2011a).

- **Take corrective action or make adjustments when the facility is not progressing toward its energy goals.** During the review of progress toward energy targets, a facility may find that some goals will not be attained by the original deadline. Several questions can be asked to determine the source of the problem:

  - Was the target realistic?
  - Were the identified tasks sufficient to achieve the targets?
  - Were some tasks not completed?
  - Did anything change (e.g., flows, energy prices, personnel)?

  Depending on the answers to these questions, the facility may need to modify its target, controls, or systems. To ensure success, the facility may need to develop an alternative strategy for achieving its goals. For more strategies, see Section 6, *Strategies for Effective Program Implementation*.

- **Monitor/reassess compliance status.** Compliance with public health and environmental standards is one of the primary goals for a water or wastewater treatment facility. The facility must ensure that the energy management program has not compromised compliance.

Act

Step 7: Maintain the Energy Improvement Program

Once the projects have been implemented, the facility can go back and evaluate the energy goals, apply lessons learned, and get others involved and aware of the projects.

- **Continually align energy goals with other business/operational goals.** Beyond compliance, there are other goals that the facility has to fulfill or strive for in order to operate successfully. Energy efficiency improvement goals will change as overall business or operational goals evolve.

- **Apply lessons learned.** After a facility has gone through an energy improvement program, the energy team can create a list of lessons learned. This list will help inform future energy program implementation at the facility, but may also be used to communicate successes and difficulties to other facilities.

- **Expand involvement of management and staff, as necessary.** After a program has been implemented, maintenance and evaluation will be continuing tasks. To get others involved in these ongoing processes, a facility can consider expanding the leadership team to include other management, staff, or local officials who have gotten involved in the project during its implementation. These people may not have been included on the original leadership team, but their perspective and experience can prove valuable.

- **Communicate success to facility management and local decision makers (e.**g., boards, town councils, etc.). Communicating the success of the program to others helps ensure continued support from management and the larger community. It may also help lead to additional projects at the facility, other facilities, or other government operations. EPA's Portfolio Manager tool, described on page 10, can help with this step because it automatically provides estimates of CO_2 emissions reductions and other benefits based on energy savings.

The activities in this step will help facilities identify opportunities for further energy efficiency improvements and future initiatives, completing the plan-do-check-act cycle and leading back to the planning activities described above under Step 1.

4. KEY PARTICIPANTS

Local governments can work with a range of participants to plan and implement programs to improve energy efficiency in water and wastewater facilities. This section provides information on these participants, along with descriptions and examples of how each can contribute unique authority or expertise.

- **Mayor or county executive.** Local government executives can provide key support for an energy efficiency program by mobilizing resources and ensuring program visibility. Many local government executives have appointed energy advisory committees to provide guidance on improving energy efficiency in facilities and operations. Working with these committees, while effectively communicating the financial and environmental benefits of energy efficiency, can gain the mayor's or county executive's support for energy efficiency improvements upfront and help ensure success.

Indianapolis Mayor Gregory Ballard faced the challenge of addressing combined sewer overflows[4] of 7.8 billion gallons per year. He initially considered a proposal to implement a new system that would cost $3.8 billion over 20 years and increase sewer rates to more than $100 per month. Convinced that more cost-effective options might be available, the mayor directed the Indianapolis Department of Public Works (DPW) to review and modify the plan. The DPW identified sustainable solutions such as green roofs, rain gardens, and bioswales[5] that could prevent nearly half the problematic runoff from entering the stormwater system and save $740 million (Indianapolis DPW, 2011). To learn how other municipalities could undertake similar integrated approaches to stormwater and wastewater planning, please see *http://cfpub.epa.gov/npdes/integratedplans.cfm*.

- **City or county council.** In many local governments, the city or county council must approve energy efficiency improvements, especially if substantial funding or a change to existing policies or codes is required. In addition, many city and county councils have initiated energy efficiency improvements by establishing policies that require departments to reduce energy consumption. Many local government legislative bodies have passed resolutions to participate in the ENERGY STAR Challenge[6] or other regional, national, and international campaigns to improve energy efficiency and reduce impacts on the climate. Involving the city/county council from the beginning of the program (e.g., attending a meeting to outline the plan) will provide an opportunity for sharing ideas and possibly developing future legislation.

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4 *Combined sewer overflows occur when the volume of wastewater and stormwater in a sewer system exceeds the capacity of the treatment plant.*

5 *Green roofs, also known as rooftop gardens, are vegetative layers grown on rooftops. Rain gardens are planted depressions that allow rainwater to be absorbed into the ground, reducing runoff. Bioswales are landscape elements designed to remove silt and pollution from surface runoff water.*

6 *The ENERGY STAR Challenge is EPA's national call-to-action to improve the energy efficiency of America's buildings and facilities by 10 percent or more. For more information, visit: http://www.energystar.gov/index.cfm?c=challenge.bus_challenge.*

The City Council of Austin, Texas has been very involved in the water efficiency measures adopted by the city. In 2006, the council charged a citizen water conservation implementation task force with recommending additional conservation measures to reduce water use. The task force set goals to reduce peak water use by 1 percent per year over a 10-year period. Its plan involved incentive programs, water audits, retrofits, education/outreach programs, and reclamation and reuse. The city has implemented many of the task force's recommendations (Alliance for Water Efficiency, 2010). In 2012, the council voted unanimously to revise Austin's water use strategy in order to continue strengthening conservation efforts while protecting the city's urban landscape and tree canopy (Austin Water, 2012).

- **Local code enforcement officials and planning departments.** Local governments can work with their code enforcement officials and planning departments to update codes to incorporate energy efficiency strategies for water and wastewater treatment. Planning departments can also be responsible for developing local energy plans that can include energy efficiency-specific goals and activities. Adding energy efficiency measures at a water or wastewater facility to the local energy plan is an effective way to address water conservation and efficiency within the community.

- **Local water consumers.** Residential, commercial, and industrial consumers have key roles to play in water efficiency and conservation, along with supporting initiatives to improve energy efficiency at water and wastewater facilities. As ratepayers, local consumers have a vested interest in reducing energy costs and improving the efficiency of operations at water and wastewater plants. Publicly owned water and wastewater facilities may need to educate and reach out to residents to raise awareness and build support for proposed improvements.

  Strong community participation in water conservation efforts can greatly reduce energy use at the water or wastewater facility by reducing demand for water and the amount of wastewater that needs to be treated. Combining community water efficiency and conservation efforts with energy efficiency improvements at water or wastewater plants can result in significant cost savings and environmental benefits.

Through its efforts to engage and educate the community, the government of Brattleboro, Vermont, succeeded in securing strong public support to move forward with a $32.8 million upgrade project at its wastewater treatment facility (City of Brattleboro, 2012). The upgrade is being financed through a combination of municipal bonds and state revolving loan funds. To inform its residents about the importance of the project, the town government held public meetings, gave presentations, and repeatedly aired a 45-minute video on local television explaining the upgrades (Urffer, 2009).

- **Water development boards.** Water development boards are state agencies that are responsible for overseeing the development, conservation, and quality of water resources for states and localities, as well as wastewater treatment. The water development board is often responsible for the long-range planning of water projects and ensuring appropriate water quality through effluent regulations, which can be an important factor in installing new energy-efficient equipment. Some development boards also administer the state revolving funds, and water or wastewater facilities and local government officials can contact them for more information about applying for these funds.

The Texas *Water Development Board's Water Conservation Best Management Practices Guides* offer a range of practices for implementing water conservation. *http://www.twdb.texas.gov/conservation/bmps/index.asp*

- **State energy and environmental departments.** State energy and environmental offices can often provide local governments with information resources and technical assistance in planning energy efficiency strategies for local water and wastewater facilities.

Florida's Department of Environmental Protection (DEP) established a water reuse program to help decrease the volume of wastewater in the state. Of the more than 3,000 wastewater treatment facilities throughout Florida, 482 facilities have been permitted to make reclaimed water available for reuse. The DEP works with Florida's five regional water management districts and with individual municipal wastewater utilities to promote and facilitate reuse activities through technical assistance and outreach. More than 280,000 residences, 500 golf courses, and hundreds of parks and schools in Florida are irrigated with reclaimed water. The state currently uses about 659 million gallons per day of reclaimed water, compared with 6 billion gallons of freshwater (Florida DEP, 2011).

- **State legislatures.** State legislatures have the authority to pass legislation that would reduce energy use at water or wastewater facilities. Several states have passed legislation that mandates water conservation programs for local governments, requires the consideration of energy-efficient equipment in new facilities, or establishes a water reuse program. Local governments would be responsible for following or implementing these programs, and may thus benefit from being involved in the decision-making process at the state level.

In 2012, a new Massachusetts law added biogas digesters to the list of technologies covered under the state's net metering law. Under net metering, facilities that produce their own renewable energy are allowed to sell their excess generation through the electrical grid. The new law provides an added incentive for wastewater facilities in the state to capture biogas from anaerobic digestion and use it to generate electricity (Commonwealth of Massachusetts, 2012).

- **State water quality agencies.** State water quality agencies monitor effluent quality for wastewater treatment plants. They also ensure that equipment or processes modified to improve energy efficiency will not affect water quality. When performing an upgrade to the treatment system, a water or wastewater facility may need to contact the agency to apply for or renew a water quality permit.

- **State drinking water primacy agencies.** State drinking water primacy agencies have been delegated the authority by EPA to implement the requirements of the Safe Drinking Water Act. They also ensure that equipment or processes modified to improve energy efficiency will not affect drinking water quality or public health. When performing an upgrade to the treatment system, a water facility may need to contact the primacy agency to review the plans for the proposed changes.

- **Public service commissions.** Public service commissions regulate rates charged by private water and wastewater utilities (and public utilities in some states), establish service territories, monitor utility services, and perform other regulatory and outreach functions. Public service commissions can play a key role in facilitating "net zero" energy and other energy or water conservation efforts at water and wastewater facilities.

After receiving an application for permission from a county water and sewer authority, the North Carolina Utilities Commission determined that biosolids used to produce energy at wastewater treatment facilities would be considered renewable energy, allowing them to qualify for a renewable energy credit from the state. Previously, North Carolina's renewable energy credit was limited to solar, wind, and other conventional renewables (North Carolina Utilities Commission, 2011).

- **Federal agencies.** Federal agencies can provide energy efficiency information and resources for local government officials and officials running water and wastewater facilities. See Section 8, *Federal, State, and Other Program Resources* for information on relevant programs.

- **Non-profit organizations.** A number of water and wastewater facilities have partnered with non-profit organizations such as the American Water Works Association, the Consortium for Energy Efficiency, the Alliance to Save Energy, the Alliance for Water Efficiency, or the Water Environment Federation to plan and implement energy efficiency projects in their facilities and operations. These organizations offer water and wastewater facilities technical assistance, and can direct them to information on energy efficiency. Refer to Section 8, *Federal, State, and Other Program Resources* for more information about specific non-profit organizations.

- **Design engineers.** Design engineers are hired to create wastewater or water treatment systems that comply with the regulations and other objectives of a treatment upgrade. Water or wastewater facilities can inform design engineers upfront when making major upgrades that energy efficiency is one of the key decision criteria and is a priority of the project.

The Brightwater Wastewater Treatment System in King County, Washington, is a $1.8 billion construction project that incorporated energy efficiency and other environmental considerations in the facility design and construction. The treatment plant's aeration system uses high-efficiency microturbine blowers that are 30–50 percent more efficient than traditional blowers, and incorporates other air handling modifications that together reduce energy consumption by approximately 50 percent compared with conventional systems. The project brought together architects, engineers, and contractors to create an environmentally friendly and financially efficient construction process. Through these efforts, the Brightwater Team has reused 370,000 tons of construction materials, saving about $39,000 and avoiding 180 metric tons of carbon dioxide emissions, equivalent to GHG emissions of more than 30 cars (EPA Region 10, 2009).

