United States Environmental Protection Agency

Strategies for Saving Energy at Public Water Systems

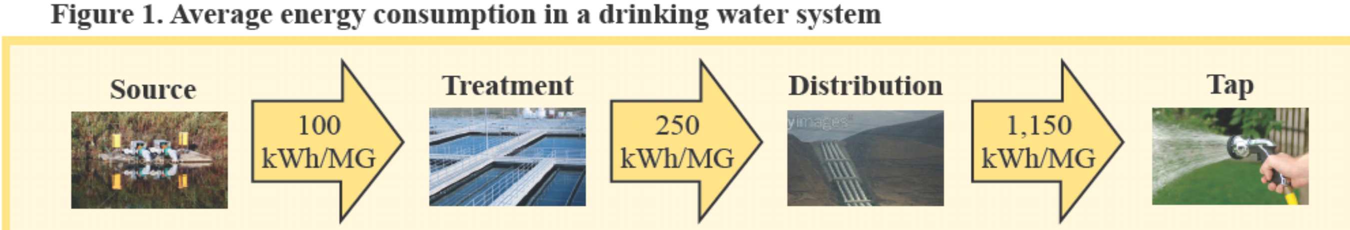
This document discusses energy issues facing public drinking water systems, steps that systems can take to understand and reduce their energy use and costs, and funding resources for energy efficiency. This document is intended for small to medium-sized water systems as well as technical assistance providers and state programs that support or regulate these systems.

How much energy do drinking water systems use?

Providing safe drinking water is a highly energy-intensive activity. At the national level, drinking water and wastewater systems account for three to four percent of U.S. energy use.[i] This is equivalent to 56 billion kilowatt hours (kWh) annually, and the generation of almost 45 million tons of greenhouse gases (GHG). At the community level, drinking water and wastewater systems are typically the largest energy consumers accounting for 25 to 40 percent of a municipality's total energy bill.[ii] Approximately 80 percent of municipal water processing and distribution costs are for electricity.[iii]

For drinking water systems, energy is needed for raw water extraction and conveyance, treatment, water storage and distribution. Energy usage can vary based on water source, facility age, treatment type, storage capacity, topography, and system size, which encompasses volume produced and service area. As illustrated in Figure 1, energy usage for a typical surface water drinking water system is 1,500 kWh/million gallons (MG), broken down as follows: 100 kWh/MG for conveyance; 250 kWh/MG for treatment; and 1,150 kWh/MG for storage and distribution.[iv] Public water systems using ground water typically have a higher average energy use than surface water systems, about 1,800 kWh/MG, primarily due to pumping raw water from aquifers.[v] Pumping in total, for either surface or ground water systems, typically accounts for 90-99 percent of energy consumption at a water system.[vi]

Figure 1. Average energy consumption in a drinking water system



Why is energy efficiency important?

Water systems face many challenges, including but not limited to aging infrastructure, increasing threats to watersheds and aquifers, changing compliance and public-health standards, shifts in population (growth and loss) and higher customer expectations. Energy efficiency can play a role in addressing all of these challenges by shifting staff resources and system operating costs away from energy bills and operation and maintenance (O&M) and towards infrastructure upgrades, source water protection efforts, treatment technology improvements and community outreach.

Fortunately, with energy use monitoring and energy audits, water accounting, and water loss reduction efforts, water systems can move toward more energy-efficient water production. In turn, by understanding the energy consumption of a drinking water system and taking advantage of energy efficiency opportunities, water systems can save money while saving energy. Water systems are encouraged to adopt best industry practices for water efficiency (for additional information see Water Efficiency for Public Water Systems, EPA 816-F-13-003) and energy efficiency. The level to which a system adopts these practices will largely depend on the system's immediate resources such as staff expertise or access to funding as well as the most pressing area of concern such as water loss reduction, immediate savings on energy bills or reducing the system's carbon footprint.

What are the benefits of reducing energy use at water systems?

1. Energy efficiency saves money. Paying for energy to operate a drinking water system can be expensive and represents a significant portion of drinking water systems' operating budgets. It is likely that the water sector will use more and more energy at higher prices for a variety of reasons including system expansions associated with population growth; new or revised regulations that may result in additional treatment or more energy-intensive treatment being added and drought; and climate change impacts that may necessitate use of new water sources of lower quality or of greater depth and/or distance from the end user. Energy savings can be achieved by improving energy efficiency, which means using less energy to provide the same level of service and water quality.

2. Energy efficiency extends the life of existing infrastructure. Drinking water systems have found that integrating energy efficiency practices into daily management and long-term planning contributes to overall system sustainability. By monitoring equipment for energy efficiency, water systems are more attuned to the overall state of their infrastructure and can proactively take steps to ensure equipment is operating efficiently. In turn, this reduces equipment strain and lowers operation and maintenance requirements.

