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Water/Energy Convergence

Introduction

We all consume a great deal of water and electricity every day simply by living our busy lives. While many Americans know the importance of saving both energy and water, few know the direct connection between the two. Water and energy are intimately interrelated - using water more efficiently conserves energy and ultimately, decreases carbon emissions. Unfortunately, many people generally continue to waste water and ignore this link.

As cities continue to grow, particularly in regions already experiencing water scarcity,¹ the linkages between water and energy use are becoming more important. A growing community needs more power, which requires additional water. This paper helps explain the water-energy nexus and highlights the importance of conserving water and practicing energy conservation.

Background

Water is essential for human survival and prosperity, whether for drinking, sanitation, industrial use, irrigation, or power generation. And every step in the water supply process uses energy.

Electricity plays a critical role in producing, treating and delivering the clean water we use in our homes every day. For example, about 4 percent of the electricity consumed in the U.S. is used for collecting, treating and moving water and wastewater.² In fact, the ENERGY STAR program estimates that about \$4 billion is spent annually for energy costs to run drinking water and wastewater utilities.³ The biggest use of electricity in most cities is supplying water and cleaning it up after it's been used.⁴ Households use considerable amounts of energy to heat water for bathing, cooking, cleaning and other uses. On the flip side, it also takes water to create energy. Vast amounts of cooling water are used in the power plants that generate electricity.⁵

Given this interrelationship between water and energy, one of the best ways to save energy across the country and in our own homes is to use water more efficiently.⁶

1 The American Water White Paper: "Challenges in the Water Industry: Meeting Demand in the West" highlights scarcity challenges in Western United States.

2 Environmental Protection Agency's WaterSense publication. "Benefits of Water Efficiency."

3 Benjamin H. Grumbles, Assistant Administrator, EPA, February 14, 2008.

4 California Energy Commission. "Saving energy." 2010

5 Environmental Protection Agency's WaterSense publication. "Saving Water Saves Energy: Make the Drop-to-Watts Connection."

6 Environmental Protection Agency's WaterSense publication. "Saving Water Saves Energy: Make the Drop-to-Watts Connection."

Communities, businesses, industries and farms all have diverse water needs and must find a way to share limited, fluctuating supplies of this precious resource. Water conservation is the most cost-effective and environmentally sound way to reduce demand for water and conserve energy. It stretches existing supplies, which prevents the need for new facilities, thereby foregoing the environmental impacts that would have been felt by the development of those new facilities.

Additionally, conservation protects the environment, puts less pressure on sewage treatment facilities, uses less energy for water pumping and heating, decreases costs for developing new sources of water supply and decreases greenhouse gas emissions.

The Report on Freshwater Supply from the Government Office of Accountability states that according to state water managers, experts, and literature GAO reviewed, freshwater shortages are expected to continue into the future. In particular, 40 of 50 state water managers expected shortages in some portion of their states under average conditions in the next 10 years. Given this fact, water conservation—using water efficiently and avoiding waste—is fundamental to ensuring water availability in the future and lessening the effects of a limited water supply. Since very little of our water is used for drinking, there is significant room to find more efficient ways to manage our water use and reduce energy.

Along with ensuring the availability of water, affordability also poses a significant challenge with the costs of providing water on the rise. Future spending for public water and wastewater systems has been reported to range between \$2.5 and \$4.8 trillion over the 20-year period of 2009 to 2028.⁷

Finding Solutions

As we confront the challenges posed by climate change, persistent droughts, and high energy prices across the country, nearly everyone is looking for ways to conserve resources and cut costs. Fortunately, there are many simple techniques consumers can employ at home to use water more efficiently and to conserve energy preserving our nation's supplies for future generations. These solutions not only make environmental sense, they make economic sense as well:

- Check for and repair leaks throughout your home.
- Install a U.S. Environmental Protection Agency (EPA) EnergyStar⁸ rated demand hot water system.
- Install U.S.EPA WaterSense⁹ rated low flow shower heads, faucet aerators, and High Efficiency Toilets (HETs). HETs use just 1.28 gallons per flush (gpf) as compared to the 3.5 gpf or more for toilets sold prior to 1994.
- Lower your water heater thermostat to 120 degrees. Some manufacturers set water heater thermostats at 140 degrees. Lowering the temperature would reduce water heating costs by 6 to 10 percent. However, if you have a dishwasher without a booster

⁷ U.S. Conference of Mayors, "Trends in Local Government Expenditures on Public Water and Wastewater Services and Infrastructure: Past, Present and Future. 15 March 2010.