- **Electric utilities.** Electric utilities can be important resources for water and wastewater facilities. Some have programs that provide free energy audits for facilities, rebates for energy-saving equipment, or programs to help increase energy efficiency at the plant. The electric utility is also an important source for obtaining the energy consumption data for the facility that will be necessary when establishing the energy baseline and as the facility is tracking progress of the energy reduction goals. Some electric providers also provide financial incentives for energy conservation and peak demand reduction—Tennessee Valley Authority is one example.

Oregon's electric utilities provide free energy audits by third-party auditors to wastewater utilities. The audits include a walk-through of the facility and preliminary cost estimates (Energy Trust of Oregon, 2011).

- **Vendors.** Vendors that sell energy-efficient products can provide cost information and details about the performance of energy-efficient alternatives to help facility energy managers decide which equipment would work best for their facility.

- **Energy services companies (ESCOs).** Many local governments have contracted with ESCOs to conduct energy audits and perform energy efficiency upgrades on a performance-contracting basis. Under a performance contract, local governments can often avoid using capital budgets to pay for the upfront costs of energy efficiency improvements, which are paid for over time using energy cost savings. For more information on energy performance contracts, see Section 7, *Investment and Financing Opportunities*. The Federal Energy Management Program keeps a list of qualified ESCOs.[7]

In September 2007, the City of Rome, New York, teamed with Johnson Controls to install $2 million worth of energy efficiency improvements that will pay for themselves through lower electric utility bills. The self-funded performance contract included lighting upgrades, a new boiler, energy management systems, and building envelope improvements. Based on the upgrades' success, the city entered into another performance contract with Johnson Controls in February 2008 to trim energy costs at its wastewater treatment facility. This contract includes both modernizing and increasing the plant's capacity. The facility will save more than $100,000 annually through reduced energy consumption, while making it easier for the plant to meet its discharge permit requirements (Johnson Controls, 2009).

- **Water efficiency services companies.** This emerging field of companies can perform water audits and implement water conservation measures to help reduce the amount of water that must be processed by water and wastewater facilities, helping to improve energy efficiency. A local government or water/wastewater facility may want to hire a water efficiency services company to implement water efficiency and water conservation measures at the largest consumers of water and producers of wastewater. These services would reduce the total amount of water that needs to be treated and ultimately lead to energy and cost savings.

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[7] *For more information on the qualifications and for a complete list, see http://www1.eere.energy.gov/femp/financing/espcs_qualifiedescos.html.*

5. FOUNDATIONS FOR PROGRAM DEVELOPMENT

This section provides examples of a range of strategies local governments have used to launch energy efficiency programs and policies in their water and wastewater facilities.

- **Mayor or county executive initiatives.** Local governments can use the visibility of the mayor's or county executive's office to encourage the local facilities to improve energy efficiency, often through executive orders or other proclamations.

Mayor Bill Finch of Bridgeport, Connecticut, is a vocal proponent of improving his city's environmental sustainability. The Finch administration has established an Energy Improvement District to promote the planning, development, and funding of energy-related activities—one of which is a project to install an anaerobic waste digester and CHP system at a city wastewater treatment plant (City of Bridgeport, 2012).

- **Local government resolutions.** City and county councils can initiate energy efficiency programs in water and wastewater facilities. Many local, state, and federal governments have adopted standards that include energy and water efficiency measures and/or have mandated that new government buildings meet green building standards (see text box on this page). Building codes are regulations adopted by local and state governments that establish standards for construction, modification, and repair of buildings and other structures. An energy code is a portion of the building code that relates to energy use and conservation requirements and standards (see *www.energycodes.gov*). Building codes can help a water or wastewater facility save energy.

- **Local government programs.** Many local governments have implemented strategic plans to improve energy efficiency within local operations. As a result, some local water and wastewater facilities have implemented energy efficiency activities under broader efforts coordinated by local governments. Electric utilities (including local municipally owned utilities) may coordinate with water and wastewater facilities to help the facilities achieve their energy reduction goals.

GREEN BUILDING

Green building initiatives promote human and environmental health and resource conservation over the life cycle of a building. A variety of green building standards exist, covering energy efficiency, water efficiency, and specific components of the building. Standards for water efficiency help reduce overall water use and demand at water and wastewater facilities. Many green building standards specify the use of WaterSense products. For more information on WaterSense, see Section 8, *Federal, State, and Other Program Resources*.

Water and wastewater facilities that construct or renovate to green building standards can achieve energy efficiency improvements in lighting, heating, and air conditioning, complementing the improvements achieved through upgrades to the facility's operating equipment.

In 2005, the City of Saco, Maine, formed an energy committee composed of one city councilor and five city staff. After signing on to the voluntary Governor's Carbon Challenge with a commitment to reduce its GHG emissions to 25 percent below 1990 levels by 2010, the committee began to identify a number of emissions reduction projects it could implement in city-owned property. It started by upgrading lighting and refrigerators, and then turned to the wastewater treatment facility—the largest consumer of energy in the city. Through a combination of energy efficiency and renewable energy upgrades—including a variety of process and equipment efficiency improvements in the plant, a wind turbine that generates electricity for the administration building, and the use of wastewater effluent to provide geothermal heating and cooling for another building, the treatment facility is expected to save $10,000 per year, or about 67,000 kWh (City of Saco, 2012).

- **Local ordinances.** Many local governments have enacted water conservation ordinances as a way to save or protect local water resources. A locality might implement an ordinance to restrict outdoor watering of lawns completely or on certain days of the week. Or a community could require that landscaping plans consider water use on new construction projects. Ordinances can also be an effective way to decrease water use, thereby reducing energy use in water and wastewater treatment facilities.

The City of Indio, California, passed an ordinance to improve water conservation through water waste prevention and by mandating the installation of landscaping equipment to improve water conservation (e.g., rain-sensing devices that override lawn sprinklers set on automatic timers) (City of Indio, 2011).

- **Individual water or wastewater facility initiatives.** An individual facility may adopt cost-effective energy efficiency initiatives in its buildings and plant operations that are not necessarily part of a larger initiative across all facilities by the parent water or wastewater utility. For example, a facility could improve the energy efficiency of building operations by installing motion sensors in rooms and task areas, which would avoid large capital investments in energy efficiency improvements while providing energy savings over time.

- **Water or wastewater facility planning process.** In both water and wastewater treatment, pumping is a very energy-intensive process. Energy use can be avoided by reducing the distance that water or wastewater must be pumped, or by using gravity rather than pumping wherever possible. While the siting of water treatment facilities is determined largely by topography and the location of water sources, wastewater facilities can be decentralized to provide treatment and reuse services close to individual point sources of wastewater generation, such as industrial facilities, clusters of homes, or individual buildings (see the text box on page 5 describing siting considerations).

Local governments have an opportunity to influence the location of water and wastewater facilities through the use of comprehensive plans and design guidelines, which set forth policies, goals, and objectives to direct development and conservation that occur within a planning jurisdiction. These plans and guidelines generally have a broad scope and long-term vision. Design guidelines provide a connection between general planning policies and implementing regulations, such as zoning codes and subdivision regulations. Zoning codes implement the goals and objectives of a comprehensive plan. By incorporating the energy-conscious siting of water and wastewater system in comprehensive plans, pumping needs can be reduced to save energy.

6. STRATEGIES FOR EFFECTIVE PROGRAM IMPLEMENTATION

Consistent with the steps described above for planning and program development, water and wastewater facilities can use a number of implementation approaches to improve energy efficiency, including:

- **Engage leadership and management.** By creating a well-defined energy plan and effectively communicating the benefits of energy efficiency, focusing in particular on costs and benefits (e.g., payback period, return on investment, rates of return, GHG reductions, criteria pollutant reductions), the energy team can build support and buy-in from facility managers as well as external decision makers such as municipal leaders.

- **Obtain adequate information on energy-efficient technologies, their costs and benefits, and how to finance upgrades.** Federal, state, and nongovernmental agencies and organizations offer a range of information resources that water and wastewater facilities can use to develop implementation plans and identify funding opportunities. For a list of resources and local government case studies, refer to Section 10, *Additional Examples and Information Resources*.

- **Pursue creative financing options.** Many local, state, and federal agencies offer funding or financing for energy efficiency improvement projects. For a list of funding and financing options, refer to Section 7, *Investment and Financing Opportunities*.

- **Develop political consensus.** Local government decisions can be inhibited, or the process can be prolonged, when key stakeholders disagree on fundamental goals or approaches. To avoid this risk, local governments can take steps to educate stakeholders about the many benefits of energy and water efficiency, and build support for incorporating efficiency goals into local initiatives and ordinances.

Strategies for Developing an Energy Efficiency Program

- **Maintain leadership to continually improve the energy efficiency program.** Maintaining the energy management leadership that was established at the beginning of the program is critical to the continued success of the energy efficiency program. Leadership could consist of one champion to head the program, or an energy team at a larger water or wastewater facility, which can be made up of local officials, operators, building maintenance officials, and other members of the facility who can gain buy-in from all groups within the operation. When the people who will be operating the equipment are involved in the planning, the benefits are more likely to be sustained.

The town of Trumbull, Connecticut, has taken a systems approach to determine how to improve the energy efficiency of one of its sewage pumping stations. The town used a team of three engineers plus several consultants from the manufacturer of a new pump being used in the project to evaluate the system as a whole. Based on the evaluation, the team installed an additional pump and removed an ineffective pump speed control system, reducing the system's energy use by 31,900 kWh per year—a 44 percent reduction—and saving $2,600 annually in energy costs. The total capital costs for implementation were $12,000, resulting in a payback of 4.6 years (U.S. DOE, 2005b).

- **Adapt activities to each unique facility.** Some energy efficiency measures may be successful for some facilities but not for others. Each individual facility can evaluate its goals and determine which energy efficiency measures are most appropriate.

- **Combine low-cost energy efficiency measures with higher-cost measures.** Combining energy efficiency measures that have lower implementation costs with those that have higher costs can allow facilities to use savings from the low-cost measures to offset the costs of the more expensive measures, shortening the overall payback period.

- **Train facilities operation and maintenance staff.** By training staff in proper use and maintenance of energy-efficient equipment and processes, facilities can increase their ability to sustain energy efficiency upgrades into the future. Equipment can become less efficient without proper maintenance and cleaning.

- **Integrate energy efficiency and clean energy supply objectives.** Water and wastewater facilities around the country are adopting renewable energy technologies to help reduce the use of energy generated by fossil fuels. Examples of renewable energy include combined heat and power, sludge digester methane use, solar panels on roofs or property, and wind turbines. (See EPA's *Green Power Procurement*, *On-Site Renewable Energy Generation*, *Combined Heat and Power*, and *Landfill Gas Energy* guides in the Local Government Climate and Energy Strategy Guides series for more information on renewable energy.)

The Sewerage Commission-Oroville Region (SCOR) in Oroville, California, has installed a 520-kW solar power system that meets 80 percent of the wastewater treatment plant's electricity needs. The facility is designed to treat 6.5 million gallons of wastewater per day and is located on 60 acres, providing plenty of room for photovoltaic panels (SPG Solar, 2012).

- **Recognize success.** Government agencies and programs have recognized exemplary work by local governments and utilities as a way to highlight innovation and promote solutions for water and energy efficiency initiatives. Local governments can help to spread the word to the public and other governments through news releases and website postings about water and wastewater facilities that have won state or federal awards.

  EPA gives out the Drinking Water State Revolving Fund (DWSRF) Awards for Sustainable Public Health Protection to recognize projects funded by DWSRF that exceed requirements and show creativity and dedication to public health protection. For more information on applications, local governments or facilities can contact the applicable program manager in their state; a list is available at: ***http://www.epa.gov/ogwdw/dwsrf/nims/dwagency2.pdf***.

EPA's CHP Partnership administers the annual ENERGY STAR CHP Awards, which are given to highly efficient CHP systems that reduce emissions and use at least 10 percent less fuel than comparable, state-of-the-art, separate heat and power generation systems. To apply, or for more information, visit: *http://www.epa.gov/chp/partnership/awards.html*.

