White Paper

Savings Multiplied: Conserving Water and Energy to Maximize Efficiency and Reduce Emissions

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Savings Multiplied: Conserving Water and Energy to Maximize Efficiency and Reduce Emissions

Water and energy are closely intertwined: Conserving one inevitably conserves the other. Similar disciplines drive water and energy savings and help communities, businesses and households operate more sustainably.

Saving energy goes hand-in-hand with sustainability, but so does saving water – in fact, even more so.

Of the two, water is arguably more finite and precious. The water now on Earth is all there ever was or ever will be. Ninety-nine percent of it is salty or locked up in ice and glaciers. People depend on the remaining amount for drinking, bathing, recreation, growing food, producing goods, and generating power.

Water and energy are closely interconnected. Simply stated, it takes large amounts of water to produce energy, and substantial energy to distribute and purify water, and to heat it for numerous uses. That interconnectivity is called the "energy-water nexus."

Societies are increasingly adept at saving energy – pure economics demands it. Conserving water is even more critical, because life itself depends on it. Fortunately, many fundamentals of using energy wisely also apply to water. Smart water management – applying the right expertise, processes and technology – can help make the most of water on each step in its journey, from its source, to users, and back to the environment. Fortunately, each improvement along the way also saves energy.

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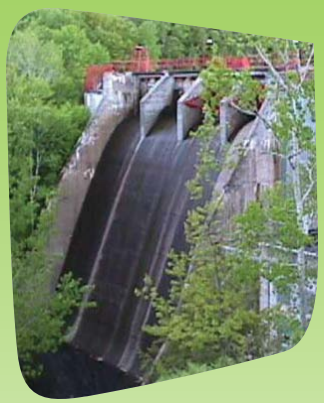
A resource under stress

The importance of fresh water becomes ever more clear as growing populations stretch supplies around the world. A 2006 United Nations report stated that by 2025, 1.8 billion people will be living in countries or regions with absolute water scarcity, and that two thirds of the world population could be under water stress conditions.[1]



In the United States, considered rich in water, the population is expected to grow by 70 million in the next 25 years, during which water and electricity use will rise by 50 percent.[2] A U.S. government study in 2008 found that by 2013, at least 36 states expect to see water shortages.[3] Water could quickly become a factor limiting economic growth.

Meanwhile, demand for energy is increasing the pressure on water resources. Some 40 percent of all daily fresh water withdrawals are used for cooling at large scale electric power plants.[4] In many regions, because of the amount of water needed to produce electricity, people use as much water turning on the lights and running electrical appliances each day as they use taking showers and watering lawns.[5]

Conversely, in the operations of mid-sized cities, 30 to 40 percent of the electricity is used by water utilities (mainly for pumping) and wastewater utilities (mainly for aeration).[6] The transportation, distribution and purification of water in the United States consumes 4 percent of all electricity.[7] And an estimated 18 percent of water used in homes and businesses is heated, requiring still more energy. In high hot water demand industries such as hospitality, 42 percent of energy use is to heat water. Other commercial buildings with heavy hot water demand include dormitories, public housing facilities, and facilities with commercial laundries or industrial processes.[8]

For these and other reasons, sustainability initiatives increasingly focus on water. Virtually every corporate, municipal, and institutional sustainability policy emphasizes water efficiency. The U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED®) certification program focuses on water efficiency with an emphasis on water use reduction, water efficient landscaping, and innovative wastewater technologies.

Rising demand and prices

For many years, water efficiency lagged behind energy efficiency, largely because users thought of water as cheap and abundant. That is changing. The U.S. Department of Energy reports that water rates have risen by 100 to 500 percent in the last decade and are likely to keep rising at an average of 10 percent per year.

Prices will go higher still if water utilities adopt full cost pricing, as the U.S. EPA advocates. In many locations, water prices do not fully reflect all the costs of producing, treating and distributing water. "Ultimately, prices signal value to consumers, and it is important for prices to reflect the increasing scarcity of water," according to the EPA. "Part of this value includes the increasing financial obligation needed to maintain our water and wastewater systems' infrastructure."[9] The EPA is encouraging utilities to charge for the full cost of service, adopt management practices that help them better manage their assets, and implement measures to use water more efficiently.

Between 1950 and 2000, the U.S. population nearly doubled, while public demand for water more than tripled.[10] In many regions, scarcity alone – whether caused by drought or population growth – has brought water efficiency to the forefront.