3. Energy efficiency reduces greenhouse gas (GHG) emissions. Reducing energy consumption has a direct impact on reducing GHG emissions. A number of municipalities and states (California, Texas, Arizona, Washington, Utah, New Mexico, Montana, Maine, New Jersey, Oregon and Wisconsin) have established initiatives to reduce carbon footprints and GHG emissions over the next 10 to 30 years. Drinking water and wastewater systems will play an important role in meeting these goals.

4. Energy efficiency enhances customer relations. Customer expectations and concern for water are increasing. According to a recent study, 95 percent of Americans rate water "extremely important," more than any other service they receive.[vii] Federal, state; and local agencies; and energy providers are encouraging energy conservation and energy efficiency in consumer purchases. Effectively communicating energy management efforts and successes to customers and other stakeholders is an opportunity for a water system to establish itself as an environmental steward in the community. It also fosters goodwill among customers and elected officials and cultivates a greater understanding of water production delivery.

GETTING STARTED ON ENERGY EFFICIENCY

What steps should drinking water systems take?

Energy can be one of the largest operating costs for drinking water systems. Drinking water systems are recognizing the importance of reducing energy consumption and costs as a means to optimize overall system performance and to continue to provide a safe water supply. But water system owners and operators may not be fully aware of the options available to them to manage their energy budget or to identify, prioritize and fund energy improvement projects. The simple steps illustrated in Figure 2 stem from the Plan-Do-Check-Act approach of most environmental management system (EMS) models, including EPA's 2008, *Ensuring a Sustainable Future: Energy Management Guidebook for Wastewater and Water Utilities*[viii] and the joint EPA and U.S. Department of Energy's ENERGYSTAR® Program. By following these simple steps, drinking water systems of all sizes can create a successful energy management program and achieve energy savings.

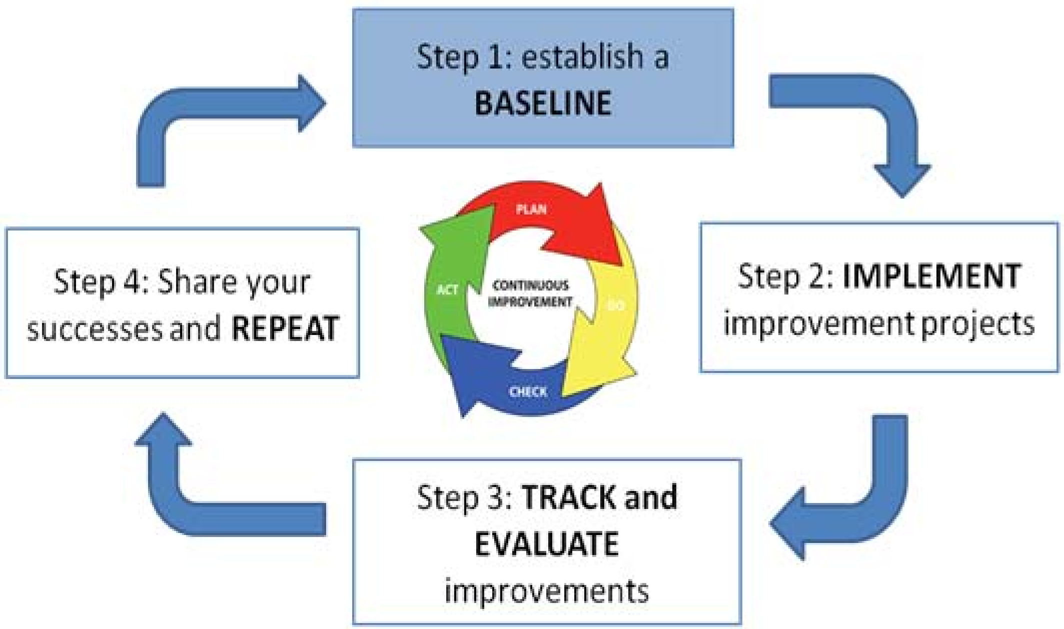


Figure 2. Steps for an Energy Improvement Program

Step 1 involves establishing a baseline of energy consumption and costs. All baselines start with the collection of energy utility data and a ***utility bill analysis*** – or the tracking of monthly and annual energy use compared to the volume of water produced. The ongoing recording, analyzing and reporting of energy consumption and costs is often termed ***energy accounting***.[ix] Energy accounting will increase knowledge of energy utility rates, possibly identify billing errors, highlight anomalies in energy use and contribute to more effective management. To get started, drinking water systems should collect one to three years of energy bills.

Once a baseline has been established it is important to gather operational and equipment-specific data through an energy audit. An **energy audit** can be a useful tool to develop a more thorough energy baseline, to identify areas of inefficiency and to provide direction for energy saving opportunities or ***energy conservation measures*** (ECMs). Energy audits vary along a spectrum of scope and robustness based on the knowledge and expertise of the person collecting and analyzing the energy information and on the needs and complexity of the water system undergoing the audit. The audit may involve a phased approach starting with a questionnaire, followed by a system walkthrough, and moving towards a complex evaluation of energy consumption at the process and the equipment level of detail. An energy audit may also include specific ECM recommendations and the development of an energy action plan.