GWINNETT COUNTY DEPARTMENT OF WATER RESOURCES

Gwinnett County, a suburb of Atlanta, Georgia, has started a public education and incentive program to encourage the use of water-efficient appliances and reduce water use. The county developed a water conservation program that was implemented in 2003 and has been updated and re-evaluated since. Some of the initiatives implemented include:

- Residential Toilet Rebate Program: replacing older, less-efficient toilets with approved low-flow toilets
- Conservation Pricing
- Conservation Kits
- Outdoor Water Schedule
- Leak Detection
- Residential Water Audits
- Commercial Water Audits
- Education/Public Outreach
- Reclaimed Water
- Advertisements

http://www.gwinnettcounty.com/portal/gwinnett/Departments/PublicUtilities/WaterConservation

Strategies for Engaging the Community

- **Work with the community.** Outreach and education to community members about the energy and water efficiency strategies that are being implemented at a local water and/or wastewater facility encourages citizens to participate in water conservation measures that will ultimately lead to energy savings. The community can be reached through a variety of ways, including: electric utility bills and mailings, through demonstration projects (demonstrating the water and cost savings associated with implementing certain measures), or through local government agencies.

The Santa Clara Valley Water District, a drinking water utility serving 1.8 million residents in the semi-arid region around San Jose, California, works closely with its customers to conserve water. In addition to providing incentives in the form of rebates to households and businesses that purchase water-efficient appliances and equipment, the district offers a free Water Wise House Call Program in which a water conservation expert comes to a home, calculates its water use, teaches residents how to read their water meter, surveys the irrigation system, and demonstrates simple ways to save water both inside and outside of the home. The district performed more than 1,500 of these house calls in 2009. Through its water conservation and water recycling programs, the water district has saved approximately $347 million over 16 years, equivalent to the annual electricity use of 412,000 average California households (SCVWD, 2011).

- **Participate in national programs.** Local governments may participate in EPA's ENERGY STAR and WaterSense programs by promoting the use of products within the community that are certified by those programs. Water and wastewater facilities can also become ENERGY STAR Partners and participate in the ENERGY STAR National Building Competition, EPA's annual competition among commercial buildings to reduce energy use and avoid climate change. For more information, visit: *http://www.energystar.gov/index.cfm?fuseaction=buildingcontest.index*.

In 2012, the City of Atlanta's Department of Watershed Management entered the Hemphill Water Treatment Plant in ENERGY STAR's National Building Competition: Battle of the Buildings. The contest pits more than 3,000 commercial buildings from all 50 states against each other to see which building can save the most energy compared with its baseline benchmarking score. With the installation of high-efficiency lighting, a variable-speed finished water pumping station, and careful monitoring of plant operations to minimize waste, the Hemphill plant reduced its energy load by 36 percent at the competition's mid-point, November 2012, which could equate to as much as $790,000 in savings and more than 9,200 metric tons of CO_2 equivalent, comparable to the annual emissions of 1,900 cars (City of Atlanta, Department of Watershed Management, 2012; U.S. EPA, 2012a).

- **Implement demonstration projects.** States have used local facilities to demonstrate the potential for water conservation and energy efficiency at a water utility. Documenting energy efficiency projects and their results can provide the data and publicity needed to develop larger initiatives, promote new technologies and help get them to market, and sometimes even encourage local economic development.

The City of Bartlett, Tennessee, participated in a demonstration program funded by the Tennessee Valley Authority and the American Public Power Association to advance the use of new optical probes[8] for dissolved oxygen in the aeration process at the city's wastewater treatment plant. Since completing the project the facility has achieved annual cost savings of nearly $9,200, reducing its aeration energy bill by 22 percent (U.S. EPA 2010a).

EPA'S CLEAN ENERGY FINANCING DECISION GUIDE AND TOOL

EPA's State and Local Climate and Energy Program has developed a decision tool and a guide to help state and local governments find and choose clean energy financing programs.

The guide, available at: ***http://epa.gov/statelocalclimate/state/activities/guide.html***, covers financing strategies for energy efficiency and renewables, and can be used to develop financing programs or to finance improvements to government-owned facilities.

The tool, available at: ***http://epa.gov/statelocalclimate/state/activities/tool.html***, helps state and local government staff identify clean energy financing programs suited to their target market and available resources.

8 *Optical probes measure changes in light emitted by a luminescent or fluorescent chemical and use this information to calculate the concentration of dissolved oxygen. They are more accurate and reliable than older technologies, and can be incorporated in automated systems that save energy by running aeration equipment only when necessary.*

7. INVESTMENT AND FINANCING OPPORTUNITIES

This section provides information on the costs of energy efficiency projects at water and wastewater facilities, along with opportunities for financing and funding these costs. Financing generally involves an assumption of future repayment, while opportunities for grants and other funding vehicles do not.

Investment

Many of the projects that make a water or wastewater treatment facility more energy efficient through infrastructure improvements require significant up-front investment. The following costs must be considered when deciding which strategy would work best for a facility:

- **Design.** Hiring a firm to design an upgrade can be a costly up-front investment that may need to occur before the funding is fully in place.
- **Equipment.** Purchasing new pumps or aerators will be a significant portion of the cost for an upgrade.
- **Controls.** Energy efficiency can be improved through an upgrade of the control system, such as a SCADA system. These costs may include more than just the cost of the control panel itself, and can include wiring and labor costs.
- **Renovation.** Undertaking significant renovations can be costly. Labor and machinery need to be considered when estimating costs of upgrades.
- **Training.** New equipment requires additional training on operations and maintenance.
- **Water efficiency programs.** If a water/wastewater facility decides to begin a community-wide water efficiency program, the costs for labor, communication materials, water-efficient appliances, and other program costs must be considered.

CASH FLOW OPPORTUNITY CALCULATOR

The ENERGY STAR Cash Flow Opportunity Calculator is a decision-making tool that can be used to influence timing of energy-efficient product purchases. The tool can be used to determine:

- The quantity of energy-efficient equipment that can be purchased and financed using anticipated savings;
- Whether it is most cost-effective for the purchase to be financed now, or to be paid with future operating funds; and
- The cost of delay: whether money is being lost while waiting for a lower interest rate.

www.energystar.gov/ia/business/cfo_calculator.xls

Financing

There are several different options for a water or wastewater facility when it comes to financing an energy efficiency project. Local governments may be able to use energy cost savings from low-cost energy efficiency measures to help pay for future higher-cost upgrades. There are also a variety of financial vehicles and funding sources available for facilities to pursue, depending on how much money is needed and the circumstances at the facility. To explore the options, a facility can use a tool such as the Financing Alternatives Comparison Tool (see the text box below) to determine the best option for that facility.

FINANCING ALTERNATIVES COMPARISON TOOL (FACT)

Developed by EPA, FACT is a financial analysis tool that helps utilities and local officials to identify the most cost effective methods to fund a water or drinking water management project. The tool incorporates financing, regulatory, and other important costs to compare multiple financing options for a specific water infrastructure project.

FACT is available at: *http://water.epa.gov/grants_funding/cwsrf/fact.cfm*

FINANCIAL VEHICLES

Many financial vehicles are available to help local water and wastewater facilities implement energy-efficient strategies, including:

- **Energy performance contracts.** An energy performance contract is an arrangement with an energy service company (ESCO) or energy service provider that allows a local government to finance energy-saving capital improvements—usually over a 7- to 15-year term—with no initial capital investment, by using money saved through reduced electric utility expenditures. Energy performance contracts bundle energy-saving investments (e.g., energy audits, design and specification of new equipment, ongoing maintenance, measurement and verification of product performance, indoor air quality management, and personnel training) and typically offer financing (Zobler and Hatcher, 2008).

  An ESCO often provides a guarantee that energy cost savings will meet or exceed annual payments covering all activity costs. Such guaranteed savings agreements are the most common type of performance contract in the public sector.[9] If the savings do not occur, the ESCO pays the difference. Some performance contracts include a reserve fund to cover potential shortfalls, while others provide security enhancements in the form of performance bonds or letters of credit. In some instances, performance insurance may be available (Zobler and Hatcher, 2008).

  As mentioned above, ESCOs often offer financing as part of the performance contract. However, because ESCOs are private sector firms that typically borrow at taxable, commercial rates, it is often possible for a public sector entity to secure better financing arrangements by taking advantage of lower, tax-exempt interest rates available to government entities (U.S. EPA, 2003).

- **Lease-purchase agreements.** A tax-exempt lease-purchase agreement (also known as a municipal lease) allows public entities to finance purchases and installation over long-term periods using operating budget dollars rather than capital budget dollars.

[9] Another type of agreement is an "own-operate" agreement, in which the ESCO maintains ownership of the facility and sells back its "output" to the government agency

Lease-purchase agreements typically include "non-appropriation" language that limits obligations to the current operating budget period. If a local government decides not to appropriate funds for any year throughout the term, the equipment is returned to the lessor and the agreement is terminated. Because of this non-appropriation language, lease-purchase agreements typically do not constitute debt. Under this type of agreement, a local government makes monthly payments to a lessor (often a financial institution) and assumes ownership of the equipment at the end of the lease term, which commonly extends no further than the expected life of the equipment. These payments, which are often less than or equal to the anticipated savings produced by the energy efficiency improvements, include added interest. The interest rates that a local government pays under these agreements are typically lower than the rates under a common lease agreement because a public entity's payments on interest are exempt from federal income tax, meaning the lessor can offer reduced rates (U.S. EPA, 2004).

Unlike bonds, initiating a tax-exempt lease-purchase agreement does not require voter referendum to approve debt, a process that can delay energy efficiency improvements. Tax-exempt lease-purchase agreements typically require only internal approval and an attorney's letter, a process that can often take one week (as opposed to months or years for bonds). Local governments can expedite the process by adding energy efficiency projects to existing tax-exempt lease-purchase agreements. Many local governments have master lease-purchase agreements in place to finance a range of capital investment projects.

- **Bonds.** Bonds are well suited for energy efficiency projects, because they allow amortization of capital costs over a multi-year repayment term. Bond holders can recover their costs through energy savings over the life of a project.

- **Loans, rebates, other assistance.** Some states have loan programs that can be used to help water and wastewater facilities finance new upgrades or energy efficiency activities. These programs often provide financial assistance to local governments via low-interest loans that can be paid off using energy cost savings. In addition, water and wastewater facilities have used rebates or other financial assistance from other sources to offset the cost of improving energy efficiency in their facilities. The Database of State Incentives for Renewables and Efficiency provides information on state government and electric utility incentives available in each state at *http://www.dsireusa.org/*.

- **State revolving loan funds.** Revolving loan funds are capital funds that make loans, collect payments, and re-lend these payments to fund new projects. The original capitalization can come from many sources, including legal settlements, billing corrections, or extended bond payments after the end of the bond term. Revolving loan funds typically offer below-market rates and long-term loans for energy efficiency or renewable energy projects. EPA provides the capitalization grants to the 51 state revolving funds (50 states plus Puerto Rico). Each individual state is responsible for choosing and providing direct oversight for the projects that receive the funds.

EPA's Clean Water State Revolving Fund (CWSRF) and Drinking Water State Revolving Fund (DWSRF) make funds available to states to finance infrastructure improvements in water and wastewater treatment facilities. The Green Project Reserve, under the CWSRF and DWSRF, allocates 20 percent of the state revolving funds for use under one of the following topics: green infrastructure, water or energy efficiency improvements, or other environmentally innovative activities. For more information on the Green Project Reserve, including case studies, guidance, and other resources, visit: ***http://water.epa.gov/grants_funding/cwsrf/Green-Project-Reserve.cfm***.

FUNDING SOURCES

Many funding sources are available to help local water and wastewater facilities implement energy-efficient strategies, including:

- **State government programs.** Some states have funds that are targeted at improving energy efficiency in water and wastewater facilities.

The New York State Energy Research and Development Authority (NYSERDA) has an Existing Facilities Program that provides incentives to facilities, including water and wastewater facilities, to encourage them to purchase and install more energy-efficient equipment for small-sized energy projects and equipment replacement projects, including combined heat and power, electric efficiency, and industrial and process efficiency. NYSERDA provides up to $30,000 per year to facilities to implement energy-efficient projects that deliver verifiable annual energy savings (NYSERDA, 2010).

