# A Tale of Two Utilities: Leveraging Energy Savings through Collaboration in the Water & Energy Sectors

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AIQUEOUS
Smarter Utilities. Smarter Cities.

# Overview

- The Upshot
- State of the Water Sector
- Water Sector’s Savings Potential
- Barriers to Capturing Full Savings
- Case Studies
- Tips for Driving Savings in the Water Sector

# The Upshot

Water utilities can improve their financial performance through energy efficiency.

- Water utilities in Central Texas are & plan to increase infrastructure spending over the next two decades
- These investments offer opportunities to lower life-cycle energy costs
- The savings potential is substantial – 10% to 35% in energy savings
- Savings opportunities are the greatest on pumping energy
- Renewable energy generation is also possible
- Work with your design engineers, state agencies, & electric utilities to optimize your capital & life-cycle energy costs

# State of the Water Sector

The mechanical & electrical components of water treatment plants have useful lives of 15 to 25 years.

**TABLE 4★ The Useful Lives of Drinking-Water System Components**

| COMPONENT | USEFUL LIFE (YEARS) |
|---|---|
| Reservoirs and dams | 50–80 |
| Treatment plants—concrete structures | 60–70 |
| Treatment plants—mechanical and electrical | 15–25 |
| Trunk mains | 65–95 |
| Pumping stations—concrete structures | 60–70 |
| Pumping stations—mechanical and electrical | 25 |
| Distribution | 60–95 |

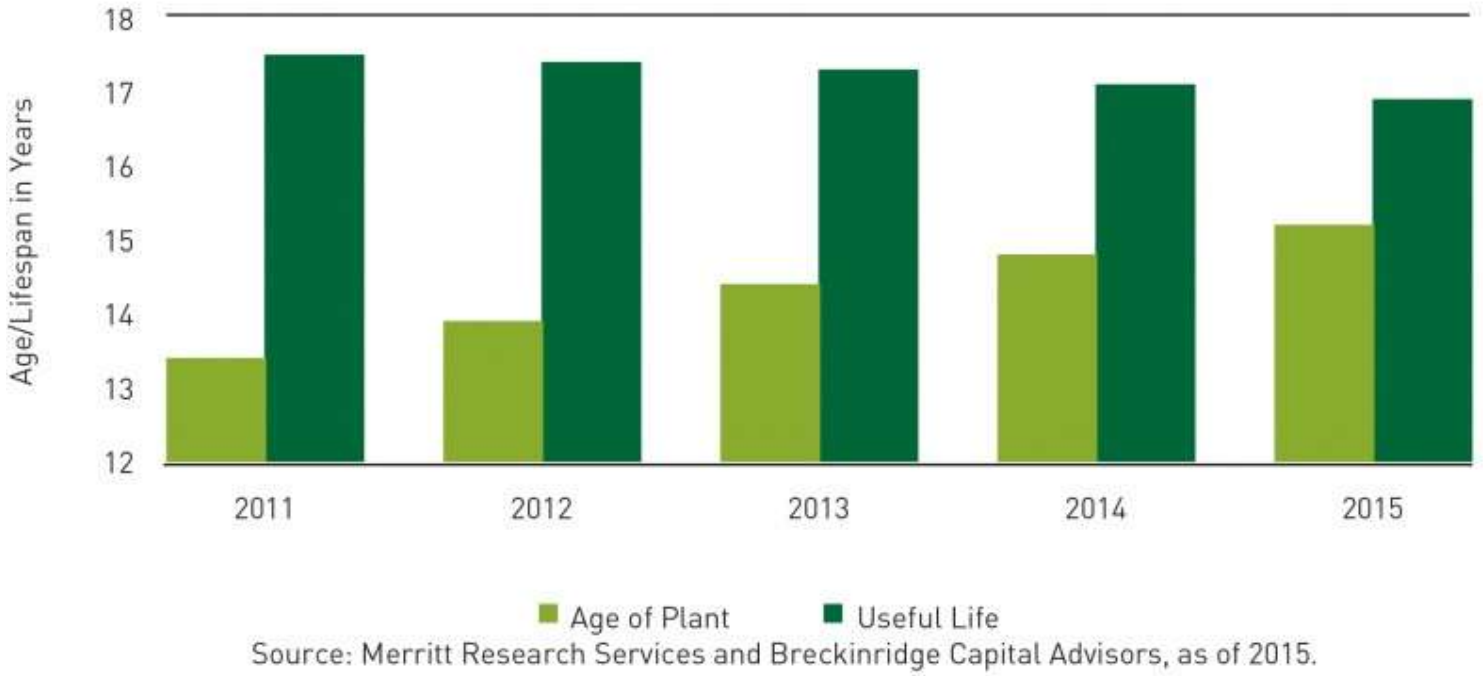
SOURCE: EPA (2002, table 2-1).

