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## Innovations in Energy Use

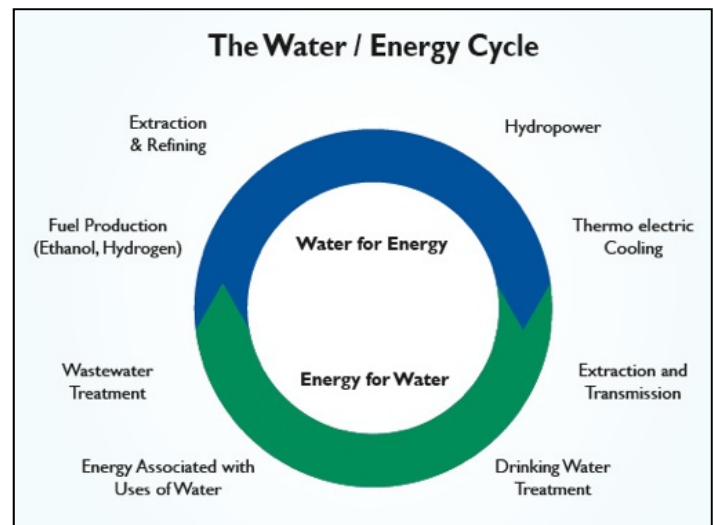
### Introduction

While no one knows precisely at what rate and by how much the climate will ultimately change, there is no doubt that the Earth's average surface temperature is on the rise – the result of a significant increase in the concentrations of heat-trapping greenhouse gases in the atmosphere. According to the Environmental Protection Agency, “the eight warmest years on record (since 1850) have all occurred since 1998, with the warmest year being 2005.” Human activity – from burning fossil fuels to deforestation – is likely the cause of most of that warming.<sup>1</sup>

Paired with a growing strain on available water and energy resources, climate change poses a serious global challenge. To reduce the emissions that contribute to climate change will require more efficient uses of conventional energy sources and the innovation of new, renewable energy technologies. The responsibility to do so is shared by government, consumers and businesses, including the water industry.

### The Energy-Water Nexus

For the nation to continue to meet its water and energy needs, and to do so in a more sustainable manner, requires an understanding of the interdependent relationship between energy and water, known as the energy-water nexus. Put simply, producing electricity requires large quantities of water, while acquiring, treating and delivering water requires a great deal of electricity. The U.S. Geological Survey in 2005 estimated that production of thermoelectric power accounted for as much as 49 percent of the nation's total water consumption. Conversely, in 2009, a report by the River Network estimated that 13 percent, or 520 million megawatt-hours, of total electricity consumed is water-related.<sup>2</sup>



A 2011 Black & Veatch survey of 700 U.S. utility leaders reveals a growing awareness of the energy-water nexus within the energy industry. For the first time in the five years of the Black & Veatch survey, water supply was the top environmental concern among all participants and water management was rated as the “game changer” business issue that could have the greatest impact on the utility industry.<sup>3</sup>

<sup>1</sup> <http://www.epa.gov/climatechange/basicinfo.html>

<sup>2</sup> Alliance for Water Efficiency and American Council for an Energy-Efficient Economy. “Addressing the Energy-Water Nexus: A Blueprint for Action and Policy Agenda.” May 2011; <http://www.aceee.org/files/pdf/white-paper/Water-Energy%20Blueprint.pdf>

<sup>3</sup> “Strategic Directions in the Electric Utility Industry,” 2011 survey by Black & Veatch. <http://www.bv.com/electricutilitytrends/#Insight5>

### Water Industry Solutions: Greater Efficiencies

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The vast majority of energy consumed by water utilities is used to pump water. Approximately 97 percent of American Water's own electricity consumption and 90 percent of its greenhouse gas emissions are related to pumping water – initially from its source to treatment and storage facilities, then later on to customers.<sup>4</sup> Improving the efficiency of pumps, then, is among the most important measures water utilities can take to decrease their carbon footprint.