Water system managers and operators are encouraged to determine their baseline energy use and conduct an energy audit either on their own or with the help of a technical assistance (TA) provider, energy service provider or experienced energy consultant.

- **RESOURCE: EPA's Energy Use Assessment Tool** is a free, downloadable, Excel-based energy audit tool. The tool allows both water and wastewater systems to conduct a utility bill analysis, determine baseline energy consumption and cost in total and also broken down to the process-level and equipment-level, and identify the most energy-intensive areas of the system. In addition, the tool highlights areas of inefficiency that users may find useful in identifying and prioritizing ECMs. The tool can be found at: http://water.epa.gov/infrastructure/sustain/energy_use.cfm.
- **RESOURCE: EPA's EnergyStar Portfolio Manager** is a free, online tool drinking water systems can use to develop a simple energy baseline based on utility bill data and track changes in energy use and GHG emissions over time. The tool can be found at: http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager.
- **RESOURCE: Understanding Your Electric Bill** is a Wisconsin Focus on Energy Fact Sheet that can be found at: http://water.epa.gov/infrastruture/sustain/Understanding-Your-Electirc-Bill.pdf
- **RESOURCE: Electric Power Research Institute (EPRI) Energy Audit Manual for Water /Wastewater Facilities** can be found at: http://www.cee1.org/ind/mot-sys/ww/epri-audit.pdf.
- **RESOURCE: How to Hire an Energy Auditor** is a California Energy Efficiency document that can be found at: http://www.energy.ca.gov/reports/efficiency_handbooks/400-00-001C.PDF.

Information needed to conduct an energy audit includes:

- utility bills from the last 12 to 36 months
- design, average and peak flows
- building square footage(s)
- operating hours
- an inventory of major equipment including pumps, motors, drive systems, lighting and HVAC equipment and the associated nameplate information.

As mentioned previously, pumps are often the largest consumers of energy in a drinking water system. As such, operating conditions of pump systems (pumps, motors and drive systems) are key elements of an energy audit. Table 1 provides a guide to what pumping system information should be collected during an energy audit as well as several key conditions to consider during a pumping system evaluation. It is important to note that pumping systems may be inefficient on the merits of the equipment alone (either poor performance ratings or through wear and tear) or due to the operation of the equipment, and both aspects should be weighed. In other words, a pump system with high efficiency ratings can still be inefficient if it is being operated at a rate or duration incompatible with the equipment's best efficiency point (see Table 2).

Table 1: Pump/Motor Equipment and Condition Checklist

Minimum Equipment Information to Gather	Additional Equipment Information to Gather	Conditions to Consider
✓ Pump style ✓ Number of pump stages ✓ Pump and motor speed(s) ✓ Pump rated head (nameplate) ✓ Motor rated power and voltage (nameplate) ✓ Full load amps ✓ Rated and actual pump discharge ✓ Operating schedule(s)	✓ Pump manufacturer's pump curves ✓ Actual pump curve ✓ Power factor ✓ Load profile ✓ Analysis of Variable Frequency Drives (VFDs) if present ✓ Pipe sizes ✓ Water level (source) ✓ Motor current ✓ Pump suction pressure ✓ Discharge pressure	✓ Maintenance records (frequent replacement of bearings and seals) ✓ Consistently throttled valves ✓ Excessive noise or vibrations ✓ Evidence of wear or cavitation on pump, impellers, or pump bearings ✓ Out-of-alignment conditions ✓ Significant flow rate/pressure variations ✓ Active by-pass piping ✓ Restrictions in pipes or pumps ✓ Restrictive/leaking pump shaft packing ✓ Multiple pump systems where excess capacity is bypassed or excess pressure is provided intermittent pump operation

- ☛ **RESOURCE: Pump System Assessment Tool (PSAT)** 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. It can be found at: http://www1.eere.energy.gov/manufacturing/tech_deployment/software_psat.html. Table 2 provides a framework for evaluating a water utility's pump system efficiency.
- ☛ **RESOURCE: Pump System Improvement Modeling (PSIM) Tool** is a free, educational tool focused on helping you better understand the hydraulic behavior of pumping systems. It can be found at: http://www.pumpsystemsmatter.org/content_detail.aspx?id=110.