- **Electric utility assistance.** Some electric utilities will help cover costs to pay for equipment upgrades or implementation of water and energy efficiency programs. A number of local governments have used rebates or other financial assistance from electric utilities to offset the cost of improving energy efficiency in their facilities. The Database of State Incentives for Renewables and Efficiency provides information on electric utility incentives available in each state at *http://www.dsireusa.org/*.

  Utilities can also help offset the costs of efficiency upgrades by performing or funding energy audits. By lowering the total electricity demand of its consumers, an electric utility may delay or reduce the need to build additional sources of power (Brown, 2009).

Fairfield Suisun Sewer District, a wastewater and stormwater utility in Fairfield, California, that runs a wastewater treatment plant processing 14.8 million gallons of wastewater per day, worked with Pacific Gas & Electric Company (PG&E) to reduce the facility's electricity use. PG&E performed an integrated energy audit to determine which processes could be made more energy efficient. The sewer district received $350,000 in incentives to install new equipment at the plant, saving 1.3 million kWh of electricity per year.

http://www.pge.com/includes/docs/pdfs/mybusiness/energysavingsrebates/incentivesbyindustry/cs_fssd.pdf

- **Public Benefits Funds.** Public benefits funds (PBFs) are funds that are supported by system benefits charges applied to electric utility customers' bills. These funds, which are used to invest in programs that benefit the public, can provide funding for local government energy efficiency projects. A number of local governments have partnered with state PBF-funded programs to purchase energy-efficient products or implement other energy efficiency improvements (Lung et al., 2011).

- **Federal agency programs.** Several federal agencies, including EPA and the U.S. Department of Agriculture (USDA) provide funds in the form of grants, low-interest loans, or incentives to water and wastewater facilities to upgrade or expand their facility or install energy-efficient equipment. Each agency funds different types of projects, depending on the specific goals of the funding.

  The USDA Rural Development Utilities Program is a public/private partnership that invests billions of dollars in rural infrastructure to help rural utilities expand and keep technology up-to-date. The investments are in the form of grants and low-interest loans, and are provided to rural areas, areas that have suffered from an emergency (earthquake, chemical spill, etc.), and projects to fund the pre-development or planning phase of projects. These funds are directed toward drinking water, sanitary sewer, solid waste, and storm drainage facilities in rural areas and in cities and towns with populations of 10,000 or less (U.S. Department of Agriculture, 2011).

  For more information, visit: ***http://www.rurdev.usda.gov/Utilities_LP.html***.

- **Rate restructuring for water conservation.** Water and wastewater facilities often try to keep the rates to the consumers as low as possible, but can increase rates to end users in order to fund upgrades or expansions to the plant that could include energy-efficient equipment. A different rate structure could also be adopted to encourage water conservation and increase revenue for the facility. There are several different rate structures that can be used for water conservation (Vickers, 2001):

  - ***Uniform rates***: All customers are charged the same rate regardless of consumption.
  - ***Inverted (inclining) block rates***: Rates increase with water consumption.
  - ***Seasonal rates***: Rates vary during different periods of the year, typically increased in summer months to discourage excessive irrigation.
  - ***Marginal cost rates***: Rates are based on the cost of providing the next incremental volume. A slight increase in rates will deter excessive water use.

8. FEDERAL, STATE, AND OTHER PROGRAM RESOURCES

Local governments can obtain information on energy efficiency strategies in water and wastewater facilities through a number of federal, state, and other programs.

Federal Programs

- **ENERGY STAR Water and Wastewater.** ENERGY STAR for Wastewater Plants and Drinking Water Systems provides a variety of resources to help water and wastewater facilities save energy, including guidelines for energy management, EPA's Portfolio Manager tool for measuring and tracking energy use, and online training sessions on energy efficiency topics. The ENERGY STAR *Resource Guide for Improving Energy Efficiency and Reducing Costs in the Drinking Water Supply Industry* provides case studies, links to key resources, and a list of sources on specific topics that facilities can turn to for further assistance.

  Websites: *http://www.energystar.gov/waterwastewater* (ENERGY STAR for Wastewater Plants and Drinking Water Systems)
  http://www.energystar.gov/index.cfm?c=business.bus_internet_presentations (ENERGY STAR Online Training Sessions)
  http://escholarship.org/uc/item/6bg9f6tk (ENERGY STAR *Resource Guide for Improving Energy Efficiency and Reducing Costs in the Drinking Water Supply Industry*)

- **ENERGY STAR Green Buildings and Energy Efficiency.** While not targeted specifically to water and wastewater facilities, the resources provided here may be useful for facilities interested in opportunities to improve energy efficiency and sustainability in their buildings.

  Website: *http://www.energystar.gov/index.cfm?c=green_buildings.green_buildings_index*

- **U.S. EPA Office of Water, Energy Efficiency for Water and Wastewater Utilities.** This website provides tools and guidance for determining energy use, reducing energy use and costs, renewable energy options, and presentations from a webinar series on energy efficiency for water and wastewater utilities.

  Website: *http://water.epa.gov/infrastructure/sustain/energyefficiency.cfm*

- **U.S. EPA Combined Heat and Power (CHP) Partnership.** The CHP Partnership is a voluntary program seeking to reduce the environmental impact of power generation by promoting the use of CHP. The partnership works closely with energy users, the CHP industry, state and local governments, and other clean energy stakeholders to facilitate the development of new projects and to promote their environmental and economic benefits.

  Website: *http://www.epa.gov/chp/*

- **U.S. EPA Green Power Partnership.** The EPA Green Power Partnership is a voluntary climate protection program that creates demand for electricity produced from renewable energy sources. Local government partners earn publicity and recognition, and are ensured of the credibility of their green power purchases. In addition, partners can receive EPA advice for identifying green power products and information on purchasing strategies. EPA also provides tools and resources that offer information on green power providers and calculate the environmental benefits of green power purchases. Through the Green Power Communities initiative, the Partnership recognizes cities, towns, and villages where local governments and their businesses and residents collectively purchase quantities of green power that meet EPA-determined requirements. To get started, the community's local government first becomes an EPA Green Power Partner and takes the lead with EPA on beginning a local community campaign.

  Websites: *http://www.epa.gov/greenpower* (Green Power Partnership)
  http://www.epa.gov/greenpower/communities/index.htm (Green Power Communities)

- **U.S. EPA Landfill Methane Outreach Program (LMOP).** LMOP is a voluntary assistance program that helps reduce GHGs from landfills by encouraging the recovery and use of landfill gas as an energy resource. LMOP forms partnerships with communities, local governments, utilities, power marketers, states, project developers, and non-profit organizations to overcome barriers to project development by helping them assess project feasibility, find financing, and market the benefits of project development to the community. The program offers technical assistance, guidance materials, and software to assess a potential project's economic feasibility; assistance in creating partnerships and identifying financing; materials to help educate the community and the local media about the benefits of landfill gas energy; and networking opportunities with peers and landfill gas energy experts to enable communities to share challenges and successes.

  Website: *http://www.epa.gov/lmop*

- **U.S. EPA Wastewater Management Website.** This website provides links to resources for wastewater facilities, including information about operations, stormwater management, renewable energy, asset management, and more.

  Website: *http://water.epa.gov/polwaste/wastewater/index.cfm*

- **U.S. EPA WaterSense Program.** This partnership program promotes water efficiency through decreasing indoor and outdoor non-agricultural water use, enhancing the market for water-efficient products, encouraging innovation, and establishing water efficiency standards.

  Website: *http://www.epa.gov/WaterSense/index.html*

- **U.S. EPA State and Local Climate and Energy Program.** This program helps state, local, and tribal governments achieve their climate change and clean energy goals by providing technical assistance, analytical tools, and outreach support. It includes two programs:

  - The Local Climate and Energy Program helps local and tribal governments meet multiple sustainability goals with cost-effective climate change mitigation and clean energy strategies. EPA provides local and tribal governments with peer exchange training opportunities along with planning, policy, technical, and analytical information that support reduction of GHG emissions.
  - The State Climate and Energy Program helps states develop policies and programs that can reduce GHG emissions, lower energy costs, improve air quality and public health, and help achieve economic development goals. EPA provides states with and advises them on proven, cost-effective best practices, peer exchange opportunities, and analytical tools.

  Website: *http://www.epa.gov/statelocalclimate/*

State Programs

Some states have developed programs that promote energy efficiency strategies in water and wastewater facilities. Local governments can look to these programs for information resources on the benefits and applicability of energy efficiency strategies, as well as information on available financial assistance.

- **California Energy Commission: Energy Water Connection.** The California Energy Commission's Process Energy Office provides resources to help water professionals control energy costs, including detailed information on proven methods and technologies; articles, fact sheets, and reports; and more.

  Website: *http://www.energy.ca.gov/process/water/index.html*

- **Efficiency Vermont.** This program, operated by a non-profit organization under appointment by the Vermont Public Service Board, provides rebates to water and wastewater facilities for installing a wide range of new, energy-efficient equipment, and can provide custom rebates and technical assistance for technologies or projects not listed on its standard rebate forms. Efficiency Vermont can also install recording meters to help water and wastewater facilities track energy use and cost savings.

  Website: *http://www.efficiencyvermont.com/for_my_business/solutions_for_me/water_and_wastewater/general_info/overview.aspx*

- **Massachusetts Department of Environmental Protection (MassDEP).** MassDEP supports energy efficiency pilot projects in water and wastewater facilities, sponsors an energy leaders roundtable to help foster greater participation among drinking water and wastewater treatment facilities in reducing energy costs, and provides information resources such as fact sheets and reports.

  Website: *http://www.mass.gov/dep/water/priorities/brpere.htm*

- **New York State Energy Research and Development Authority (NYSERDA).** Through research, demonstration, outreach, and cost-shared technical assistance programs, NYSERDA encourages municipalities in New York State to adopt commercially available and innovative technologies that improve the energy efficiency and economics of their water and wastewater treatment facilities, while meeting or exceeding regulatory requirements and reducing the facilities' overall environmental impact.

  Website: *http://www.nyserda.ny.gov/BusinessAreas/Energy-Efficiency-and-Renewable-Programs/Commercial-and-Industrial/Sectors/Municipal-Water-and-Wastewater-Facilities.aspx*

- **Oregon Energy Trust.** The non-profit Oregon Energy Trust has helped a number of Oregon water and wastewater facilities realize savings of millions of dollars or more annually by implementing hydroelectric and biopower energy generation systems, improving mechanical processes, making solar electric installations, upgrading lighting and lighting controls, and more. The organization offers cash incentives and technical assistance, including a no-cost system optimization study, to water and wastewater facilities.

  Website: *http://energytrust.org/industrial-and-ag/incentives/water-treatment/*

- **Texas Water Development Board.** The Texas Water Development Board offers information on State Revolving Funds and other financing opportunities for water and wastewater facilities in Texas, including information about interest rates and the intended use plan.

  Website: *http://www.twdb.state.tx.us/financial/programs/*

- **Wisconsin Focus on Energy.** Wisconsin's Focus on Energy service offers a one-day training course to officials at water and wastewater facilities. The course is designed to show participants how to identify practical ways to reduce energy use and operating costs, from installing energy-efficient pumps and variable-speed drives to adopting energy-saving best practices, modifying process operations, and using renewable energy.

  Website: *http://www.focusonenergy.com/learning-center/business/saving-energy-business/water-wastewater-industry-energy-best-practice*

Other Programs

A number of non-governmental organizations provide energy efficiency resources and assistance to municipal water and wastewater facilities.

- **Alliance for Water Efficiency.** The Alliance for Water Efficiency is a stakeholder-based non-profit organization dedicated to the efficient and sustainable use of water. It serves as an advocate for water-efficient products and programs, and provides information and assistance on water conservation efforts.

  Website: *http://www.allianceforwaterefficiency.org/*

- **Alliance to Save Energy (ASE).** ASE is a non-profit organization that promotes energy efficiency through research, education, and advocacy. It works with businesses, governments, and environmental and consumer leaders to encourage the use of energy-efficient practices as a means to reduce water and energy use, avoid GHG emissions, and save money. ASE established the Watergy program (*http://watergy.org*) to address the strong connection between water and energy; the program offers a tool kit for municipalities that includes training videos (e.g., how to conduct audits and detect leaks), manuals, case studies, best practice guides, and resource documents.