⁸ Reference the USEPA Energy Star Web site for more information: <http://www.energystar.gov/>.

⁹ Reference USEPA WaterSense Web site for more information: <http://www.epa.gov/WaterSense/>.

- heater, it may require a water temperature within a range of 130-140 for optimum cleaning.¹⁰
- Search for pipes that are not insulated, or that pass through unheated spaces such as crawlspaces, basements or garages. Wrap them with pre-molded foam rubber sleeves or fiberglass insulation, available at hardware stores.
 - Use energy and water efficient appliances (e.g., U.S. EPA EnergyStar and WaterSense rated dishwashers and clothes washers).
 - Use drip irrigation systems in gardens and landscaping rather than hose sprayers or sprinklers.
 - Wrap your water heater in an insulation blanket to help reduce heat loss. Nearly 20 percent of an average home energy bill goes to heating water.

Technologies in Practice

Just as other industries have been “going green” in recent years, the water industry has likewise developed ways to use its resources more efficiently. American Water has deployed various technologies and practices to help customers use water with greater efficiency, prevent leaks and, ultimately, to save energy:

Construction - Several water treatment plants are being designed and constructed to obtain Leadership in Energy and Environmental Design (LEED) Certification. The design team considers all environmental, energy efficient and sustainable aspects as they pertain to the individual building and structure on the project. Energy modeling is used to evaluate the relative importance of construction materials, such as glazing or insulation and to optimize building shell design to reduce long-term operating costs of the facility.

Leak detection - Developed comprehensive water preservation and efficiency strategies utilizing leak detection technologies that support conservation and consumption changes significantly impacting overall supply. For example, in Connellsville, Pa., MLOG acoustic leak detectors and an advanced metering infrastructure system was deployed, resulting in non-revenue water dropping by more than half, from over 25 percent within six months, saving about \$175,000 in annual water purchase costs in just the first year.¹¹

Lighting - American Water has been retrofitting lighting at a number of its facilities across the state subsidiaries and corporate offices for several years. Recently, the Hershey and Norristown Water Treatment Plants in Pa. and several facilities in N.J. were retrofitted with occupancy sensors and high efficiency fluorescent lighting and/ or LED lighting.

Pumping water - Increased use of variable speed drives on pumps by installing them on at least one pump in each station or plant to vary the pumping rate so it only pumps what is needed at a specific time, thus, saving energy. American Water also launched a pump efficiency initiative that identifies inefficient pumps and either replaces or rehabilitates them to improve efficiency.

¹⁰ Department of Energy

¹¹ Reference American Water leak detection white paper.

Alternative energy – American Water maintains a portfolio of alternative energy supplies. This portfolio includes solar, wind and biomass facilities. It is estimated that this portfolio saves over 2,500 metric tons of CO₂ annually. The company has installed over 3.1 MWdc of solar generating capacity at 11 facilities across three states (New Jersey, Illinois and Missouri), with plans for additional facilities.

In 2005, Pennsylvania American Water committed to operate its Yardley Water Treatment Plant with 100 percent pollution-free, wind-generated electricity. As a result, each year, the company purchases 1,603,200 kWh of green power, which is the environmental equivalent of planting more than 119 thousand trees or not driving 1.5 million miles each year.

Also in 2005, New Jersey American Water installed the state's largest ground-mounted solar electric system at its Canal Road Water Treatment Plant in Somerset, N.J., as part of an energy savings initiative. The system, which can produce up to 730,000 kilowatt-hours of energy a year, supplements 20 percent of the peak usage power needed to run the plant. Reducing energy usage by 585,000 kilowatt-hours a year prevents 1,577 pounds of nitrogen oxide, 4,875 pounds of sulfur dioxide and 699,856 pounds of carbon dioxide from being emitted into the air. This savings in carbon dioxide pollution is equivalent to planting 94 acres of tree seedlings or preserving 2.6 acres of land from deforestation.¹² This facility will celebrate 10-years of continuous “green” service in 2015.

