"If it ain't broke, don't fix it!" was a phrase popularized by Bert Lance who ran the Office of Management and Budget under Jimmy Carter in 1977. Lance thought he could save the government lots of money by following this philosophy.

The philosophy tells us to do the minimum; it tends to stifle innovation and promotes the status quo. In the water world it means we focus on treating water, getting water from point A to point B, small budgets, and emergency repairs. Our water system isn't really broke, with over 400 billion gallons of water flowing through pipes every day in the United States, but we need to fix it anyway. We need to make it smarter and sustainable!

The specter of infrastructure renewal and shovel-ready projects looms over the 2016 US election with both candidates promising billions of dollars for upgrades. However, money alone will not solve the problem. The question is: Can we change the way we think about water distribution?

A "Fix it Anyway" vision for water operations in the US:

Net-Zero Energy - water operators are energy neutral because they use in-pipe hydropower, they convert non-powered dams to hydroelectric, they use anaerobic digesters to generate electricity with methane or hydrocarbons from bio-solids, they recover heat from bio-solids, and they have solar, small wind, and use electric vehicle fleets powered by all or some of the above.

Smart Infrastructure - water operators will be a premier example of the "internet of things," using advanced metering installed with every customer, flow, pressure and quality meters installed throughout the distribution system, and advanced software analyzing the data in order to identify leakage, contamination, and ways to conserve and isolate problems.

Conservation - water operators reuse effluent water for irrigation, toilets, industrial processes and cooling or they work with buildings on systems that will reuse water on
Irrigation systems put all exposed water into closed pipes eliminating evaporation.

Over the last 100 years, innovations in the clean water world pale in comparison to other industries. Little has changed since we replaced hollowed-out redwood pipes with ductile iron and concrete pipes. And there is no incentive to innovate. Water utilities are generally financially stressed and can only focus on their daily task of treating water and getting it to and from their customers. There isn’t time or money to look towards new methods and new technology.

In a world of instant gratification with smartphones and apps, water and wastewater are simply not sexy. Other than industry trade publications, the media doesn’t cover water because they think it bores people. For the most part, water stays out of sight, underground, and out of mind. Our clean water infrastructure is taken for granted. But because it has been ignored for so long, the industry is ripe for disruption. There are so many areas of water to think differently about, twist around, turn up side down and make money while making our water grid smart and sustainable.

Let’s explore some ideas on how renewable energy, conservation and efficiency make our water infrastructure smart and sustainable for the future. If it ain’t broke, fix it anyway!

**Renewable Energy from Water** - Moving and treating water uses a tremendous amount of electricity, but moving and treating water also provides a lot of opportunity to produce renewable distributed generation. And it can all be done using existing infrastructure.

Recently the federal government has stepped out of the way when it comes to developing micro hydropower. The Hydropower Regulatory Efficiency Act of 2013 excludes conduit hydropower from federal licensing and allows an exemption to the federal licensing process for the development of small hydropower (under 10 MW) on existing dams as well as piped drinking, agricultural water and process water for industries like food, beverage and pharmaceuticals.

Small hydropower is a fantastic opportunity for self-generation. Water distribution systems often have excess pressure that is relieved with pressure reduction or flow control valves. Since pressure is
energy these valve can be bypassed with a turbine generator, which reduces pressure and generates renewable electricity. This is conduit hydropower or in-pipe hydropower.

Only 3% of the nation’s 80,000+ dams generate electricity and water utilities and irrigation districts own a significant number of these dams. Electrifying these existing dams is also a renewable energy opportunity.

Wastewater treatment and industrial outfalls have tremendous opportunities in distributed generation. Wastewater can recover energy in the form of heat, methane and hydrocarbons from bio-solids. Some of the facilities that are doing this generate enough or more of their entire energy needs.

Water operators, who are upgrading aging distribution systems, can play a larger role in our movement away from fossil fuels and use their existing and new infrastructure to generate highly efficient and predictable renewable energy.

**Conservation and Efficiency** - The majority of our water infrastructure is well over 60 years old. According to the AWWA, there is at least one million miles of pipes in the United States that need to be replaced. There are an average of 850 breaks in water pipes daily and the country loses greater than 7 billion gallons of water daily to leaking pipes.

Leakage is wasted water and wasted money. Often water utilities have no idea how many leaks they have or where the leaks are because they need multiple flow meters throughout a system in order to triangulate data. We need many more flow meters deployed and easy-to-install flow meter technology, then water utilities can use this data to identify leakage locations.

We need to gather real-time data on customers and analyze that data. This means deploying more advanced meters. The electric utilities started doing this 10 years ago with smart metering. Some water utilities have advanced metering, but many do not. Smart metering provides data on water use, detects leaks at the customer level, and can detect water theft as well.