In the face of this demand, communities and water utilities find that – just as with energy – water efficiency is the best and cheapest route to greater capacity: Building or expanding treatment plants is far more expensive.

Wasting water

Although many communities are making progress with comprehensive water conservation initiatives, losses are still significant at every point in the system. Thousands of U.S. water utilities deliver more than 34 billion gallons of drinking water per day. The U.S. Geologic Survey has estimated that as much as 6 billion gallons per day is unaccounted for due to leakage, poor accounting and other unbilled consumption – enough to supply the nation's ten largest cities.[11]

The American Water Works Association's 2007 State of the Industry Report estimated losses at 10 to 20 percent in water distribution systems throughout the nation. In parts of the northeastern U.S., more than 30 percent of treated water is lost through exfiltration.[12] In some extreme cases a water utility may bill for only 50 percent (or less) of the water it treats and pumps to distribution.[13]

The picture is no better at the end user level, where buildings consume 20 percent of the world's available water.[14] A Natural Resources Defense Council issue paper states that if businesses in California alone were to adopt proper water efficiency measures, they could save enough water to supply San Francisco, Los Angeles, and San Diego.[15]

Meanwhile, an American household can waste, on average, 11,000 gallons of water every year from running toilets, dripping faucets, and other leaks.[16] If all United States households installed water efficient appliances, the country would save more than 3 trillion gallons of water and more than $18 billion per year. Older, inefficient toilets waste the most water in American homes. Replacing them with toilets bearing the U.S. EPA WaterSense® label could save nearly 2 billion gallons per day across the country.

Similar or greater gains in water efficiency are possible in many other settings, from commercial and industrial facilities to hospitals, schools, universities, government office buildings, correctional facilities, and military bases.

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Efficiency pays

The good news is that conserving water pays large dividends – arguably even more so than saving energy. On average, applying water efficient designs and products leads to 15 percent less water use, about 10 percent less energy use, and about 12 percent lower operating costs.[17]

Research in the construction industry shows that lower energy and operating costs are the top two reasons owners are incorporating water efficiency into projects.[18] The basic disciplines are the same in saving water and saving energy:

- Identify and fix the sources of waste.
- Install more efficient equipment.
- Add automation and controls where possible.
- Improve maintenance and operating practices.
- Measure results and establish continuous improvement strategies.
- Educate users and change wasteful behaviors.

An effective efficiency program follows a continuous cycle: measure, manage, monitor, report. Here are several basic ways in which water providers and users can reduce water consumption, increase efficiency in systems that distribute and use water, and in general employ sustainable practices related to water:

Commercial and residential strategies

Water efficient green building solutions. Facilities of all kinds can benefit from efficiency enhancements, which can cut energy and water consumption by 10 to 50 percent through conservation and operational changes. Possibilities include HVAC system modernization; process improvements in industrial buildings, hotels and hospitals; products to curtail domestic water use (faucets, toilets, showerheads); and education and awareness initiatives for building occupants. Efficiency upgrades are available for many processes and equipment that use water from hospital imaging equipment cooling and process cooling systems, to cooling towers.

Landscaping and smart irrigation. Landscape irrigation uses vast amounts of potable water. Simple conservation measures include choosing plants that need less water, capturing runoff from roofs and parking lots for irrigation, and avoiding watering during the day when evaporation losses are high. A more advanced measure includes installing weather-based irrigation controllers, which automatically modify watering schedules based on weather and plant/soil combinations.

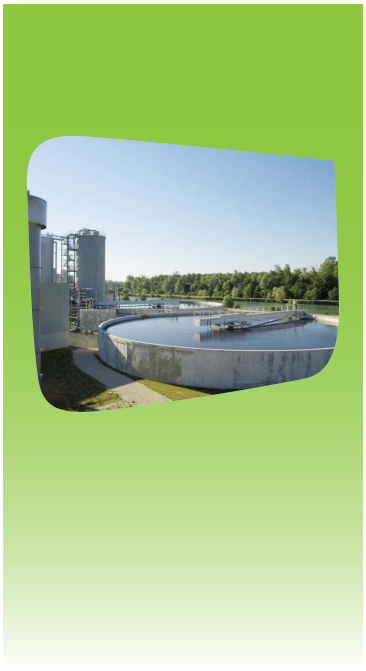
Conservation education. Building owners, cities and water utilities can use education and communication tools to teach residents how to conserve water – both directly by cutting water usage and indirectly by saving electricity. Building owners can install and pursue water saving products and measures. Cities can encourage residents to install water efficient fixtures and appliances and provide incentives in the form of rebates or tax breaks for participating.