  Website: *http://www.ase.org/*

- **American Council for an Energy-Efficient Economy (ACEEE).** ACEEE is a non-profit organization that acts as a catalyst to advance energy efficiency policies, programs, technologies, investments, and behaviors. It works collaboratively with businesses, government officials, public interest groups, and other organizations to carry out its mission. ACEEE provides an online toolkit for improving energy efficiency in water and wastewater treatment (available at: ***http://www.aceee.org/sector/local-policy/toolkit/water***), and has a database of over 450 water-energy programs, available at: ***http://aceee.org/w-e-programs***.

  In 2012, ACEEE and the Alliance for Water Efficiency launched a series of awards to recognize exceptional efficiency programs that save both water and energy; information is available at: ***http://www.aceee.org/press/2013/01/12-programs-awarded-saving-both-wate***.

  Website: ***http://www.aceee.org***

- **American Water Works Association (AWWA).** AWWA's mission is to unite the water community to protect public health and to provide safe and sufficient water for all. Its members share knowledge on water resource development, water and wastewater treatment technology, water storage and distribution, and facility management and operations. AWWA has published a guide to *Energy Efficiency Best Practices for North American Drinking Water Utilities*, available at: ***http://www.waterrf.org/PublicReportLibrary/4223.pdf***.

  Website: ***http://www.awwa.org***

- **Consortium for Energy Efficiency (CEE).** The CEE National Municipal Water and Wastewater Facility Initiative (***http://library.cee1.org/content/initiative-description-cee-national-municipal-water-and-wastewater-facility-initiative***) endeavors to increase the demand for energy efficiency in water and wastewater treatment and distribution. The initiative encourages suppliers of products and services to adopt energy efficiency as a standard industry practice.

  Website: ***http://www.cee1.org/***

- **Imagine H_2O.** Imagine H_2O is a non-profit organization that hosts prize competitions for water efficiency, energy efficiency, and wastewater innovations. The organization helps innovators identify problems that have social impact and major commercial market opportunities, chooses the most promising plans, and brings together leaders in water business, government, and social enterprise to help contestants turn their ideas into self-funding, high-impact solutions.

  Website: ***http://imagineh2o.com/***

- **National Association of Clean Water Agencies (NACWA).** NACWA provides policy leadership and technical expertise in protecting water quality. Members include publicly owned wastewater treatment agencies, wastewater collection systems, and stormwater management agencies ranging in size from metropolitan and county agencies to small towns and communities.

  Website: ***http://www.nacwa.org/***

- **Water Environment Federation (WEF).** WEF and its members research and publish information on wastewater treatment and water quality protection and provide technical expertise and training on issues including wastewater collection, treatment, reuse, and operations; residuals and facility management; sustainability; and emerging water quality issues such as microconstituents. WEF has published a guide to energy conservation in water and wastewater facilities, as well as a road map to reaching energy neutrality (net zero) for the water sector, available at: ***http://www.e-wef.org/Default.aspx?TabId=192&productid=5308*** and ***http://www.wef.org/WorkArea/linkit.aspx?LinkIdentifier=id&ItemID=12884902042&libID=12884902042***, respectively.

  Website: ***http://www.wef.org/AWK/pages_cs.aspx?id=568***

- **Water Environment Research Foundation (WERF).** WERF is a non-profit scientific research organization dedicated to providing peer-reviewed reports on issues in wastewater and stormwater.

  Website: ***http://www.werf.org/i/ka/Energy/a/ka/Energy.aspx***

- **Water Innovations Alliance.** The Water Innovations Alliance works to promote federal and state policies that support development, reduce barriers, and improve market conditions for the U.S. water technologies market.

  Website: ***http://www.waterinnovations.org/***

- **Water Research Foundation.** The Water Research Foundation works with a variety of partners to identify, prioritize, fund, manage, and communicate scientific research on the treatment and delivery of clean drinking water.

Website: *http://www.waterrf.org/knowledge/energy-management/em-greenhouse-gases/Pages/default.aspx*

9. CASE STUDIES

City of O'Fallon, Missouri

The City of O'Fallon's wastewater treatment plant participated in a statewide energy management pilot program that included developing an energy management plan, implementing an energy efficiency project, maintaining data, and sharing results. The facility is currently on track to reduce its energy use by 10 percent by 2014, compared with its baseline energy use in 2009 (U.S. EPA Region 7, 2011b).

PROGRAM INITIATION

In 2009, U.S. EPA Region 7 invited the City of O'Fallon to join seven other pilot cities in an Energy Management Initiative for Water and Wastewater Utilities led by the Missouri Water Utilities Partnership (MOWUP). The MOWUP initiative, created through a partnership among EPA Region 7, the Missouri Department of Natural Resources, the Missouri University of Science and Technology, and the Siemens Corporation, required pilot cities to assess current assets, plan for capital and process improvements, and develop an energy management plan through participation in a series of workshops. Prior to participating in MOWUP, the city's Water and Sewer Department had no formal mechanism to track its energy use. During the first phase of the pilot project, MOWUP partners worked with the city to develop a comprehensive energy management plan to track energy use and identify areas of improvement. In the second phase of the pilot, the city worked with plant supervisors and operators to develop an energy efficiency improvement project (U.S. EPA Region 7, 2011b).

PROFILE: CITY OF O'FALLON, MISSOURI

Area: 22.47 square miles

Population Served by Treatment Plant: Wastewater Services: 15,350.

Plant Capacity: Wastewater–11.25 MGD

Structure: The governing body for the City of O'Fallon, Missouri, consists of a mayor and a 10-member city council. The Public Works Commission advises the mayor, city council, city administrator, and Department of Community Development regarding water and wastewater systems. The Department of Water and Sewer oversees the water and wastewater system, and the Director of Water and Sewer administers the energy management plan.

Program Scope: The energy management plan addresses energy conservation and energy efficiency at the city's wastewater treatment plant.

Program Creation: The City of O'Fallon Water and Sewer Energy Management Plan was initiated in 2009 through an EPA pilot project. The plan aims to reduce energy use by at least 10%, reduce costs, and reduce GHG emissions.

Program Results: The facility is on track to reduce its annual energy use 10% by 2014. Upgrades with a total cost of $450,000 resulted in an annual cost savings projected at more than $53,000. The annual projected GHG reductions are 292 metric tons of CO_2 equivalent.

PROGRAM FEATURES

The MOWUP Energy Management Initiative for Water and Wastewater Utilities encouraged its participants to set goals to reduce their energy use. In meeting their goals, participants use the Plan-Do-Check-Act approach described in Section 3, *Planning and Implementation Approaches*, in order to continuously improve upon previous actions. The City of O'Fallon has implemented a number of measures to meet its reduction target, including:

- **Energy assessment and documentation.** MOWUP partners conducted an energy audit at the city's wastewater treatment plant. This process helped the facility identify its most energy-consuming processes and pinpoint opportunities to improve efficiency.

- **MOWUP Workshops.** Representatives from the City of O'Fallon attended a series of four MOWUP workshops over the course of eight months. The workshops brought together all eight participating pilot cities and provided participants with information and tools to develop their energy management plans.

- **ENERGY STAR Portfolio Manager.** While attending the workshops, the city adopted and now uses EPA's free online energy management tool, Portfolio Manager, which allows the wastewater facility to track and compare its energy use and costs with those of other wastewater treatment plants across the country.

- **Aeration equipment upgrades.** After discussing a range of potential projects with facility supervisors and operators, the City of O'Fallon replaced the blowers used for aeration at its wastewater treatment plant with turbo blowers, which are 10–20 percent more efficient than conventional blowers, are small and quiet, and require very little maintenance. The city also incorporated energy-efficient panel diffusers into its aeration system. The blowers and panel diffusers together introduce very fine air bubbles into the wastewater. This project cost $450,000 and is expected to save the city $53,000 per year (U.S. EPA Region 7, 2011b). Through its participation in MOWUP, the city learned about a number of grant opportunities and ultimately received a grant of $367,000 from the Missouri Department of Natural Resources. With the grant funding covering 70 percent of the project's cost, the energy efficiency improvements will pay for themselves in two years.

- **Automated meter-reading system.** Following the MOWUP workshops, the City of O'Fallon elected to replace all of its older water meters at once in order to better track water use and ensure that consumers are billed properly. The city chose an energy services company to manage this $6 million project, which will install 12,000 new water meters fitted with radio transmitter technology that can be read remotely. When complete, the project is expected to increase the accuracy of the meters from 92.8 percent to 98.5 percent. From operational savings, energy savings, and increased revenue, this project will pay for itself in nine years (U.S. EPA Region 7, 2011b).

PROGRAM RESULTS

The City of O'Fallon water and wastewater energy management plan has put its Department of Sewer and Water on a path to reduce its annual energy use by 10 percent by 2014, compared with its baseline consumption in 2009. This plan and its activities will avoid more than 292 metric tons of GHG emissions annually, equivalent to the annual emissions from 61 cars (U.S. EPA Region 7, 2011b). Participation in the MOWUP initiative led the department to establish not only an energy management plan but also a broader energy policy, which stipulates that the department will purchase and use energy in the most cost-effective, efficient, and environmentally friendly manner possible. Under this policy and its commitment to continuous improvement, the city considers energy efficiency in any new projects involving damaged or inefficient equipment. Consequently, it has addressed savings opportunities in its water system as well, implementing a leak detection program for its entire water system in order to save electricity and chemical treatment costs by reducing unaccounted water loss by 5 percent.

Greater Lawrence Sanitary District, North Andover, Massachusetts

The Greater Lawrence Sanitary District participated in a state-run pilot program for energy management in drinking water and wastewater facilities. Through the course of the pilot, its wastewater treatment facility implemented several energy efficiency and renewable energy installations, which are projected to decrease its annual energy costs by nearly $1.5 million and avoid nearly 5,000 metric tons of CO_2 emissions per year, equivalent to the annual emissions of nearly 1,000 cars (Mass DEP, Undated).

PROGRAM INITIATION

Beginning in 1995, in response to concerns about its energy consumption, the Greater Lawrence Sanitary District (GLSD) facility began to look at ways to reduce its operational costs. Over the next 10 years, the facility conducted several targeted energy audits that enabled facility managers to understand energy consumption, identify opportunities for energy efficiency improvements, and identify and prioritize projects to reduce costs and GHG emissions. The facility performed a lighting retrofit project in 2001, a biosolids upgrade in 2003, and a fine bubble aeration upgrade in 2006.

Profile: Greater Lawrence Sanitary District

Service Area: 116.32 square miles

Service Area Population: 213,961

Capacity: Design Capacity–52 MGD. Peak Flow Capacity–135 MGD.

Structure: The Greater Lawrence Sanitary District is governed by a district commission consisting of seven voting members and an eighth non-voting member. The executive director is appointed by the district commission and implements decisions made by the commission. Its energy management plan is administered by the executive director

Program Scope: The energy management pilot program, led by the State of Massachusetts, includes energy efficiency, energy conservation, and renewable energy measures.

Program Creation: The State of Massachusetts initiated the program in 2007 to reduce energy costs and increase overall energy efficiency at seven drinking water and seven wastewater facilities.

Program Results: Implemented projects in the Greater Lawrence Sanitary District are on track to achieve an annual electricity cost savings of $1,473,270 and a reduction of 4.9 million kWh. The district projects annual GHG emissions reductions of 4,840 metric tons of CO_2.

Building on these earlier efforts, the GLSD wastewater facility joined six other Massachusetts wastewater treatment plants and seven drinking water facilities in late 2007 to participate in the first phase of the Massachusetts Energy Management Pilot for Drinking Water and Wastewater Treatment Facilities. Led by the Massachusetts Department of Environmental Protection (MassDEP) and the Massachusetts Executive Office of Energy and Environmental Affairs, this pilot program assists drinking water and wastewater facilities in saving money while reducing their energy consumption and GHG emissions. In order to achieve these goals, the program created a new public/private partnership that brought together state and federal agencies, electric and gas utilities, and other partners to share resources and knowledge (U.S. EPA, 2009a, 2009b).

