# Innovations Put Sustainable Water Systems in Reach

BY FRANK ZAMMATARO

**Innovations in the water industry pale compared with other industries. Little has changed since hollowed-out redwood pipes were replaced with ductile-iron and concrete pipes. Water utilities are financially stressed and can only focus on treating water daily and getting it to and from their customers. Frequently, they haven't the time or money to look to new methods or adopt new technologies.**

Our water infrastructure is taken for granted. Because it's been ignored for so long, the industry is ripe for disruption. It's time to think differently about so many areas of the water sector, turn them upside down—and make money while we make our water grid smarter, resilient, and more sustainable.

## INNOVATIVE THINKING FOR WATER SYSTEMS

Hope for infrastructure renewal, plans for shovel-ready project development, and the prospect of hundreds of billions of dollars for upgrades face our current administration and lawmakers. However, money alone won't solve the problem. The question is *Can we change the way we think about water distribution?* Following are ideas on how renewable energy, conservation, and efficiency can provide a new vision for US water operations.

**Renewable Energy From Water.** Moving and treating water take tremendous amounts of electricity, but also provide opportunities to produce renewable energy using existing infrastructure.

The federal government has stepped aside concerning the development of micro-hydropower systems. The Hydropower Regulatory Efficiency Act of 2013 excludes conduit hydropower from federal licensing and allows an exemption to the federal licensing process for small (less than 10 MW) hydropower systems on existing dams as well as piped drinking water; agricultural water; and process water for food, beverages, and pharmaceuticals industries, among others.

Water distribution systems often have excess pressure that's relieved with pressure-reduction or flow-control valves. Pressure is energy. These valves can be bypassed with a turbine generator, which reduces pressure and generates renewable electricity. This is called *conduit hydropower*, or *in-pipe hydropower*.

Only 3 percent of the nation's 80,000+ dams generate electricity, and water utilities and irrigation districts own many of these dams. Electrifying the dams is a renewable energy opportunity.

Wastewater treatment and industrial outfalls present vast opportunities in distributed generation. Wastewater can recover energy in the form of heat, methane, and hydrocarbons from biosolids, which some facilities are doing to generate a surplus above their total energy needs. Also, water systems upgrading their distribution systems could move away from fossil fuels by using their infrastructure to generate efficient, predictable renewable energy.

**Conservation and Efficiency.** Most of our water infrastructure exceeds 60 years of age. According to AWWA, at least 1 million miles of US pipes need to be replaced. An average of 850 breaks/day occur in water pipes, and the country loses more than 7 bil gal/day of water to leaking pipes.

Leakage wastes water and money. Often, water utilities don't know how many leaks they have or where the leaks are, because they need flowmeters throughout their systems to triangulate data to identify leaks. To gather such data, water utilities require more flowmeters and easy-to-install flowmeter technology.

Gathering and analyzing customers' real-time data is also needed but would require deploying more advanced meters. Electric utilities started doing this 10 years ago with smart metering. Such technology can provide data on water use and detect leaks at the customer level, including water theft.

In addition, gray water, or reused water, provides opportunities—e.g., where buildings install infrastructure to have stormwater, shower water, and sink water routed for use in toilets and irrigation. Wastewater treatment facilities can also sell effluent water for the same uses.

## THINKING BIG ON DISTRIBUTION

Treating and distributing water is energy intensive, just as generating electricity is water intensive. The critical interrelationship known as the *water–energy nexus* presents major issues for any water or wastewater system, as approximately 4 percent of all US energy consumption is associated with water conveyance and treatment.

**Promoting Decentralization.** Many people are chipping away at the water–energy nexus, but the issues need to be considered holistically. Water passes through large distribution systems, but these systems can be decentralized. Examples of decoupling water and energy are instances in which the electric grid creates options in distributed energy generation. The same is true of energy-recovery technologies that harness hydraulic power in distributed water treatment.

In many countries where water scarcity has reached the crisis level, buildings, homes, and campuses can separate, reuse, and treat wastewater. Stormwater and gray water is reused for irrigation and toilets. Small energy-recovery devices can use

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biosolids to heat and power homes. Localized and distributed treatment, in concert with gray water infrastructure, also reduces the growing pressure on older, centralized treatment plants and reduces electricity demand needed to process wastewater.

Could drinking water treatment be decentralized, too? What if we had small water treatment units throughout distribution systems that are powered by distributed generation systems?

**Innovating the Water–Energy Nexus.** In most cities, water pipes and electrical wires share the same physical space or electrical power lines run overhead and water pipes are sited directly belowground. The water–energy nexus is real in terms of the amount of energy used for water and the amount of water used for energy. Also, the physical nexus of these technologies is real and offers opportunities to innovate.

San Francisco Public Utilities Commission puts power and water together by using water from the Hetch Hetchy reservoir in the Sierra Mountains to generate a tremendous amount of San Francisco's electricity, along with solar arrays and biogas cogeneration facilities from wastewater treatment. Other cities in California are opting out of Pacific Gas and Electric's service and creating their own electric utilities. Although these community utilities only purchase electricity on behalf of their residents, they could lay the foundation for a more localized grid, or microgrid, largely existing off distributed generation technology. Water systems could join these local pursuits.

## MOBILIZING FOR A BETTER FUTURE

It's hard for water utilities to focus on anything except getting water to and from their customers that meets US Environmental Protection Agency drinking water requirements. Meeting water quality standards is the most important part of a water utility's job, but it also eats up most of a utility's budget. Capital improvement programs often suffer.

The cost of upgrading US water infrastructure is estimated at more than $1 trillion, but this staggering nationwide burden falls almost completely on local governments. Water utilities receive 4 percent of funding from the federal government, which is well below other local infrastructure federal funding—highways receive 28 percent, mass transit 22 percent, and aviation 44 percent. Water is out of sight, so out of mind, causing a funding gap toward 21st-century improvements.

To start, we need federal funding for upgrades, a mandate that all new infrastructure be smart and sustainable, leaks regulated, and implemented smart metering programs. With these things, our water systems become data enabled, and we can promote new technology development.

Can government agencies play a role? Can state environmental protection departments support the efforts? What role can water industry companies have? Can we set up programs like renewable portfolio standards and efficiency surcharges that promote water efficiency programs? What if no new water pipeline project moved forward without determining if energy can be recovered? Such steps are mandated for government buildings. Could we do it for water infrastructure as well? The solution won't be found in any one policy, financial investment, or technology. Rather, it will take a new way of thinking and, most important, leadership.

***Editor's Note:*** *See page 24 to read a case study of a water utility's in-pipe hydropower implementation.*