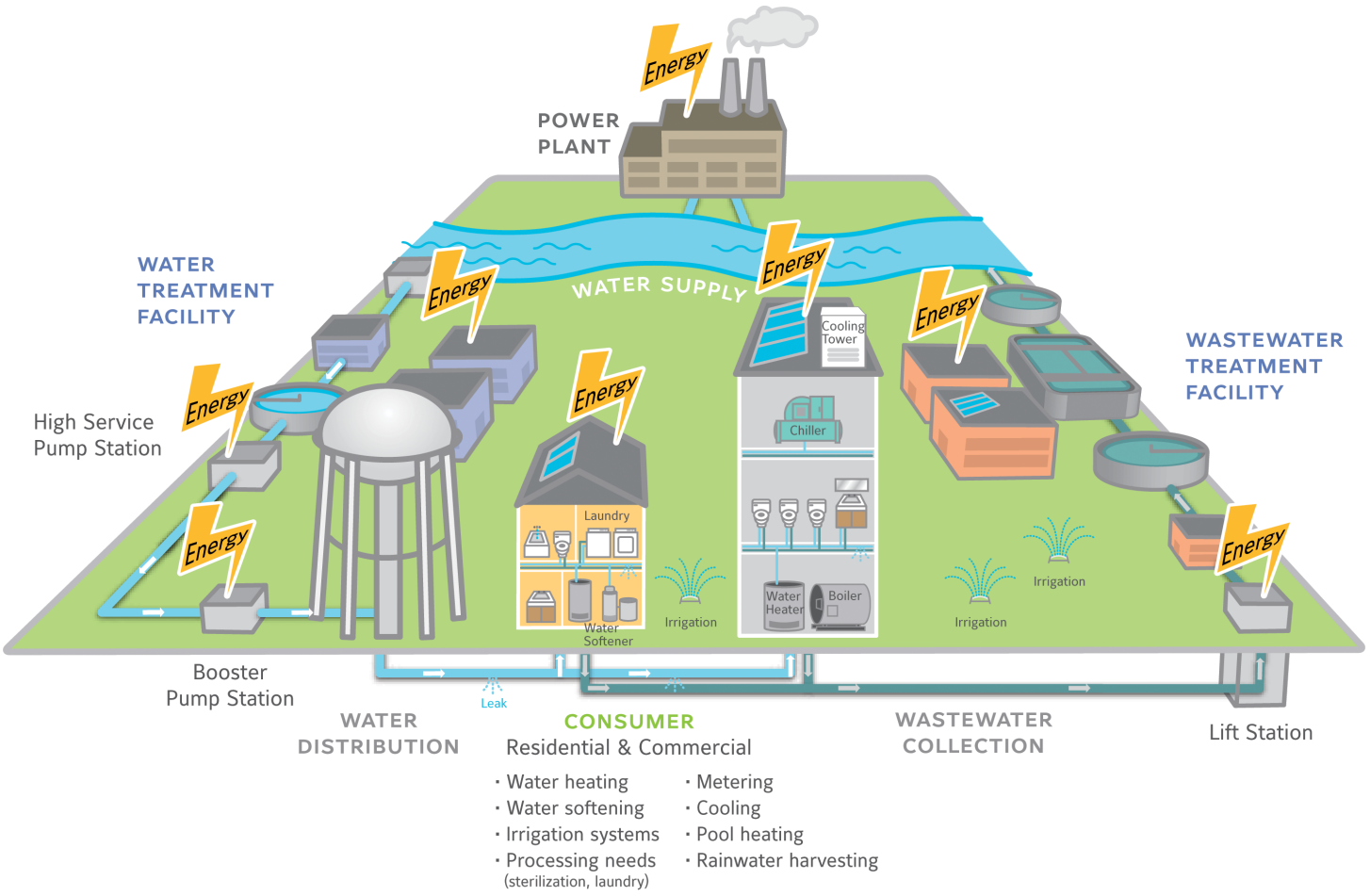
Utility system optimization

Water loss prevention. Municipal utilities can lose substantial water – from major line breaks or from slow, persistent leaks. A good starting point for optimization is to perform a "water balance" – an accounting of all uses. Data from a water balance can drive water conservation, water reuse and water loss control initiatives. An optimization program then can include measures such as ongoing leak detection and repair, pressure management, metering of usage with the correct meter types and sizes, Advanced Metering Infrastructure (AMI), periodic meter testing, and system wide review of service and business operations.