PROGRAM FEATURES

The goals of the Massachusetts Energy Management Pilot for Drinking Water and Wastewater Treatment Facilities were to reduce the amount of energy that municipal facilities use in treating the water that flows through their plants by 20 percent, reduce GHG emissions by 20 percent, and ultimately save communities money (U.S. EPA, 2009a, 2009b). Through its participation in the energy audits, benchmarking, and energy management roundtables of the program, the GLSD facility improved its energy efficiency, lowered energy costs, and reduced GHG emissions by completing the following activities:

- **Energy audit.** In 2008, MassDEP worked with investor-owned utilities to conduct a comprehensive energy audit of processes in place at the GLSD facility. The audit quantified the costs and consumption of electricity, natural gas, and fuel oil, and identified operational measures, energy conservation measures, and supply measures for improving energy performance at the facility. Energy-saving areas included addressing the lighting, pumping, aeration, anaerobic digestion, and HVAC systems.

- **Benchmarking energy needs and performance.** The facility received an EPA ENERGY STAR benchmarking energy performance score. This score provides a baseline for the facility and allows it to track its energy performance against that of similar facilities across the country.

- **Assessing renewable and clean energy opportunities.** In 2008, while the energy audit was underway, the Massachusetts Technology Collaborative Renewable Energy Trust, a quasi-public development agency for renewable energy (now the Massachusetts Clean Energy Center) addressed the pilot program's objective to assess renewable energy potential by providing free preliminary screenings for opportunities to pursue wind power, bioenergy, solar, microturbines, and other sources of renewable energy at the facility. The screening identified opportunities for 110 kW of hydropower capacity and about 200 kW of solar power. As a result, the facility has installed a 310-kW solar photovoltaic system and a 100-kW hydroelectric turbine to generate renewable power (U.S. EPA, 2009a, 2009b).

- **Attending energy management roundtables.** Members of the GLSD facility attended five EPA-sponsored energy management roundtables during the pilot program, designed to help municipalities develop and implement energy management plans based on the Plan-Do-Check-Act framework outlined in EPA's Energy Management Guidebook for Wastewater and Water Utilities. The roundtables provided technical information on energy efficiency and offered an environment for plant operators to discuss the application of EPA assessment tools, share success stories, and receive advice on common challenges.

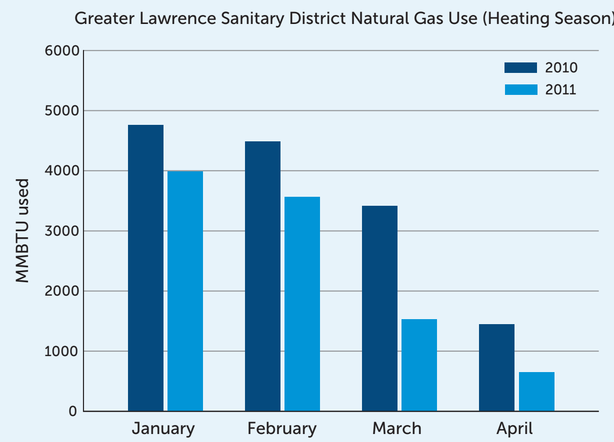
- **Implementing energy-saving upgrades.** Based on its energy audit and the renewable energy assessment, and federal assistance from the American Recovery and Reinvestment Act of 2009, the facility made several energy-saving upgrades. It installed variable speed drives in its pumping systems, which cost more than $1.2 million but returned more than $300,000 in annual savings. The facility also insulated its digesters and improved its HVAC and heat recovery systems, costing $425,000 and saving about $335,000 per year (see Figure 3 at right). Finally, the facility implemented improvements to its operational measures, aeration, plant water pumping system, and lighting. This final set of improvements cost nearly $970,000, but is expected to save more than $815,000 annually. Additionally, a 310-kW solar photovoltaic system was installed on the site, which is generating 433,000 kWh of on-site power and saving the facility an additional $65,000 per year (Mass DEP, Undated; U.S. EPA, 2009a, 2009b).

PROGRAM RESULTS

The total cost of the GLSD's upgrades for energy efficiency and renewable energy was approximately $4.5 million, which was funded through a combination of renewable energy grants, State Revolving Funds, American Recovery and Reinvestment Act assistance, and energy efficiency incentive funds from participating electric and gas partners (U.S. EPA, 2009a, 2009b). The upgrades are projected to save nearly $1.5 million, or 49 percent of the district's energy budget, annually, while saving more than 4,900,000 kWh of electricity and generating up to 410 kW of renewable power. The facility's energy efficiency and renewable energy upgrades avoid approximately 4,840 metric tons of CO_2 per year, equivalent to the annual electricity-related GHG emissions of 603 homes (Mass DEP, Undated).

As part of the GLSD's continuous commitment to improving energy management at its facility, it is currently evaluating the technical and financial feasibility of installing a CHP system to its anaerobic digesters, and evaluating the option of co-digesting organic food wastes with wastewater sludge in its anaerobic digesters.

FIGURE 3. NATURAL GAS USE BY THE GREATER LAWRENCE SANITARY DISTRICT DURING THE HEATING SEASON, 2010 AND 2011



Source: Michael DiBara, Massachusetts Department of Environmental Protection.

10. ADDITIONAL EXAMPLES AND INFORMATION RESOURCES

Title/Description	Website
Local Examples of Energy Efficiency Measures in Water and Wastewater Facilities	
Arizona Water Infrastructure Finance Authority (WIFA) ARRA Green Project Reserve Case Study, Phoenix, Arizona. In 2009, WIFA received ARRA funding to support WIFA's efforts to advocate green projects that address water conservation, energy efficiency, green storm water infrastructure, and environmentally innovative projects for drinking water and wastewater systems. ARRA Green Project Reserve funding also helped facilitate an enhancement of WIFA's traditional technical assistance program offerings and advanced new green project eligibilities.	*http://water.epa.gov/aboutow/eparecovery/upload/2010_01_26_eparecovery_ARRA_AZ_Case-Study_FINAL_low-res_10-28-09.pdf*
Big Gulch Wastewater Treatment Plant, Washington. The plant required an upgrade to its aeration system due to increases in biological oxygen demand (BOD) and total suspended solids (TSS) loadings. The plant installed a fine bubble diffuser, an automatic blower operation system to control the oxygen levels for aeration, and an anoxic control system to control the oxygen levels. The energy savings from the energy efficiency upgrade were 148,900 kWh, or $10,076 annually.	*http://water.epa.gov/scitech/wastetech/upload/Evaluation-of-Energy-Conservation-Measures-for-Wastewater-Treatment-Facilities.pdf*
City of Cleburne, Texas. The city used an ESCO to design conservation measures, which included installation of a fine bubble aeration system, replacing old blowers with new energy-efficient blowers, and installing a new automated control system.	*http://www.naesco.org/resources/casestudies/default.aspx*
City of Kingston, New York. The city worked with an ESCO to identify energy efficiency improvements to its wastewater plant, including increases in the efficiency of UV disinfection, sludge pump and motor, solids handling, odor control, digester mixing, and the belt press.	*http://www.naesco.org/resources/casestudies/documents/City%20of%20Kingston%20WWTP%20Efficiency%20Improvements.pdf*
City of Oswego, New York. The city partnered with an energy performance contractor to identify a number of improvements to the water and wastewater treatment systems, including increasing pumping efficiency, an automated control system that modulates pump speed to maximize efficiency, a new SCADA system, and lighting system replacement. The plant was able to reduce energy consumption by more than 25%.	*http://www.naesco.org/resources/casestudies/documents/City%20of%20Oswego%20Energy%20Performance%20Contract.pdf*
Grafton Water and Wastewater Utility, Grafton, Wisconsin. The Grafton wastewater plant was able to make minor modifications that would not only increase capacity but also improve effluent quality and reduce energy costs. Grafton cut annual electricity costs by an estimated 10–12%. During the first two years of operations, kilowatt-hour consumption dropped by about 112,440 kWh/yr (on average), saving about $9,200 per year.	*http://www.cee1.org/ind/mot-sys/ww/Perfect_Storm_of_Upgrades.pdf*
Gresham, Oregon, Wastewater Treatment Plant. Gresham, Oregon's wastewater treatment plant is becoming first in the state, and the second on the West Coast, to feed restaurant grease into its solid waste treatment system.	*http://www.oregonlive.com/gresham/index.ssf/2012/07/greshams_wastewater_treatment.html*
Gwinnett County Department of Water Resources, Georgia. This facility installed a new real-time online energy management software system that allows the facility to control production plant rates, raw water and high-service pump scheduling, booster pump station operations, and filling tanks in the water distribution system.	*http://www.derceto.com/Case-studies/Case-studies/GC*
James River Treatment Plant, Virginia Beach, Virginia. This plant conducted a demonstration study to test whether an integrated fixed-film activated sludge (IFAS) process could meet tough nutrient limits. Retrofitting the existing tanks with IFAS was more cost-effective in terms of achievable nitrogen removal compared with other options.	*http://www.cee1.org/ind/mot-sys/ww/Testing_Nutrient_Removal_Option.pdf*

Title/Description	Website
Kent County Department of Public Works, Delaware. This 16-MGD wastewater treatment plant implemented an automatically controlled aeration system to save 50% of its energy requirements in the aeration system. Additionally, the facility installed a wind turbine to generate on-site energy.	*http://www.rivernetwork.org/sites/default/files/EnsureSustainable.PDF*
Lake Bradford Road Water Reclamation Facility, Tallahassee, Florida. This reclamation facility upgraded to a membrane bioreactor, a high-energy-demand system. In turn, the facility implemented measures to reduce the facility's overall energy use by 20% while still meeting high-quality effluent requirements.	*http://www.cee1.org/ind/mot-sys/ww/Energy_Efficient_MBR.pdf*
Lowell Regional Wastewater District, Massachusetts. This wastewater facility implemented several energy efficiency projects, such as installing motion sensors and energy-efficient pumps. The facility also adopted new purchasing and bidding procedures to specify that new equipment purchased must be energy efficient.	*http://www.rivernetwork.org/sites/default/files/EnsureSustainable.PDF*
Massachusetts Energy Management Pilot Program for Drinking Water and Wastewater Case Study, Boston, Massachusetts. A total of 14 facilities across the state, seven wastewater treatment plants and seven drinking water treatment plants, are taking part in an innovative pilot program designed to reduce the amount of energy that municipal facilities use in treating the water that flows through the plant by 20%, reduce GHG emissions by 20%, and save communities money.	*http://water.epa.gov/aboutow/eparecovery/upload/2010_01_26_eparecovery_ARRA_Mass_EnergyCasyStudy_low-res_10-28-09.pdf*
Moulton Niguel Water District, California. The 48-MGD water treatment and 17-MGD wastewater treatment facility installed new logic controllers to benefit from lower off-peak electric utility rates, installed variable-frequency drives on the wastewater system to control pump speed, and specified that all motors used in new construction are 95–97% efficient. The facility was able to save 20% of the $1.5 million/year that it was previously spending on electricity.	*http://www.energy.ca.gov/process/pubs/moulton.pdf*
Narragansett Bay Commission's Bucking Point Wastewater Treatment Facility, Rhode Island. The 23.7-MGD facility modified its aeration process control system to optimize dissolved oxygen levels and minimize energy consumption, realizing an average 12% reduction in annual energy consumption during the first three years.	*http://water.epa.gov/scitech/wastetech/upload/Evaluation-of-Energy-Conservation-Measures-for-Wastewater-Treatment-Facilities.pdf*
Oxnard Wastewater Treatment Plant, California. This plant implemented activated sludge process optimization and automation components to upgrade its activated sludge aeration process. The reduction in energy consumption from the upgrade was $27,000 per year, for a five-year payback.	*http://water.epa.gov/scitech/wastetech/upload/Evaluation-of-Energy-Conservation-Measures-for-Wastewater-Treatment-Facilities.pdf*
Sheboygan Regional Wastewater Treatment Plant, Wisconsin. In 2005, this 11.8-MGD facility needed to replace all four of its aeration blowers. The plant replaced them with two higher horsepower, high-efficiency centrifugal blowers. The operators discovered that they were having trouble controlling the dissolved oxygen levels in the evenings and in winter months, so they installed an air flow control valve. These upgrades saved 6.2% of the facility's annual energy bills, or more than $25,000.	*http://water.epa.gov/scitech/wastetech/upload/Evaluation-of-Energy-Conservation-Measures-for-Wastewater-Treatment-Facilities.pdf*
Simsbury, Connecticut. Simsbury installed a new SCADA system to replace the dial-up phone lines that were previously reporting alarms, as well as flow meters that reported data via manual downloads. The facility was able to reduce its energy bill significantly by reducing its total amperes used, which was how its electricity use was being billed by the electric utility.	*http://www.wateronline.com/download.mvc/New-Technology-Enhances-Data-Monitoring-0001*