Table 2: Typical Pump System Efficiency[x]

Pump System Component	Efficiency[1]			
	Range	Low	Average	High
Pump	30 – 85%	30%	60%	75%[1]
Flow Control[2]	20 – 98%	20%	60%	98%
Motor[3]	85 – 95%	85%	90%	95%
Efficiency of System		5%	32%	80%

1. *For pumping wastewater. Pump system efficiencies for clean water can be higher.*
2. *Represents throttling, pump control valves, recirculation, and VFDs.*
3. *Represents nameplate efficiency and varies by horsepower.*

Step 2 is the implementation of ECMs. Once a drinking water system has determined its baseline energy use and conducted an energy audit, the next step is to identify, evaluate and prioritize potential ECMs. Typical criteria used to prioritize ECMs include:

- Estimated capital or upfront investment,
- Expected energy reductions (kWh/MGD) or percent energy savings,
- Simple ***payback periods*** – the number of years of energy savings that it will take to account for the costs of the energy efficiency improvement, and
- Annual cost savings (both energy and O&M).

When making decisions, a drinking water system can use this information to prioritize the implementation of ECMs over time. In general, the shorter the payback period the more attractive the project is, particularly for drinking water systems where there is limited funding available. It is important to remember, however, that every piece of equipment has a life cycle cost associated with it. For example, the initial cost of buying a pump is only 10 percent of its life cycle cost, whereas the energy costs and maintenance costs associated with that pump are 45 percent and 37 percent, respectively.[xi] As such, a high efficiency pump system may cost more now but have significant savings over the long-term. Further, it is important to remember that energy savings may be gained by simple, low-to-no cost operational changes (e.g., managing energy demand in treatment and pumping, water loss reduction and water efficiency efforts) versus technology upgrades.

A drinking water system might want to consider the potential for staged implementation – starting with the easier, less expensive projects and planning forward for larger-scale or more complex/expensive projects. This approach has multiple benefits of building confidence and demonstrating immediate success in order to maintain and grow both internal and external support for a continued energy management program.

Water systems may choose to develop an ***energy action plan*** to document their decisions and clearly spell out the selected ECMs, both operational and technological. The energy action plan could also include timelines for funding and completion of ECMs; listings of the staff responsible for the associated changes, technical requirements for implementation, such as specific staff training or new standard operating procedures necessary to carry out the ECMs; and communication message mapping for stakeholders. Drinking water systems may also want to incorporate objectives or targets and define performance indicators to measure progress in the energy action plan. For example, a water system may choose a simple goal to improve overall energy performance by 10 percent above its baseline. The performance indicator would be kWh/MGD and could be monitored through follow-up energy audits conducted regularly. Energy action plans can be as simple or sophisticated as necessary based on the system's specific characteristics. To maximize success, the energy action plan should have staff buy-in at all levels of the drinking water system, as applicable.

☛ **RESOURCE: EPA's Ensuring a Sustainable Future: Energy Management Guidebook for Wastewater and Water Utilities** provides guidance to utilities to develop an effective and lasting energy management program. It can be found at:

http://www.epa.gov/owm/waterinfrastructure/pdfs/guidebook_si_energymanagement.pdf.

- ☛ **RESOURCE: Improving Pump System Performance: A Sourcebook for Industry, Second Edition.** A U.S. Department of Energy (2006) document that can be found at: http://www1.eere.energy.gov/industry/bestpractices/pdfs/pump.pdf.
- ☛ **RESOURCE: Consortium for Energy Efficiency RFP Guidance for Water-Wastewater Projects** provides recommendations and model language for solicitations for energy efficiency design services. It can be found at: http://www.cee1.org/ind/mot-sys/ww/rfp/index.php3.
- ☛ **RESOURCE: 5 Steps to Successful Energy Performance Contracting** can be found at: http://www.energyservicescoalition.org/resources/5steps.htm.

Step 3 is tracking performance and evaluation. It is important for water systems to periodically monitor and measure performance to review progress, refine goals and priorities, and to determine next steps for future energy improvements projects. Comparing current performance to the pre-determined baseline energy use is a good way for drinking water systems to evaluate whether the energy efficiency improvements or ECMs they have made have resulted in energy and cost savings. Simple spreadsheet tracking tools, such as EPA's Energy Use Assessment Tool, might be useful for smaller systems, whereas larger water systems may require a more complex program, such as an Energy and Water Quality Management System (EWQMS). These evaluations can be used to inform an energy management program and to justify future ECMs.

- ☛ **RESOURCE: EPA's Energy Use Assessment Tool** is a free, downloadable, Excel-based energy audit tool. The tool allows both water and wastewater systems to conduct a utility bill analysis, determine baseline energy consumption and cost in total as well as broken down to the process-level and equipment-level and identify the most energy-intensive areas of the system. In addition, the tool highlights areas of inefficiency that users may find useful in identifying and prioritizing ECMs. The tool can be found at: http://water.epa.gov/infrastructure/sustain/energy_use.cfm.
- ☛ **RESOURCE: EPA's EnergyStar Portfolio Manager** is a free, online tool drinking water systems can use to develop a simple energy baseline based on utility bill data and track changes in energy use and GHG emissions over time. The tool can be found at: http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager.