Greening treatment plants. Many water and wastewater treatment plants waste substantial energy. Energy conservation and operational changes can cut energy consumption by 10 to 30 percent. In addition to traditional HVAC, lighting, building automation systems and domestic water use improvements, water treatment plants can be improved with high efficiency raw water pumps, backwash water pumps, and high service pumps. Wastewater plants can benefit from high efficiency lift pumps, aeration system improvements, and combined heat and power systems using digester gas. Both kinds of plants can deploy wind and solar energy systems.

Metering accuracy and automation. One of the best ways to help fund efficiency and sustainability initiatives is to maximize revenue from water delivered to customers. Automation programs, such as AMI, replace old meters with new and properly sized units that record usage accurately and often enhance a utility's ability to use data to detect and address leaks and other anomalies. Automation saves the labor, fuel, inaccuracies, and other costs of manual meter reading. Automated reading systems that upload usage data directly to billing systems also make it feasible to bill customers more frequently, improving cash flow. More frequent and accurate data also enables faster detection of anomalies and better customer service.





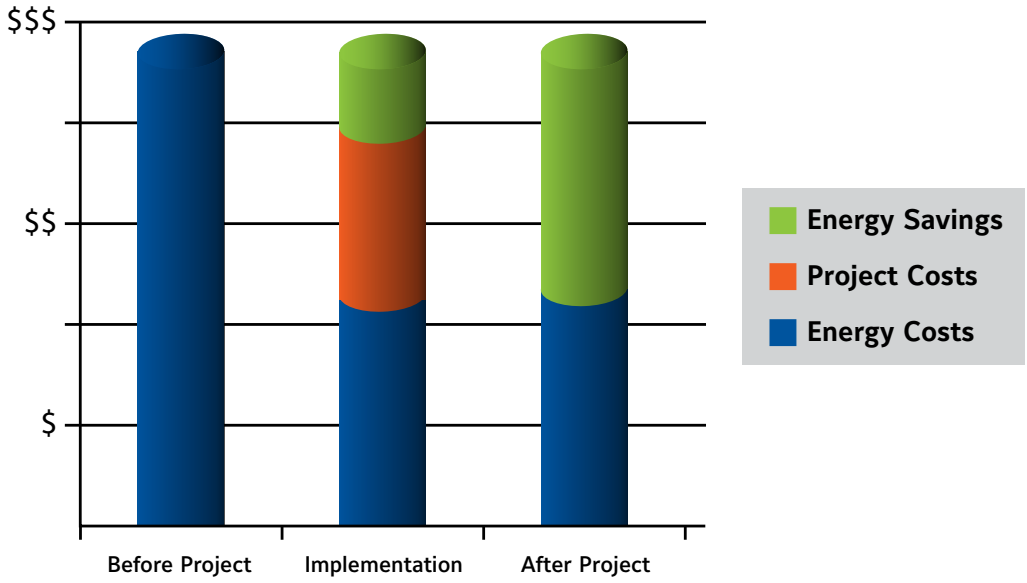
Conserve water and energy to maximize efficiency

Finding the funds

Naturally, water efficiency requires investments. Private and public entities alike can receive grants or low interest loans under state-sponsored efficiency initiatives. They can also take advantage of performance contracting, a proven way to fund water and energy efficiency projects with the project's guaranteed savings.

In a typical performance contract, an organization engages an energy service company (ESCO) to replace aging equipment and systems with modern, efficient technologies, including renewable energy. Some of the most rewarding performance contracts combine water and energy saving projects in a single package.

The ESCO guarantees the customer savings over a contract period, such as 10 to 15 years, and those savings pay off the capital investment in the improvements. Usually, the owner's operating costs go down immediately, even as the initial investment is repaid. At the end of the contract, when the project is paid in full, the owner has substantially lower costs than before the improvements were made, and those savings drop to the bottom line.



Performance Contracting Funding Model

Sense of urgency

Sustainability initiatives will continue to expand, and with them the motivation to conserve water and energy. Supplies of both are under stress. Using them wisely only makes sense – both financial and environmental.