Water conservation is also crucial. Due to their low rate of replacement, broken and leaking pipes currently result in 1.7 trillion gallons of water (\$2.6 billion) wasted every year.<sup>5</sup> Early detection and repair of leaks saves water and energy and reduces repair costs.<sup>6</sup>

American Water has developed a proactive approach to increasing efficiency, conserving energy and water, and reducing waste within its operations. This four-fold “line of attack” is as follows:

- Design for efficiency via enhanced pump, lighting and process design standards
- Construct for efficiency using sustainable construction standards and methods
- Operate for efficiency utilizing enhanced Best Operating Practices, leak detection and repair procedures
- Maintain for efficiency via Computerized Maintenance Management Systems and Preventive Maintenance Systems<sup>7</sup>

### Harnessing the Elements

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New, renewable energy technologies hold the other key to reducing the emissions that contribute to climate change. Solar and wind power are among the clean sources of energy that carry far less environmental impact than do conventional energy technologies, and which have practical applications in the water industry.

**Solar energy** generates electricity without producing harmful greenhouse gases, and produces maximum output at times of peak demand, when electricity is of highest value. Solar energy can be purchased from a third-party supplier or owned outright. In addition to environmental benefits, solar energy affords a financial hedge against rising fuel costs, as well as new revenue streams through the sale of tradable solar credits. Financial incentives are also available in the form of rebates and tax credits from local and federal government.<sup>8</sup>

Local **wind farms** produce clean, renewable energy with no design, construction, operation or maintenance commitments on the part of the utility. Since wind power is feeding energy to the electricity service provider's grid, there is no perceivable difference in the energy being provided to the company. Because wind power is generated off-site, enrolling in a wind energy program is ideal for smaller utilities that want to commit to greener operations but can't undertake the level of commitment required by solar installations.<sup>9</sup>

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<sup>4</sup> Young, John. “The ‘Greening of Water: American Water Takes Aim at Climate Change Through Reducing Greenhouse Gas Emissions, Increasing Efficiency.” Journal AWWA. June 2010

<sup>5</sup> “Value of Water Survey,” ITT Corporation, 2010. <http://www.itt.com/valueofwater/>

<sup>6</sup> Young, John. “The ‘Greening of Water: American Water Takes Aim at Climate Change Through Reducing Greenhouse Gas Emissions, Increasing Efficiency.” Journal AWWA. June 2010

<sup>7</sup> Young, John. “The ‘Greening of Water: American Water Takes Aim at Climate Change Through Reducing Greenhouse Gas Emissions, Increasing Efficiency.” Journal AWWA. June 2010

<sup>8</sup> American Water. “Harnessing the Elements: Using Solar and Wind Energy to Power Water Treatment Plants”

<sup>9</sup> American Water. “Harnessing the Elements: Using Solar and Wind Energy to Power Water Treatment Plants”

### An Early Adopter of New Technologies

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As the first US water or wastewater utility to join the EPA's Climate Leaders program and subsequently the Carbon Disclosure Program, American Water has set an ambitious goal to lower by 16 percent its greenhouse gas emissions per volume of water produced over a 10-year period (from 2007 to 2017). And, it is leveraging its position as the nation's largest publicly traded water and wastewater services provider to spur the industry to greener practices through measures such as these:

- Testing the efficiency of existing water pumps, evaluating alternatives for improvement, designing improvements, and executing them.
- Tasking the Research and Development team to reduce water lost to leaks through a variety of new technologies – including Continuous Acoustic Monitoring, Advanced Metering Infrastructure communication, leakage control zones and pressure monitoring.
- Conducting a pilot program to evaluate the potential savings of incorporating high-efficiency lighting technology at its facilities. (Lighting accounts for less than one-half of one percent of American Water's electricity use.)
- Participating in demand response programs through its New Jersey, Ohio, Pennsylvania and Long Island subsidiaries. Along with other electricity consumers, American Water has agreed to reduce its electric consumption during peak times. This helps avoid blackouts on the electric grid and ensures that fewer new generation plants will need to be built to cope with spiking energy demand at peak times.
- Evaluating options to expand the use of renewable energy within its operations, especially where state and federal incentive programs make it cost-effective to do so.