Step 4 is communicating successes and making continual improvements. Communicating success internally to employees and management as well as externally to consumers and other stakeholders is a critical aspect of an effective energy management program. Water systems can share their efforts and successes with elected officials, at board meetings, on their Web site, through bill stuffers, in Consumer Confidence Reports, and through newsletters or other outreach mechanisms. This establishes rapport with the community (good public relations) and builds support for future energy improvement projects. System operators or managers may also wish to participate in water association conferences to trade their experiences with their peers. By learning of others' successes and how they addressed challenges and by building a support network, water systems can continually make improvements to their energy management program.

What ECMs should drinking water systems consider?

There are substantial opportunities to reduce energy costs at drinking water systems. These savings can be realized through changes in O&M with no-to-low investment costs to technology upgrades, which may have a high initial investment but may offer life cycle operational savings.

As mentioned previously, pumping represents the largest portion of energy used at a drinking water system. If resources are limited, improving pump and motor efficiency should be the focus of a system's energy management program. Such efforts may include correcting for inappropriate pump sizing, upgrading standard efficiency motors with premium efficiency motors or installing **variable frequency drives (VFDs)**, where appropriate. Beyond pumps and motors, savings can be realized through a range of ECMs including, but not limited to, energy demand management, water efficiency initiatives, renewable and alternative energy development or purchases, and HVAC and lighting upgrades. These ECMs will be discussed in more detail below.

COMMON ECMS FOR WATER SYSTEMS

- Proper equipment sizing
- Use of premium efficiency motors
- Install VFDs if applicable
- Energy demand management
- Water efficiency efforts
- Renewable energy
- Building upgrades (e.g., lighting and HVAC)

Proper equipment sizing involves matching pumps to their intended duty and flow rate. Often water systems are intentionally overdesigned as a result of conservative engineering practices and planning for future population growth projections. Unfortunately, oversized pumps add to system operating costs in terms of both energy and maintenance requirements. Further, sometimes population projections are never fully realized, or, by the time they are realized the useful life of the pump has been exhausted. The latter is especially true in many rural communities, which have experienced consistent population losses,[xii] further exacerbating the problem. Here are some corrective actions that systems can take to address oversized pumps [xiii]:

- Replace the pump/motor with a downsized version;
- Replace the impeller with a smaller one;
- Install VFDs to match variable speed to load requirements for the pump(s); or
- Add a small pump to reduce the intermittent operation of the existing pump.

New communities or communities with growing populations can most efficiently incorporate energy efficiency during the design phase of new projects or expansion projects, respectively.

Motor efficiency measures can be realized at the operations level with very little capital expenditure, such as by maintaining ventilation and temperature control to the optimal operating conditions provided by the motor manufacturer. The replacement of inefficient motors with higher efficiency models is also a common and effective way for drinking water systems to improve their energy performance. Table 3 shows potential energy savings in kWhs for a single percentage point improvement in motor efficiency. While percent energy savings are modest when upgrading motors, they are reliable – typically resulting in savings of 2-5 percent.[xiv]

Table 3: Single Percentage Point Motor Efficiency Improvements
Motor HP and kWh Savings [xv]

Horsepower	Full Load Motor Efficiency (%)		Annual Savings kWh
	Original Efficiency	Final Efficiency	
10	89.5%	90.5%	605
25	92.4%	93.4%	1,420
50	93.0%	94.0%	2,803
100	94.5%	95.5%	5,431
200	95.0%	96.0	10,478

It is important to make decisions before a pump or motor fails and to plan for replacing standard efficiency motors with premium efficiency motors. A drinking water system may want to address this in their energy action plan.

- ☛ RESOURCE: **U.S. Department of Energy factsheet Determining Electric Motor Load and Efficiency** found at: http://www1.eere.energy.gov/industry/bestpractices/pdfs/10097517.pdf.
- ☛ RESOURCE: **Consortium for Energy Efficiency Motor Systems Initiative Tool Kit** found at: http://www.cee1.org/ind/mot-sys/mot-sys-tools.php3.
- ☛ RESOURCE: **U.S. Department of Energy Motor Challenges Program** provides downloadable books, tips, and fact sheets on technical and economic topics related to motors at: http://www1.eere.energy.gov/manufacturing/tech_deployment/motors.htm.
- ☛ RESOURCE: **Consortium for Energy Efficiency Motors and Motor Systems Industrial Program** provides technical material, links and fact sheets at: http://www.cee1.org/ind/mot-sys/mtr-ms-main.php3.

A **VFD** is an electronic control device that modulates the amount of power being delivered to a motor to allow for continuous matching of motor speed to load requirements for the pump. VFDs easily accommodate fluctuating flow demands, avoiding losses from throttled valves and bypass lines (unless system is designed with static head), allow "soft starts" (less wear and tear on the motor) and provide for more precise control of process. VFDs are often used to increase motor and pump efficiency in drinking water systems, and case studies suggest that when VFDs are installed appropriately with premium efficiency motors, savings of 10-50 percent can result with a payback of 1-8 years.[xvi] It is important to note that VFDs are not a panacea for energy efficiency; they will not save energy for systems without variability and will yield benefits only when operated properly.