Title/Description	Website
Struthers Water Pollution Control Facility, Ohio. This wastewater treatment plant received $5.4 million in American Recovery and Reinvestment Act funding from the Ohio Environmental Protection Agency's Clean Water State Revolving Fund program for a project that will use biogas to power treatment processes and reduce the facility's energy footprint.	*http://water.epa.gov/grants_funding/cwsrf/upload/Struthers-Water-Pollution-Control-Facility-Case-Study-FINAL.pdf*
The Clearwater Cogeneration Wastewater Treatment Plant, California. The city installed a biosolids heat drying project that dries 110 wet tons per day of municipal sludge and burns a combination of natural gas and digester gas. The volume of the biosolids is reduced by 80% and the dried sludge can be land-applied or used as an organic fuel.	*http://www.naesco.org/resources/casestudies/default.aspx*
Turbo Blower Pilot, Fort Myers, Florida. The city pilot-tested a turbo blower in the aerobic digestion system of its Central Advanced Wastewater Treatment plant. Initial calculations indicated that the optimum blower for the plant would cut energy needs by about 40%.	*http://www.cee1.org/ind/mot-sys/ww/Aerate_For_Less.pdf*
Ventura Regional Sanitation District (VRSD), Ventura, California. VRSD needed a new way to dispose of the biosolids produced by its wastewater treatment plants. VRSD proposed using methane gas produced from decaying refuse in a local landfill to fuel a regional biosolids drying system and simultaneously drive a network of microturbines to generate power for the facility and the local grid. The system prevents 1 million vehicle trucking-miles per year, avoiding approximately 1,800 tons of carbon dioxide emissions annually.	*http://www.epa.gov/lmop/documents/pdfs/conf/13th/grant.pdf*
Village of Essex Junction Wastewater Treatment Facility, Vermont. The village installed a combined heat and power facility to generate electricity instead of flaring the methane generated from sludge digestion. This project provided $37,000 in savings and a payback period of about seven years.	*http://www.rivernetwork.org/sites/default/files/EnsureSustainable.PDF*
Waco Metropolitan Area Regional Sewer System, Texas. This facility upgraded its aeration system with more fine bubble diffusers and a new automatic control system. The payback period was only 2.4 years, with an annual energy cost savings of $423,226 per year.	*http://water.epa.gov/scitech/wastetech/upload/Evaluation-of-Energy-Conservation-Measures-for-Wastewater-Treatment-Facilities.pdf*
Washington Suburban Sanitary Commission Western Branch, Maryland. The plant had two inefficiently operated natural gas furnaces, and decided to enhance the system by installing flue gas recirculation to recycle the exhaust and allow the furnace to run at a lower temperature. This resulted in a $400,000 savings in natural gas consumption per year.	*http://water.epa.gov/scitech/wastetech/upload/Evaluation-of-Energy-Conservation-Measures-for-Wastewater-Treatment-Facilities.pdf*
Information Resources on Energy Efficiency Measures in Water and Wastewater Facilities	
Adaptation to Climate Change	
Climate Ready Water Utilities Toolbox. Tools from EPA that can be used to find water utility-specific information on funding opportunities, reports, tools and models, and workshops and seminars that can help a water utility become climate ready.	*http://www.epa.gov/safewater/watersecurity/climate/toolbox.html*
Climate Resilience Evaluation and Awareness Tool (CREAT). A software tool developed by EPA to assist water and wastewater facilities in understanding the potential impacts of climate change on their operations, buildings, and equipment.	*http://water.epa.gov/infrastructure/watersecurity/climate/creat.cfm*

Title/Description	Website
EPA's Adaptation Strategies Guide for Water Utilities. The EPA Climate Ready Water Utilities initiative has developed an Adaptation Strategies Guide to assist drinking water and wastewater utilities in better understanding the climate change-related impacts they may face in their region and the adaptation strategies they can use to prepare their system for those impacts. The information provided in the guide will help jump-start the adaptation planning process at drinking water and wastewater utilities that may not have begun to consider climate change impacts or adaptation. It can also be used by any group or organization that is interested in water sector climate challenges.	*http://water.epa.gov/infrastructure/watersecurity/climate/upload/epa817k11003.pdf*
Preparing for Extreme Weather Events: Workshop Planning Tool for the Water Sector. A tool that provides drinking water and wastewater utilities with information to conduct workshops focused on planning for extreme event impacts such as flooding, drought, wildfire, sea level rise, and changes in snowpack.	*http://yosemite.epa.gov/ow/SReg.nsf/description/TTX_Tool*
Water Utilities and Climate Change: A Research Workshop on Effective System Adaptation. The Water Research Foundation published a report on a workshop held in South Florida that brought together utility professionals, academics, and others to review the current role of climate change in utility planning and to make recommendations for the future. The workshop focused on four South Florida-based water utilities (Palm Beach County, Broward County, Miami-Dade County, and Tampa Bay Water) and featured presentations on current climate change science and climate scenarios for Southeast Florida, adaptation planning, the variety of adaptations available, and the evaluation of proposed adaptations.	*http://www.waterrf.org/PublicReportLibrary/4228.pdf*
CHP and Renewables	
EPA CHP Catalog of CHP Technologies. This resource provides an overview of how CHP systems work and the key concepts of efficiency and power-to-heat ratios. It also provides information about the cost and performance characteristics of five commercially available CHP prime movers.	*http://www.epa.gov/chp/technologies.html*
EPA CHP Emissions Calculator. The CHP Emissions Calculator compares the anticipated carbon dioxide, methane, nitrous oxide, carbon dioxide equivalent, sulfur dioxide, and nitrogen oxide from a CHP system with those of a separate heat and power system. The calculator presents estimated emissions reductions as metric tons of carbon equivalent and emissions from passenger vehicles.	*http://www.epa.gov/chp/basic/calculator.html*
EPA CHP Partnership: Project Development. The Partnership has developed resources to assist energy users to design, install, and operate CHP systems at their facilities. This website provides information, tools, and hints on CHP project development, CHP technologies, and the resources of the CHP Partnership.	*http://www.epa.gov/chp/project-development/index.html*
EPA CHP Spark Spread Estimator. The Spark Spread Estimator provides organizations with a preliminary spark spread screening of CHP economic viability for a single or multiple end-use sites. The screening includes assumptions about typical CHP system performance characteristics, fuel prices, and credit for displaced thermal energy to estimate the operating cost of onsite power generation at each site.	*http://www.epa.gov/chp/partnership/tech_assistance.html*
Going Green: Renewable Energy Options for Water Utilities. A website that gives links to several resources to help water utilities understand and get involved in renewable energy projects.	*http://water.epa.gov/infrastructure/sustain/goinggreen.cfm*

Title/Description	Website
Opportunities for and Benefits of Combined Heat and Power at Wastewater Treatment Facilities: Market Analysis and Lessons from the Field. Information about CHP in wastewater facilities, including technical information about the potential for CHP and financial information, such as cost estimates for installation and cost savings.	*http://www.epa.gov/chp/documents/wwtf_opportunities.pdf*
Energy Management and Efficiency	
2009–2011 Indiana Energy Management Pilot Factsheets. This collection of factsheets covers five wastewater and water treatment plants included in the 2009–2011 Indiana Energy Management Pilot program. Each plant's factsheet includes a summary, success story, data metrics, and list of key improvements.	*http://www.epa.gov/r5water/energymanagement/pdf/IN_Pilot_WW_fact_sheets-April_2012.pdf*
2009–2011 Indiana Energy Management Pilot Summary Report. This report presents an overview of the 2009–2011 Indiana Energy Management Pilot conducted by EPA Region 5 and the Indian Department of Environmental Managements, and completed by 10 drinking water and wastewater public utilities (pilot utilities). The report includes a background of the pilot, documented outcomes, and a presentation of the key findings and recommendations.	*http://www.epa.gov/r5water/energymanagement/pdf/IN_Pilot_WW_Summary_report-April_2012.pdf*
Addressing the Energy-Water Nexus: A Blueprint for Action and Policy Agenda. Offers an action plan to link and reduce both energy and water use.	*http://www.allianceforwaterefficiency.org/WorkArea/linkit.aspx?LinkIdentifier=id&ItemID=5770*
American Council for an Energy-Efficient Economy's Water-Energy Program Database. This database offers basic information on more than 450 existing programs saving both water and energy from across the United States, Canada and Australia.	*http://aceee.org/w-e-programs*
Cutting Your Energy Usage and Costs. EPA's online portal gives information and resources for best practices, training, and funding for energy efficiency projects.	*http://water.epa.gov/infrastructure/sustain/cutting_energy.cfm*
Determining Your Baseline Energy Use. This site provides links to several resources for information about performing energy audits at water and wastewater facilities.	*http://water.epa.gov/infrastructure/sustain/energy_use.cfm*
Efficiency Vermont Water & Wastewater Facilities. Efficiency Vermont provides a number of publications, resources, tips, and case studies to help water and wastewater facilities save energy. The resources include a comprehensive list of recommended practices.	*http://www.efficiencyvermont.com/for_my_business/solutions_for_me/water_and_wastewater/general_info/overview.aspx*
Electric Power Research Institute (EPRI) Energy Audit Manual for Water/Wastewater Facilities. This guide introduces the fundamentals of water and wastewater systems to marketers and field personnel of electric utilities. The guide provides a discussion of specific unit processes and their energy/demand relationships, and explains how the audit data can be used to improve energy performance.	*http://watercenter.montana.edu/training/savingwater/mod2/downloads/pdf/EPRI_Energy_Audit_Manual.pdf*
Energy and Water for Local Governments. This report from the Local Government Energy Assurance Planning program helps local governments understand the energy-water nexus. It discusses how energy is used in the water sector, how water is used in the energy sector, and covers a range of water and energy efficiency measures available to local governments.	*http://www.energyassurance.us/publications/LEAP_Energy_%26_Water.pdf?attredirects=0*
Energy Conservation in Water and Wastewater Treatment Facilities. Published by the Water Environment Federation, this manual discusses principles and concepts of energy requirements, potential sources of inefficiency, and recommended energy conservation measures for specific equipment and processes.	*http://www.e-wef.org/Default.aspx?TabId=192&productid=5308*