Specifically, the company has introduced industry-leading innovations that range from tapping solar and wind power to “smarter” energy management to inventing a more sustainable wastewater treatment method. Among the highlights in recent years:

**Floating Solar Power (Canoe Brook Water Treatment Plant, Millburn, N.J.):** In fall 2011, New Jersey American Water installed the East Coast's first solar array on a body of water designed to withstand a freeze/thaw environment -- weather conditions that are common to a northern New Jersey winter. Featuring a unique mooring system that allows the 538 solar modules to rise and fall with the water level of the reservoir, the array will generate approximately two percent of the water treatment plant's power. Annually, the solar field will produce 135,000 kilowatt hours for an estimated energy cost savings of \$16,000. The \$1.35-million pilot project was designed and built by ENERActive Solutions of Asbury Park, New Jersey. Solar tax rebates obtained through the American Recovery and Reinvestment Act may offset some of the costs of the project, to the benefit of ratepayers. “Solar bees,” also at Canoe Brook Treatment Plant, are employed to improve water quality by constantly circulating reservoir water. The company will monitor the effectiveness of the solar station during changes in weather, and consider adding more solar panels on the 735-million gallon reservoir. This is New Jersey American Water's fourth solar project.

**Solar Electric System (Canal Road Water Treatment Plant, Somerset, N.J.):** Launched in 2005, this system produces 585,000 kilowatt-hours per year – enough to supplement 20 percent of the peak usage power needed to run the plant. This annual reduction in energy usage 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. According to the EPA and U.S. Climate Technology Cooperation, this savings in carbon dioxide pollution is equivalent to planting 94 acres of tree seedlings or preserving 2.6 acres of land from deforestation.

**Demand-side Energy Management (Shire Oaks Pumping Station, Penn.):** 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. This

provides Grid Balance to electricity system operators. A successful pilot program at Pennsylvania American Water's Shire Oaks Pumping Station offset 2-3 percent of the site's total energy bill and has led to a larger partnership between American Water and ENBALA Power Networks that will bring ENBALA's Grid Balance technology to large treatment facilities throughout American Water.<sup>10</sup>

**Wind Power (Yardley Water Treatment Facility, Yardley, Penn.):** American Water enrolled in a wind power program in 2005 for its Yardley plant through local electricity service provider PECO. Today, the plant runs on 100 percent wind-generated energy, purchasing 1.6 million kilowatt-hours of wind power annually. While the move has not been a money-saving one, its environmental benefits are substantial – the equivalent of planting more than 119 thousand trees or not driving 1.5 million miles each year.<sup>11</sup>

**A Patent for Optimized Nutrient Removal from Wastewater:** In 2011, the United States 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 also used its industry-leading role to launch an **Innovation Development Process** in 2009. Designed to drive innovation and support the development of new products, the program tests new ideas, both from within the company and from business partners, to create greater efficiencies in areas such as water reuse, desalination, wastewater operations and bio-energy. The Enbala partnership and NPXpress innovation are two results of the company's Innovation Development Process.

### Conclusion

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If greenhouse gases continue to increase, the end of the 21<sup>st</sup> century could see the Earth's surface temperatures increase somewhere between 3.2 °F and 7.2°F above 1990 levels, according to climate models.<sup>12</sup> The growing awareness of humanity's potential impact on climate change has led to the development of new strategies over the past few decades to reduce harmful emissions through increased efficiencies and new, renewable energy technologies. Only recently, however have the water and energy communities begun to recognize the need to work together to create solutions that address their interdependency – a relationship known as the energy-water nexus.

In reducing its own carbon footprint, American Water has introduced innovations that it hopes will set the stage for more environmentally friendly practices throughout the industry. While solving the climate change challenge will ultimately require a unified and sustained effort between government, business and consumers, the water industry should, and must, take a leadership role.

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<sup>10</sup> Enbala Power Networks. "Pennsylvania American Water Connects to the Smart Grid."

<http://www.enbala.com/media/casestudies/Pennsylvania%20American%20Water%20Connects%20to%20the%20Smart%20Grid.pdf>

<sup>11</sup> American Water. "Harnessing the Elements: Using Solar and Wind Energy to Power Water Treatment Plants"

<sup>12</sup> <http://www.epa.gov/climatechange/basicinfo.html>