Managing energy demand allows a drinking water system to work independently or in agreement with its energy provider to evaluate various savings scenarios related to pumping during off-peak hours. This reduces overall and peak energy requirements for the drinking water system. In other words, significant energy cost savings can be realized simply by maximizing the use of existing or additional storage capacity and switching water production to take advantage of time-of-use energy rates, thus avoiding the highest electricity costs. For example, when necessary storage capacity is available and water quality goals can still be met, a water system may pump and fill its storage tank at night during off-peak hours, then use the storage head to offset energy costs associated with distributing the water to the system during peak hours of the day.

Some energy providers offer incentives and rebates for consultations with them since these actions can reduce their overall demand too. The utility bill analysis described in Step 1 can also inform water operators and managers of load shifting opportunities at their water system. Load shifting can result in reduced energy cost and these savings can be reinvested in energy efficiency improvement projects.

Water efficiency efforts can reduce energy use by reducing the amount of water needed to be produced, treated and distributed. These savings can be realized through supply-side water efficiency efforts (e.g., water accounting, water loss control, or leak detection and repair) and through demand-side water conservation efforts (e.g., public outreach and education programs to reduce water consumption, free water audits for large volume customers, retrofit programs for residential customers, water pricing and water-use regulations).

Water saved is energy saved.

- ☛ **RESOURCE: U.S. EPA WaterSense** is a program that sets criteria for labeling water efficient products. It also allows water systems to become partners to promote WaterSense and water efficiency. Benefits to being a partner include gaining access to templates and other WaterSense-developed materials. Information about the program can be found at: http://www.epa.gov/watersense/.
- ☛ **RESOURCE: U.S. EPA's *Control and Mitigation of Drinking Water Losses in Distribution Systems*, EPA 816-R-10-019,** provides guidance on conducting water audits and developing water loss control programs. It can be found at: http://water.epa.gov/type/drink/pws/smallsystems/technical_help.cfm.
- ☛ **RESOURCE: American Water Works Association's (AWWA) Water Audit Software** is a free, online tool for water systems that want to conduct a standard water audit. It can be found at: http://www.awwa.org/Resources/WaterLossControl.cfm?ItemNumber=48511&navItemNumber=48158.

☛ **RESOURCE: AWWA Manual M36 Water Audits and Loss Control Programs** found at: http://www.awwa.org/Resources/WaterLossControl.cfm?ItemNumber=47957.

Renewable Energy. A number of drinking water systems have installed solar, wind or geothermal systems to generate power and reduce dependence on the energy grid. While drinking water systems are limited in their ability to generate power, there may be opportunities such as the use of in-line turbines instead of pressure reducing valves to generate energy and power ancillary equipment or the installation of wind turbines in open spaces owned by the water system.

- ☛ **RESOURCE: U.S. EPA Green Power Partnerships** found at: http://www.epa.gov/greenpower.
- ☛ **RESOURCE: U.S. DOE Energy Efficiency and Renewable Energy Clearinghouse** found at: http://www.eere.energy.gov.
- ☛ **RESOURCE: SAVING WATER & ENERGY IN SMALL WATER SYSTEMS** is a training program with four 45-minute presentations and associated resource files specific to small public water systems concerning water conservation, water audit and leak detection, energy efficiency, and the application of alternative energy sources found at: http://watercenter.montana.edu/training/savingwater/default.htm.

HVAC. While the greatest opportunity for HVAC energy savings occurs during the design phase, drinking water systems can reduce energy use by 10-40 percent through the use of high efficiency air conditioning; utilizing controls to reduce energy use; regularly cleaning air filters; using mixed flow impeller fans; adding programmable thermostats; and installing ventilation fans, low-emittance windows, and reflective coatings on building roofs.

Lighting can account for a significant amount of a building's energy use (35-45 percent depending on hours of operation, occupancy, and fixture type) even though it may be a relatively small component of a drinking water system's total energy load. Drinking water systems can install occupancy sensors, upgrade incandescent lamps with fluorescent lights, and replace mercury lights with metal halide or high-pressure sodium lights.

These are just a few of the options and opportunities available to drinking water systems. Since each drinking water system is unique, individual approaches to energy needs, energy demands, and energy efficiency solutions will also be unique. However, all drinking water systems can take steps to improve their energy efficiency.

ADDITIONAL RESOURCES

How can a water system fund energy efficiency efforts?

How a drinking water system finances energy efficiency improvements may depend on the nature of the improvement, the ownership status of the drinking water system (public or private), the drinking water system's size and credit rating, the availability of federal energy efficiency financing programs and regional or local incentives. Fortunately, there are many opportunities for drinking water systems to obtain financial assistance for projects that reduce their energy consumption.