Investments in water and energy efficiency can bring quick and substantial returns on investment. Funding mechanisms available today make those investments more attractive than ever. The time is right for all who use, distribute, and treat water to apply the latest knowledge and tools to drive out waste and use the resource to the fullest.

Water Efficiency Case Studies

Water savings support city's sustainability initiative

The city of Charleston, S.C., expects to save $18.5 million over 15 years through a performance contract that includes savings on water, energy, and operating costs. Projects include a new irrigation system for the city's many decorative plantings at a recreation complex and four city parks that will reduce water use by 40 percent.

Lower water usage cuts energy consumption for water treatment and pumping. The projects, which support city sustainability initiatives, will prevent nearly 10,000 tons of carbon dioxide emissions per year, equivalent to removing more than 1,600 cars from the road for a year.

Accurate metering saves $1.3 million per year

New accurate water meters, an advanced automated meter reading system, and distribution system upgrades enabled the city of Galveston, Texas, to capture lost water revenue and improve system efficiency. The work also included replacement of large, inefficient motors at two wastewater treatment plants.

The new meters helped the city capture $1.3 million per year in previously lost revenue, and savings on electricity brought the total benefit to $1.5 million annually. A performance contract, with financing through the State Energy Conservation office at advantageous interest rates, enabled the city to pay for the improvements without issuing bonds or raising taxes.

Digester gas drives combined heat and power system

A combined heat and power system (CHP) fueled by digester methane helped the Back River Wastewater Treatment Plant in Baltimore, MD, to cut energy costs by $1.4 million per year and eliminate emissions by 12.9 million pounds of carbon dioxide and 7.7 million pounds of nitrogen oxides. The 2.4 MW generating system also produces steam for process and space heating. All told, the plant undertook $14 million in energy conservation and facility improvement measures that will save $1.8 million per year.

Leading zoo cuts water usage by half

After a complete audit of water and energy efficiency, the Milwaukee County Zoo in Milwaukee, WI, made improvements that will save $1.4 million over 12 years and cut water usage by 50 percent (100 million gallons per year).

Water efficiency measures include putting control valves on drinking trays in the Aviary Building, installing low flow sinks, aerators, and toilets throughout the complex, turning off the water at night in the Macaque Monkey Island exhibit, and shutting off the water when not needed for decorative displays and at the waterfall for hippos and giraffes.

Energy and comfort improvements include high efficiency boilers in the aquatic reptile buildings, energy efficient lighting in the laboratories and ENERGY STAR® vending machines.

Water efficiency contributes to LEED silver certification

Parrish Medical Center in Titusville, FL, became the state's first LEED certified outpatient healthcare facility with a design that includes substantial water conservation components. Its green attributes, which earned a LEED silver rating, are part of an effort to create the best healing experience for patient and families.

Water conservation measures include landscaping with native vegetation that needs 50 percent less watering, using holding ponds to trap rainwater for irrigation, installing low flow plumbing fixtures that use 20 percent less water, and choosing dual flush toilets and waterless urinals that cut water usage by 30 percent.

Energy features include high efficiency lighting with occupancy and daylighting sensors, high efficiency HVAC with environmentally friendly refrigerants, and an integrated building management system.

Back River Wastewater Treatment Plant in Baltimore, MD

Milwaukee County Zoo in Milwaukee, WI

The solar photovoltaic field at Johnson Controls Corporate Headquarters in Glendale, WI

LEED Platinum campus conserves water and energy

The global headquarters campus of Johnson Controls, Inc., in Glendale, WI, has been registered for LEED Platinum status. This 33 acre site includes 258,000 square feet of new and fully renovated office space.

Energy features include Wisconsin's largest solar photovoltaic field (31,115 square feet), reducing greenhouse gas emissions by 1.1 million pounds per year while generating electricity for the site. In addition, solar heating on 1,330 square feet of roof fulfills nearly all hot water needs. The facility also uses extensive geothermal heating and cooling.

A 30,000 gallon cistern captures rainwater from all new roof surfaces for reuse. Gray water is used to flush toilets, reducing potable water for bathroom fixtures by 77 percent, or 595,000 gallons per year. All plumbing fixtures are high efficiency units. A three acre parking lot is surfaced with permeable pavers that allow rain and snowmelt to filter through and move via groundwater to a retention pond. The system prevents runoff that used to carry motor oil and other pollutants to storm sewers and waterways. A green roof also helps to reduce runoff.

Resources

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