Title/Description	Website
Energy Efficiency Best Practices for North American Drinking Water Utilities. This report from the Water Research Foundation and the New York State Energy Research and Development Authority provides a compendium of best practices compiled from literature and case studies.	*http://www.waterrf.org/PublicReportLibrary/4223.pdf*
Energy Efficiency for Water and Wastewater Utilities. This website from EPA's Office of Water provides tools and guidance to help water industry professionals determine energy use, reduce energy use and costs, and learn about renewable energy opportunities. It also includes presentations from an EPA webinar series on energy efficiency for water and wastewater utilities.	*http://water.epa.gov/infrastructure/sustain/energyefficiency.cfm*
ENERGY STAR for Wastewater Plants and Drinking Water Systems. This ENERGY STAR website provides resources and tools to help water and wastewater facility managers reduce energy use.	*http://www.energystar.gov/index.cfm?c=water.wastewater_drinking_water*
ENERGY STAR Resource Guide: Improving Energy Efficiency and Reducing Costs in the Drinking Water Supply Industry. This guide describes resources for cost-effectively improving the energy efficiency of U. S. public drinking water facilities. It includes a large compilation of case studies and cost-effectiveness analysis of energy efficiency measures.	*http://escholarship.org/uc/item/6bg9f6tk*
ENERGY STAR Training. Regular ENERGY Star training presentations that are relevant to water and wastewater utilities are available online.	*http://www.energystar.gov/index.cfm?c=business.bus_internet_presentations*
Ensuring a Sustainable Future: An Energy Management Guidebook for Wastewater and Water Utilities. This guidebook provides facility operators with a step-by-step plan for implementing energy efficiency projects at a water or wastewater facility.	*http://www.epa.gov/waterinfrastructure/pdfs/guidebook_si_energymanagement.pdf*
EPA Region 1: Energy & Water Infrastructure. This website provides tools and guidance for water industry professionals related to energy use, energy efficiency, and renewable energy.	*http://www.epa.gov/region1/eco/energy/mitigation-efforts-epane.html#EnergyWaterInfrastructure*
EPA Region 9: The Water-Energy Connection. This website provides educational information on the relationship between energy savings and water savings. It also provides resources related to water and energy efficiency practices.	*http://www.epa.gov/region9/waterinfrastructure/waterenergy.html*
EPA's Principles for an Energy Water Future. This document describes the nexus between energy and water as an increasingly important area of focus for EPA. In Principles for an Energy Water Future, EPA states that government can take a leadership role in this relationship and lead by example. EPA is proposing these principles for "government, service providers and ratepayers to foster valuable collaboration in both the water and energy sectors to work together to meet water and energy needs both nationally and locally."	*http://water.epa.gov/action/upload/Energy_Water_Principles.pdf*
Handbook on Wastewater Management for Local Representatives. NYSERDA's reference tool for local officials, public administrators, and managers to help them understand the wastewater system. Includes many resources for utilities outside of New York as well.	*http://www.nywea.org/_default.inc/content/DECHandbook/DECHandbk(1-27-07).pdf*
Massachusetts Energy Management Pilot Program for Drinking Water and Wastewater Case Study. Reporting on a pilot program for 14 water and wastewater facilities in Massachusetts, this document gives an overview of the projects implemented during the program, including funding sources, energy savings, and results.	*http://water.epa.gov/aboutow/eparecovery/upload/2010_01_26_eparecovery_ARRA_Mass_EnergyCasyStudy_low-res_10-28-09.pdf*

Title/Description	Website
NEMA Premium. A national premium-efficiency electric motor program launched by the National Electrical Manufacturers Association in 2001. Ten motor manufacturers participate in the program, which is endorsed by the Consortium for Energy Efficiency.	*http://www.nema.org/premiummotors*
Pump System Assessment Tool (PSAT) Tool. The PSAT Tool is a free, online tool developed by the U.S. Department of Energy that helps users assess energy-savings opportunities in existing pumping systems. It relies on field measurements of flow rate, head, and motor power or current to perform the assessment.	*http://www1.eere.energy.gov/industry/bestpractices/software_psat.html*
Pump System Improvement Modeling (PSIM) Tool. The PSIM Tool a free, educational tool focused on helping users better understand the hydraulic behavior of pumping systems. PSIM calculate the pressure drop and flow distribution in both straight-path and simple branching or looped pumping systems.	*http://www.pumpsystemsmatter.org/content_detail.aspx?id=110*
Risks and Benefits of Energy Management for Drinking Water Utilities. This document provides detailed information to water utilities on the trends in energy resources that might affect energy management.	*http://watercenter.montana.edu/training/savingwater/mod2/downloads/pdf/AWWA_Risks_Benefits.pdf*
River Network Saving Water Saving Energy Blog. The Saving Water, Saving Energy blog provides news, resources, and analysis on water, energy, and climate change issues with an emphasis on the connections between water and energy.	*http://www.rivernetwork.org/blog/swse*
Roadmap to Energy In the Water and Wastewater Industry. This report gives an overview of the water and wastewater markets and industries, including stakeholder interests and areas for research and development.	*http://files.harc.edu/Sites/GulfCoastCHP/Publications/RoadmapEnergyWaterIndustry.pdf*
Saving Water & Energy in Small Water Systems. This training program offers four 45-minute presentations and associated resource files specific to small public water systems. The files cover water conservation, water audit and leak detection, energy efficiency, and the application of alternative energy sources.	*http://watercenter.montana.edu/training/savingwater/default.htm*
Saving Water and Energy: Municipalities and Water Utilities. A tip sheet from the Watergy program of the Alliance to Save Energy, to help municipalities and water utilities learn about strategies to reduce water and energy.	*http://watergy.org/resources/tipsheets/municipal.php*
Tackling the Nexus: Exemplary Programs that Save Both Energy and Water. This research report from the American Council for an Energy-Efficient Economy describes lessons learned by five exemplary programs that provide sustainable, cost-effective energy and water savings to their customers.	*http://aceee.org/research-report/e131*
TR-16 Guides for the Design of Wastewater Treatment Works. This document covers the important elements of wastewater treatment that can be considered in the design of wastewater treatment works. The content reflects current practices and advances in technology, nutrient removal, energy efficiency, and instrumentation.	*http://www.neiwpcc.org/tr16guides.asp*
Understanding Your Electric Bill. This technical data sheet overviews how electricity is measured, how electricity is charged, and how to better manage electricity consumption.	*http://water.epa.gov/infrastructure/sustain/upload/Understanding-Your-Electric-Bill.pdf*
Wastewater Management Fact Sheet: Energy Conservation. An EPA fact sheet on energy conservation strategies for wastewater utilities, including adjusting rate structure and installing a SCADA system or other upgrades.	*http://water.epa.gov/scitech/wastetech/upload/2008_01_16_mtb_energycon_fasht_final.pdf*

Title/Description	Website
Water and Energy: Leveraging Voluntary Programs to Save Both Water and Energy. This EPA report gives an overview of water use in the United States and highlights opportunities for residential and commercial customers and power plants to save water and energy.	*http://www.energystar.gov/ia/partners/publications/pubdocs/Final%20Report%20Mar%202008.pdf*
Water and Wastewater Energy Best Practice Guidebook. A guidebook developed by Wisconsin's Focus on Energy program that outlines best practices in planning, design, operation, and funding/financing.	*http://watercenter.montana.edu/training/savingwater/mod2/downloads/pdf/SAIC_Energy_Best_Practice_Guidebook.pdf*
Watergy: Energy and Water Efficiency in Municipal Water Supply and Wastewater Treatment. A training manual for the Watergy toolkit that serves as a guide for implementing energy efficiency strategies at water and wastewater treatment facilities.	*http://www.watergy.org/resources/publications/watergy.pdf*
Financing, Funding, and Incentives	
Database of State Incentives for Renewables and Efficiency (DSIRE). This database lists state incentives and resources for renewable and energy efficiency projects.	*http://www.dsireusa.org/*
ENERGY STAR Cash Flow Opportunity (CFO) Calculator. The CFO Calculator helps decision makers determine how much new energy efficiency equipment can be purchased from the anticipated savings, whether equipment purchases can be financed now or later, and whether money is being lost by waiting for a lower interest rate.	*http://www.energystar.gov/index.cfm?c=assess_value.financial_tools*
EPA Financing Alternatives Comparison Tool (FACT). Allows a water or wastewater utility to plug in a financial situation and enter financing options to identify the most cost-effective method to fund a project.	*http://water.epa.gov/grants_funding/cwsrf/fact.cfm*
How to Finance Public Sector Energy Efficiency Projects. This document from the California Energy Commission outlines cost-effectiveness criteria and financing options for energy-efficient projects in the public sector, including water and wastewater treatment districts.	*http://www.energy.ca.gov/reports/efficiency_handbooks/400-00-001A.PDF*
How to Hire an Energy Services Company (ESCO). California's handbook for hiring an ESCO that includes many answers about the types of contracts and services offered.	*http://www.energy.ca.gov/reports/efficiency_handbooks/400-00-001D.PDF*
List of qualified ESCOs. The Federal Energy Management Program established the Department of Energy Qualified List of Energy Service Companies in accordance with the Energy Policy Act of 1992 and 10 CFR 436.	*http://www1.eere.energy.gov/femp/financing/espcs_qualifiedescos.html*
Local Government Energy Assurance Planning (LEAP). The LEAP program, an initiative under the Recovery Act, provides assistance to participating cities so they can identify and resolve energy infrastructure problems and more effectively plan for and communicate during energy emergencies.	*http://www.energyassurance.us/*
Water and Wastewater Facilities RFP Guidance. This guidance from the Consortium for Energy Efficiency helps water and wastewater utilities learn how to effectively incorporate energy efficiency improvement projects in their requests for proposals and requests for qualifications.	*http://www.cee1.org/ind/mot-sys/ww/rfp/index.php3*
Water and Wastewater Pricing. Articles, reports, case studies, and other information from EPA on pricing at water and wastewater utilities.	*http://water.epa.gov/infrastructure/sustain/Water-and-Wastewater-Pricing-Introduction.cfm*

Title/Description	Website
Water Conservation and Reuse	
Control and Mitigation of Drinking Water Losses in Distribution Systems. This document provides information on developing a water loss control program at drinking water utilities.	*http://water.epa.gov/type/drink/pws/smallsystems/upload/Water_Loss_Control_508_FINALDEc.pdf*
EPA 2012 Guidelines for Water Reuse. The 2012 reuse guidelines update and build on EPA's previous reuse guidelines issued in 2004, incorporating information on water reuse that has been developed following the release of the 2004 document. In addition to summarizing existing U.S. regulations, the document includes water reuse practices outside of the United States, case studies, information on planning for future water reuse systems, and information on indirect potable reuse and industrial reuse. It also discusses disinfection and treatment technologies, emerging contaminants, and public involvement and acceptance.	*http://www.waterreuseguidelines.org/*
Other Water and Wastewater Topics	
EPA Decentralized MOU Partnership Papers. EPA and 16 partner organizations have published four papers that highlight how decentralized wastewater treatment systems can be sustainable and appropriate options for communities and homeowners. The papers provide information on the benefits and types of decentralized onsite approaches for collection, treatment, dispersal, and reuse of wastewater.	*http://water.epa.gov/infrastructure/septic/Decentralized-MOU-Partnership-Products.cfm*
EPA's Planning for Sustainability: A Handbook for Water and Wastewater Utilities. This handbook describes a number of steps utilities can undertake to enhance their planning processes to ensure that water utilities are sustainably managed using cost-effective life cycle analysis.	*http://water.epa.gov/infrastructure/sustain/upload/EPA-s-Planning-for-Sustainability-Handbook.pdf*
New York State Energy Research and Development Authority (NYSERDA) Municipal Water & Waste Water Facilities. NYSERDA provides tools, case studies, funding, workshops, and resources to municipalities in order to helping them address regulatory pressures to decrease nutrients in wastewater, develop innovative ways to disinfect water, and optimize performance to improve efficiency and increase water-and wastewater-treatment capacity.	*http://www.nyserda.ny.gov/Energy-Efficiency-and-Renewable-Programs/Commercial-and-Industrial/Sectors/Municipal-Water-and-Wastewater-Facilities.aspx*
Sustainability and the Clean Water State Revolving Fund: A Best Practices Guide. EPA's Office of Wastewater Management developed this Best Practices Guide to provide an overview of state policies and practices supporting the priorities outlined in the Clean Water State Revolving Fund sustainability policy and pilot projects. This guide is intended for state programs as they consider policies and initiatives to promote community and water infrastructure	*http://water.epa.gov/grants_funding/cwsrf/upload/CWSRF-Best-Practices-Guide.pdf*
Sustainable Infrastructure: Better Management. A Web-based portal that offers information to water utilities on how to improve their environmental and operational performance.	*http://water.epa.gov/infrastructure/sustain/sustainable_infrastructure.cfm*

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