Drinking water systems can access internal or external funding sources to make energy efficiency improvements and fund energy improvement projects. Examples of internal funding include rate increases, impact fees, system development and expansion charges and supplements to the water system's capital budget. It may also be possible to tap into fees or assessments from developers and manufacturers, builders, energy providers, and water customers. External funding options include capital markets, Energy Service Companies (ESCOs), local and regional incentive programs, and federal government funding programs. Short-term debt instruments such as bank loans, anticipation notes (in anticipation of bond, tax, grant or revenues to be received), commercial paper (taxable or tax-exempt unsecured promissory note that can be refinanced or rolled over for periods exceeding one year) and floating-rate demand notes (notes that allow the purchaser to demand that the seller redeem the note when the interest rate adjusts) may also be considered. Long-term debt is frequently in the form of bonds such as general obligation bonds and revenue bonds.

What funding options are available to water systems?

Drinking water systems should explore the financial assistance programs available to meet the specific energy efficiency needs of their system. Drinking water systems should recognize that they may need to use a combination of incentive programs and funding sources. A number of useful Web sites and external financial resources for energy efficiency are provided here:

- **The Drinking Water State Revolving Fund** (DWSRF) can provide low-interest loans for a variety of energy efficiency and water efficiency projects. States are encouraged to continue to use their DWSRF capitalization grant to fund green drinking water projects to address green infrastructure, water and energy efficiency improvements and other environmentally innovative activities. In FY2010 and FY2011, states were required to use a minimum of 20 percent of their capitalization grant for green projects (also known as the Green Project Reserve or GPR). For the FY2012 capitalization grant, designating green projects is at the discretion of the state. Examples of fundable green projects include energy audits, equipment upgrades, leak detection equipment, water meter installation and installation of water efficient devices. Other improvements, which in FY2010 and FY2011 required the development of a business case to be designated for GPR, include retrofit or replacement of pumps and motors with high efficiency motors, replacement or rehabilitation of distribution lines or installing Supervisory Control and Data Acquisition (SCADA) systems. These improvements may also still be eligible for funding even if they are not designated for GPR. Drinking water systems should contact their state DWSRF programs to find out more about the state's priorities and funding options.

- ☛ **Resource: DWSRF Green Project Reserve 2010 Guidance** found at: http://www.epa.state.il.us/water/financial-assistance/publications/green-project-reserve-guidance.pdf.

- Many energy utility providers offer financial incentives such as rebates and reduced energy rates for customers who purchase energy efficient equipment or implement energy efficiency management practices.

- Drinking water systems can use energy performance contracting, an innovative financing mechanism that allows drinking water systems to install energy conservation measures without paying up front. Installation costs are repaid out of guaranteed energy savings. For example, public agencies, including municipal drinking water systems, can enter into tax-exempt lease-purchase agreements (TELPs) to finance energy efficiency improvements and equipment purchases using savings captured from the projects to pay for the associated upfront costs. The most frequently used type of performance contract is the **Guaranteed Savings Performance Contract** that incorporates equipment and system performance guarantees issued by the contractor. Performance contracts are not financing vehicles by themselves, and they often separate financing from the technical services.

- State funding organizations offer a variety of financial assistance programs including shared-cost energy efficiency studies, incentives for efficiency measures and renewable energy projects, and loan funds to reduce the cost of installing equipment to improve efficiency and promote the use of alternate energy sources.

  - ☛ **Resource: Database of State Incentives for Renewables and Efficiency (DSIRE)** is a comprehensive source of information on state, local, utility, and federal incentives and policies that promote renewable energy and energy efficiency. It can be found at: http://www.dsireusa.org/.
  - ☛ **Resource: Federal Energy Management Program (FEMP)** provides state-by-state information on energy efficiency and renewable energy incentives at: http://www1.eere.energy.gov/femp/financing/energyincentiveprograms.html.

- A number of federal agencies including the U.S. Department of Energy, the U.S. Department of Agriculture Rural Development Program, and the U.S. Department of Health and Human Services Rural Assistance Center also provide funding for various types of projects.
  - ☛ **Resource: U.S. Department of Energy**
    - ☛ **Save Energy Now Program** is an initiative to reduce industrial energy intensity. Companies can participate in no-cost energy assessments. Information can be found at: http://www1.eere.energy.gov/industry/saveenergynow/assessments.html.
    - ☛ **Energy Efficiency and Conservation Block Grant Program** (EECBG) information can be found at: http://www.eecbg.energy.gov/.
  - ☛ **Resource: U.S. Department of Agriculture**

- **Rural Energy for America Program Grants/Energy Audit and Renewable Energy Development Assist (REAP/EA/REDA)** provides grants for energy audits and renewable energy development assistance. Information can be found at: http://www.rurdev.usda.gov/rbs/busp/REAPEA.htm.
- **Rural Development through the Rural Energy for America Program Guaranteed Loan Program (REAP LOAN)** provides financing for energy improvement projects. Information can be found at: http://www.rurdev.usda.gov/rbs/busp/9006loan.htm.