*Source: ASCE's Failure to Act: The Economic Impact of Current Investment Trends in Water & Wastewater Treatment Infrastructure*

# State of the Water Sector

Water plants themselves are nearing the end of their useful lives.

**Figure 3: Infrastructure Condition is Worsening Among U.S. Cities**



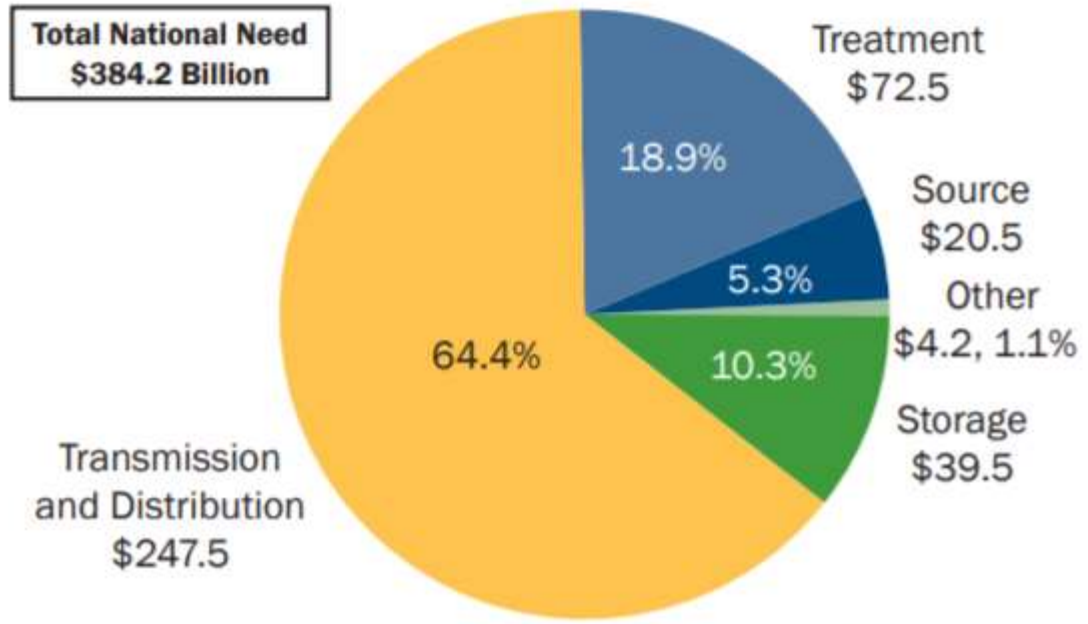

Source: Merritt Research Services and Breckinridge Capital Advisors, as of 2015.

*Source: Breckinridge Capital Advisors' Infrastructure Accounting: A Blind Spot Facing Investors?*

# State of the Water Sector

Estimated infrastructure investments range anywhere from $384 billion to $1 trillion over the next 10 to 20 years.

**Exhibit 1.4: Total 20-Year Need by Project Type (in billions of January 2011 dollars)**




Note: Numbers may not total due to rounding.