And in 2011, New Jersey American Water installed solar modules on a reservoir at the Canoe Brook Water Treatment Plant in Millburn, N.J. This is the first solar array on the East Coast on a body of water designed to withstand a freeze/thaw environment. The 400 solar modules, measure 110 ft by 110 ft and rest on a docking station designed to float on the water's surface. The array generates 112 kilowatts of DC (direct current) power, which will then be converted to AC (alternating current) power. Annually, the solar field will produce 135,000 kilowatt hours per year, or approximately two percent of the plant's power.

By reducing household water use, you not only help reduce the energy required to supply and treat public water supplies, but also can help address climate variability. In fact:

- A family of four employing water-saving devices like low-flow toilets and more efficient appliances can save approximately 35,000 gallons of water a year, thereby lowering water use and water and energy bills.¹³
- A study conducted by the Pacific Institute for Studies in Development Environment and Security found that bottled water consumes as much as 2,000 times more energy than tap water. The study also found the total bottled water consumption in the U.S. consumed 32 to 54 million barrels of oil in 2007.¹⁴
- If one out of every 100 American homes was retrofitted with water-efficient fixtures, we could save about 100 million kWh of electricity per year—avoiding 80,000 tons of greenhouse gas emissions. That is equivalent to removing nearly 15,000 automobiles from the road for one year.¹⁵

¹² According to the Environmental Protection Agency and the U.S. Climate Technology Cooperation

¹³ Vickers, Amy. Handbook of Water Use and Conservation.

¹⁴ The Pacific Institute Studies in Development Environmental Security.

¹⁵ Environmental Protection Agency's WaterSense publication. “Benefits of Water Efficiency”.

Innovations in Energy Use

Water utilities around the world are faced with enormous infrastructure challenges that will demand better strategies for delivering the expected efficiencies that have become the standard within other more progressive industry environments. And like all companies, American Water is challenged to find innovative ways to operate at the lowest possible cost for the benefit of the company and its customers.

Through American Water's Innovation Development Process, the company has tested new approaches and technologies to create greater efficiencies in water reuse, desalination, wastewater operations, and bioenergy. Specifically, the company has introduced:

Demand-side Energy Management (Shire Oaks Pumping Station, Pa.): American Water is the first U.S. water utility to use the Smart Grid technology of ENBALA Power Networks. This innovative technology manages the way American Water's treatment plants and pumps use electrical power. Instead of adjusting electrical generation to match changes in electrical demand, the network adjusts demand, enabling electrical equipment to consume more energy when demand is low and less when it is high.

A Patent for Optimized Nutrient Removal from Wastewater: In 2011, the U.S. Patent and Trademark Office awarded American Water a patent for NPXpress, a more affordable and sustainable method to remove nutrients such as nitrogen and phosphorus from wastewater. Removing these nutrients – a requirement in various watersheds across the country – has traditionally been a difficult and costly process that involves the addition of extra chemicals and high concentrations of dissolved oxygen. The new patented process, credited to three American Water scientists, creates savings in both energy and process chemicals used for wastewater treatment. American Water and Abengoa signed a licensing agreement for this technology in 2014.

More information can be found in American Water's [Innovations In Energy Use](#) white paper.

Conclusion

As discussed in this paper, vast amounts of energy are used to pump, treat, deliver, and heat our nation's water every day. Without the implementation of significant energy and water conservation methods, energy and water consumption are likely to grow. If consumers become more 'water-wise' and pay extra attention to how water is used and its impact on energy usage, we can help conserve our most precious resources for future generations. As new challenges in the water industry arise, so will the opportunity to leverage more green solutions to preserve both water and energy.

Sidebar

Did you know?

- A faucet that leaks enough water to fill a soda bottle every 30 minutes will waste 2,192 gallons of water a year.¹⁶
- About 75 percent of the water we use in our homes is used in the bathroom. A leaky toilet can waste more than 10,000 gallons of water a year.¹⁷
- American public water supply and treatment facilities consume about 50 billion kilowatt-hours per year, which is enough electricity to power more than 4.5 million homes for an entire year.
- It takes 3,000 to 6,000 gallons of water to power a 60-watt incandescent bulb for 12 hours per day over the course of a year.¹⁸

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¹⁶ California Energy Commission. "Saving energy." 2010

¹⁷ California Energy Commission. "Saving energy." 2010

¹⁸ Environmental Protection Agency's WaterSense publication. "Saving Water Saves Energy: Make the Drop-to-Watts Connection."