ACEEE
American Council for an Energy-Efficient Economy

The Energy–Water Nexus: Exploring the Stream of Opportunities

Energy and water are inextricably connected. Energy heats water for showers, dishwashers, and other appliances in our homes; it is also essential for treating and delivering water to our neighborhoods. Some estimate that these uses accounted for more than 12% of primary energy consumption in the United States in 2010.[1] The energy–water nexus is also apparent in energy production, where large amounts of water are needed to cool power plants, extract and process fuels, and irrigate crops for biomass. These interrelationships mean that saving water saves energy, and saving energy saves water.

ACEEE's interest in the energy–water nexus is spurred by the large amount of energy consumed in the water and wastewater industries, as well as in water end uses, primarily heating. This high energy use implies considerable potential for energy savings. By 2030, some estimates indicate that the water and wastewater industries could improve energy efficiency by 8% compared to a 2010 baseline.[2] Such savings could particularly benefit local governments, whose water and wastewater services often account for 30– 40% of their total energy consumption.[3]

Addressing water and energy efficiency together can lead to substantial cost-effective savings. In addition, increased efficiency's multiple benefits include mitigating climate change and increasing community resilience. Saving water and energy reduces greenhouse gas emissions. Efficiency also increases community resilience because it allows households and business to better cope with acute stressors like drought as well as chronic stressors like high energy and water bills.

Increased coordination between the water and energy sectors is breaking down traditional siloes and paving the way for an integrative approach to saving energy and water. ACEEE has been at the forefront of these efforts along with several partners including the Alliance for Water Efficiency (AWE), the Water Environment Federation, the National Association of Water Companies (NAWC), and a number of national laboratories.

ADVANCING THE CONVERSATION

In 2005, ACEEE took its first formal foray into the energy–water field by convening thought leaders to chart a path forward for research. Partnering with Lawrence Berkeley National Lab, we held a workshop with leading thinkers to identify opportunities, synergies, key market players, and barriers related to energy issues in the water and wastewater industries. We presented the results in the *Roadmap to Energy in the Water and Wastewater Industry* report. We then convened panels of experts at our biennial summer study on energy efficiency in buildings to discuss topics such as energy efficiency in treatment facilities, energy awareness in wastewater system design, and best practices from the field. In 2008, we held our first annual Hot Water Forum, bringing together manufacturers, utilities, and others to discuss efficient water heating, fixtures, and practices.

These initial efforts led to new conversations and partnerships. In 2011, ACEEE and AWE held a workshop with 41 organizations from the water and energy sectors. We released the workshop's takeaways in *Addressing the Energy–Water Nexus: A Blueprint for Action*. The blueprint outlines eight ways to advance our understanding of the energy–water nexus and consequently change the way energy and water are managed (see the box below).

THE BLUEPRINT: WAYS TO INCREASE WATER EFFICIENCY

1. Increase collaboration between the water and energy communities in planning and implementing programs.
2. Better understand how energy is embedded in water and water is embedded in energy.
3. Learn from and replicate the best practices of successful energy–water efficiency programs.
4. Integrate water in energy research efforts.
5. Decouple water utility revenues from sales.
6. Leverage existing voluntary standards that address the energy–water nexus.
7. Implement codes and mandatory standards.
8. Create education and awareness opportunities for various audiences and stakeholders.

GATHERING BETTER DATA

To address the blueprint's second element—better understanding energy embedded in water and water embedded in energy —ACEEE began conducting research and collecting data to inform program design. Our first effort was the 2014 report, *Watts in a Drop of Water: Savings at the Water–Energy Nexus*. This study included energy intensity ranges for water conveyance, distribution, and treatment, and for wastewater treatment and

discharge. The report also estimated the energy required to heat domestic hot water. We used these data to estimate the potential energy savings from some water efficiency goals.

Our 2015 follow-up report, *A Survey of Energy Use in Water Companies*, analyzed surveys of NAWC member companies concerning energy use in water processing. Our findings supported our previous conclusions: energy intensity varies within the water and wastewater industries depending on the water's source and quality, and on the treatment technologies applied. Major factors include the extent to which the water supply is powered by gravity or pumping, and whether the water is pumped over long distances, over high elevation gains, or from deep wells.

ENCOURAGING COLLABORATION

ACEEE has also focused on another element of the blueprint: increased collaboration between the energy and water communities. ACEEE's 2013 report, *Saving Water and Energy Together: Helping Utilities Build Better Programs*, identified the opportunities and benefits of creating joint programs to save water and energy in the residential, commercial, industrial, agricultural, and municipal sectors. Such programs allow utility efficiency program managers to learn from each other, develop and expand relationships, lower program costs, and ultimately achieve greater energy and water savings. Accounting for both energy and water savings also provides additional justification for efficiency programs.

Another report, *Tackling the Nexus: Exemplary Programs that Save Both Energy and Water*, identified successful joint programs. It also highlighted common challenges program administrators face and how they overcome them (see table 1). A third report, *Saving Energy and Water through State Programs for Clothes Washer Replacement in the Great Lakes Regions*, took a deep dive into the potential water and energy savings from replacing clothes washers with more efficient models. While not focused on utility collaboration, the report highlighted joint programs for clothes washer replacement.

Table 1 Exemplary solutions to joint-program challenges

Challenges	Solutions
Commitment	Clearly delineate roles for stakeholders and ensure that benefits are well understood
Communication	Establish a decision-making process and rules of operations, and draft legal documents to ensure collaboration
Resources	Collaborate with multiple organizations and/or apply for federal grant money
Data	Include embedded use in savings calculations (resources permitting)

WHAT'S NEXT?

Additional efforts are needed to put research and policy agendas into action. Practitioners—including energy and water utilities—need guidance and tools to help them establish joint programs and policies to save both energy and water. Coordination is key to sharing best practices and advancing the discussion on embedded energy in water systems and water end uses. To this end, ACEEE sees potential in disseminating our past research to new audiences of practitioners and also in updating selected research. For example, an update of our research on energy and water utility collaboration would provide examples of innovative new programs that have achieved substantial water and energy savings.

We will also consider new topics, including the connection between climate change and the energy–water nexus, and how efforts to increase efficiency in water end uses and the water system can increase community resilience. Climate change will continue to affect water availability and put new stresses on energy systems, but the degree of impact is uncertain. A potential increase in desalination and water reuse will likely affect energy use, as will increased pumping for irrigation and in response to flooding. Further research is needed on efficient technological solutions and policies to support uptake of these solutions.

We must also consider water and energy efficiency benefits in relation to broader community resilience efforts. Future research should document how efficiency in water end uses and the water system can reduce community exposure to acute and chronic stressors, including high utility bills for low-income households.

Building on our previous efforts, ACEEE will continue to work with our partners to prioritize research areas and deliver insightful, high-quality analysis on ways to efficiently save both energy and water.

ACEEE'S ENERGY–WATER NEXUS STUDIES

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3. Environmental Protection Agency, "Energy Efficiency for Water Utilities," accessed April 13, 2016. www.epa.gov/sustainable-water-infrastructure/energy-efficiency-water-utilities.