Many irrigation distribution and some drinking water systems are in open channels. A great deal of water is lost to evaporation this way, approximately 6% of exposed surface water. If we piped this distribution we would save water...
and have even more opportunities for in-pipe hydropower.

Gray water or reused water has many opportunities to be used locally – on site where buildings put in the infrastructure to have storm water, shower water, sink water routed to be used for toilets and irrigation. Or the effluent water at wastewater treatment facilities can be sold for the same uses.

**Thinking Big**

Can we start thinking completely differently about water distribution? The water-energy nexus is the relationship between water and energy. Treating and distributing water is energy intensive just as generating electricity is water intensive. Approximately 4% of all US energy consumption is associated with water movement and treatment. Let’s of people are trying to chip away at the issues involved in the water-energy nexus, but not holistically.

Water passes through large distribution systems, but these systems can be de-centralized, like the electric grid creating opportunities in distributed energy generation and even distributed water treatment.

Necessity is truly the mother of invention when it comes to water. In many countries where water scarcity has already reached the crisis level, buildings, homes, campuses can separate, reuse, and treat wastewater. Storm water and gray water is reused for irrigation and toilets. Small energy recovery devices can use 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 used to process wastewater.

And can we decentralize drinking water treatment too? Water treatment is very energy intensive. What if we had small water treatment units throughout the distribution system that are powered by distributed generation?

In most cities, water pipes and electrical wire share the same physical space. Where you see electrical power lines above head, there are pipes typically directly below the ground. The water energy nexus is just not a reality in terms of the amount of energy used for water and the amount of water used for energy, but the physical nexus of these centralized technologies offer enormous opportunities to innovate.
What if communities put power and water together more often? A good example is the San Francisco Public Utilities Commission. They deliver water to the city from a reservoir in the Sierra Mountains and generate a tremendous amount of electricity at the dam on the reservoir for the city (Hetch Hetchy), using solar arrays and biogas cogeneration facilities from wastewater treatment.

Some other towns in California are opting out of PG&E’s service and creating their own electric utilities. Although these community utilities are currently just purchasing electricity on behalf of their residents, this could be the foundation for a more localized grid, or microgrid, largely existing off distributed generation technology. And water should join these localized pursuits.

**Mobilizing**

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

The cost of upgrading our water infrastructure is estimated at over one trillion dollars, but right now this burden falls almost completely on local governments. Water utilities receive 4% of funding from the federal government. This is well below other local infrastructure federal funding - highways receive 28%, mass transit 22%, and aviation 44%. Again, I blame this on the fact that water is out of sight and out of mind. With the exception of manhole covers and ballast tanks, there is no indication that there is an elaborate network of pipes under the ground.

So how do we fund improvements and bring those improvements into the 21st century?

To start we need federal funding for upgrades, we need to mandate that all new infrastructure be smart and sustainable, we need to regulate leaks, and we need smart meter programs. Just by doing these things our water systems become data enabled and we promote new technology development.

Can DOE or the EPA play a role? How can state environmental protection departments support the efforts? How can corporations in the water industry play a role? Can we set up programs like renewable
portfolio standards and efficiency surcharges that promote water efficiency programs? Should no new water pipeline or infrastructure project move forward without determining if energy can be recovered and if data gathering technology can be added? We are mandating this for government buildings, now can we do it for water infrastructure?

The vision discussion perhaps is the easy part, especially when you have spent years observing and living the realities of the water industry. However, formulating the answers, the architecture, and actions are harder. The solution will not be found in any one policy, financial investment or technology. Rather it will take a new mindset, a way of thinking, a new philosophy and most importantly leadership.

Right now the market for water innovation is nascent because most people in the United States turn on a faucet and the system generally works. But it can be better – safer, smarter, and sustainable. Even if it ain’t broke, we must fix it anyway!

The 21st century is defined by technologies that make life easier. We don’t settle, there is no status quo. We look at everything differently and challenge it to be better. We’ve done this to the taxi business, the way we take vacation, food deliveries, thermostats, you name it. And none of these were broken, they worked just fine, but now they are better. It is time to do this for water.

“If it ain’t broke, fix it anyway!” means that we can do better. We need to upgrade our infrastructure, but before we do that let’s look at water from all angles, turn it on its head, shake it up a little and we can end up with new, self-sufficient, efficient, smart and sustainable ways of distributing water and wastewater.

If it Ain’t Broke, Fix it Anyway!

About Frank Zammataro
Frank is the CEO and Co-Founder of Rentricity Inc., an In-pipe Hydropower Company located in New York City. After spending over 20 intrapreneurial years at Merrill Lynch, he pursued a business and technology that could help the world change, developing a new best practice for water and energy. Frank is a contributing columnist, speaks frequently at leading industry events, and participates in various industry, municipal, and academic organizations.