- **RESOURCE: U.S. Department of Health and Human Services - Rural Assistance Center (RAC)** offers funding to help rural communities, including funds for energy audits and renewable energy. Information can be found at: http://www.raconline.org/funding/.

How can State's help water systems become more energy efficient?

States can play a significant supporting role for water systems by helping them understand the importance of energy efficiency, assisting them with energy audits and/or energy action plans and finding funding vehicles that will work for their situation. States may also develop energy programs that encourage and support energy management programs in drinking water systems through technical and financial assistance. Two examples of such state programs are described below:

- **New York State Energy Research and Development Authority (NYSERDA)** is a public benefit corporation created in 1975 whose aim is to help New York meet its energy goals. Currently, NYSERDA is primarily funded by state rate payers and is governed by a board of 13 members. NYSERDA's programs and services provide a vehicle for the state to work collaboratively with stakeholders with funds allocated towards energy-efficiency programs, research and development initiatives, low-income energy programs, and environmental disclosure activities. Information can be found at: http://www.nyserda.ny.gov/.

  - **RESOURCE: NYSERDA Water & Wastewater Energy Management Best Practices Handbook** found at: http://www.nyserda.ny.gov/Page-Sections/Commercial-and-Industrial/Sectors/Municipal-Water-and-Wastewater-Facilities/~/media/Files/EERP/Commercial/Sector/Municipalities/best-practice-handbook.ashx.

- **Wisconsin's Focus on Energy** is a state program that works with eligible Wisconsin residents and businesses to install cost-effective energy efficiency and renewable energy projects. Its efforts help Wisconsin residents and businesses manage rising energy costs, promote in-state economic development, protect the environment, and control the state's growing demand for electricity and natural gas. The program was developed under a State Act that prescribes that the investor-owned electric and gas utilities collectively establish and fund the statewide energy efficiency and renewable energy programs and can be found at http://www.focusonenergy.com/.

☛ **Resource:** ***Find it with Focus*** search tools can be found at: http://www.finditwithfocus.com/.

Case studies

Oswego, New York. The City of Oswego Water Department provides potable water to approximately 29,000 customers. The water is supplied from Lake Ontario, and the City's conventional water treatment plant has a capacity of 20 million gallons per day (MGD) and average flow rate of 5-10 MGD. The water system consists of a raw water pumping station, the water treatment plant with finished water pumping station, three booster pump stations and water storage tanks with a combined capacity of 11 million gallons. The six buildings total approximately 50,000 square feet and employ 20 people. The City hired an energy performance contractor to provide energy evaluations, energy grant services and design, bidding, and construction services for the rehabilitation of the raw and finished water pumping stations and booster pump stations. The annual electric cost was approximately $500,000, and the annual natural gas cost was approximately $50,000. Based on contractor recommendations, the following improvements were made:

- Rebuilt two 450 horsepower (hp) finished water vertical turbine pumps,
- Rebuilt one 350 hp finished water vertical turbine pump,
- Replaced motors and variable speed drives at the finished water and raw water pump stations (7 motors from 125-450 hp),
- Installed VFDs to modulate pump speeds to maximize energy efficiency,
- Installed a SCADA system with remote telemetry,
- Upgraded the filter valve actuators,
- Upgraded the coagulant chemical feed system, and
- Replaced the lighting system.

While improvements cost $2.4 million, the City obtained approximately $270,000 in energy incentives through various NYSERDA programs. The improvements reduced the peak-electric demand at the facility by 1,463 kW and resulted in an annual electric savings of 1,474,664 kWh and an annual energy cost savings of $95,892. In addition, operation and maintenance savings is approximately $60,000 annually.

Darlington, Wisconsin. The City of Darlington Municipal Water Department provides potable water to approximately 2,500 customers. The water system consists of two ground water wells, seven pressure reducing valve (PRV) stations, two booster pumps and two storage towers with a combined capacity of 600,000 gallons. The water is supplied from ground water 800 feet below the surface. One well pumps at 300 gallons per minute (GPM) and the other at 550 GPM. The water is chlorinated and fluorinated prior to distribution. The water system used Wisconsin's *Focus on Energy* to develop a baseline assessment and employed a consulting engineer to help with an energy audit. Based on their findings, the following improvements were made: reduced water loss through main replacement and resizing; balanced the PRV stations; installed a SCADA system to maximize off-peak pumping; and added a VFD to one well and switched two-thirds of use to the more efficient well pump. The annual energy usage dropped 406 MWh to 208 MWh and the annual electric cost fell from approximately $30,000 to approximately $13,350.

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