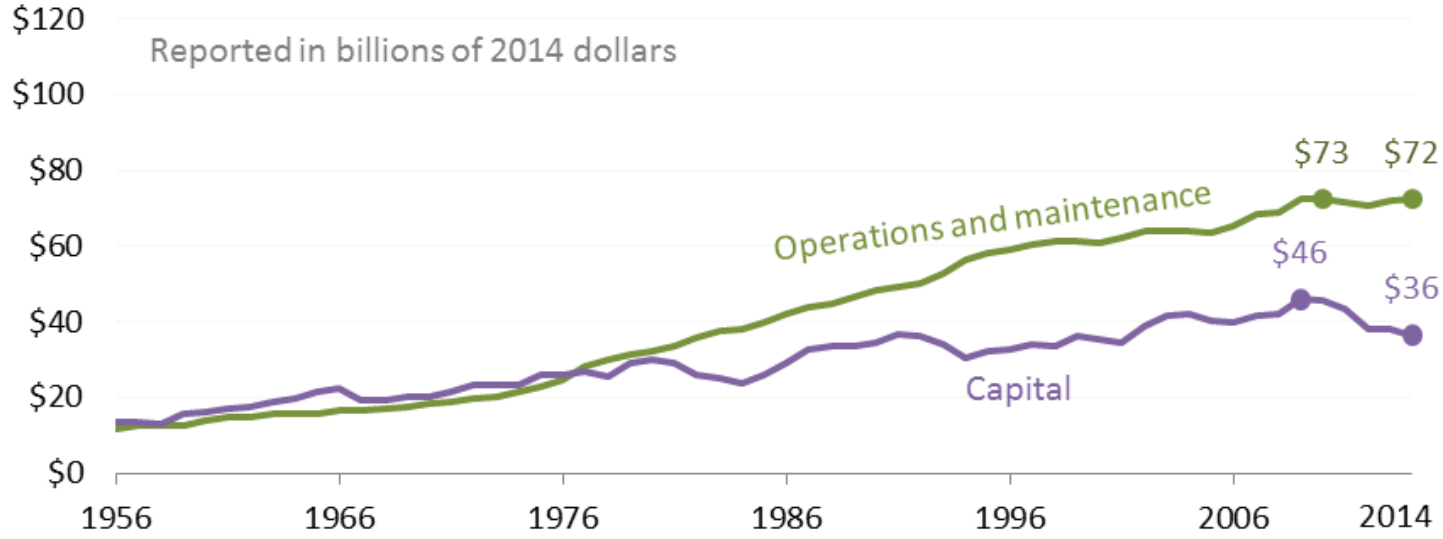
*Source:* *EPA's Drinking Water Infrastructure Needs Survey & Assessment*

# State of the Water Sector

Despite these capital needs, water utilities are spending more on operating & maintenance expenses. Energy costs can account for as much as 55% of facility operating budgets.

**Public spending on operations and maintenance rose at a faster rate than public spending on capital infrastructure for water and wastewater utilities**

Between 1980 and 2014, real spending on O&M grew 126% while real spending on capital grew 22%, including a decline of 21% between 2009 and 2014

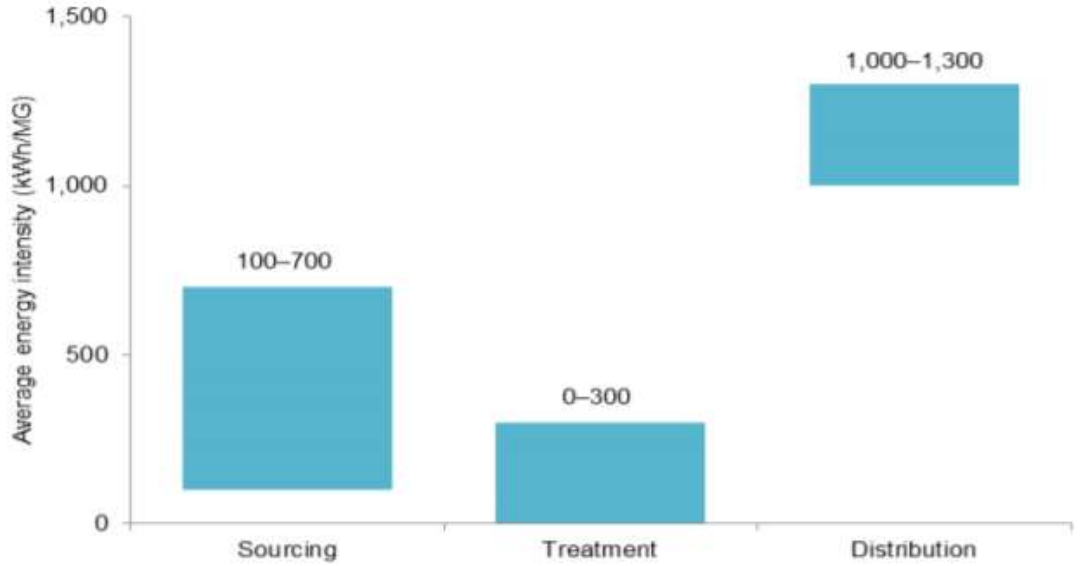



*Source: UNC Environmental Financing Center, Four Trends in Government Spending on Water & Wastewater Utilities since 1956*

# State of the Water Sector

Total energy requirements for water sourcing, treatment, & distribution can range from 1,000 kWh to 2,500 kWh per MG. Larger systems are typically more energy efficient than smaller ones due to the scalability of processes.

## *Energy Intensity of Water Supply Processes*




## *Energy Intensity by System Size*

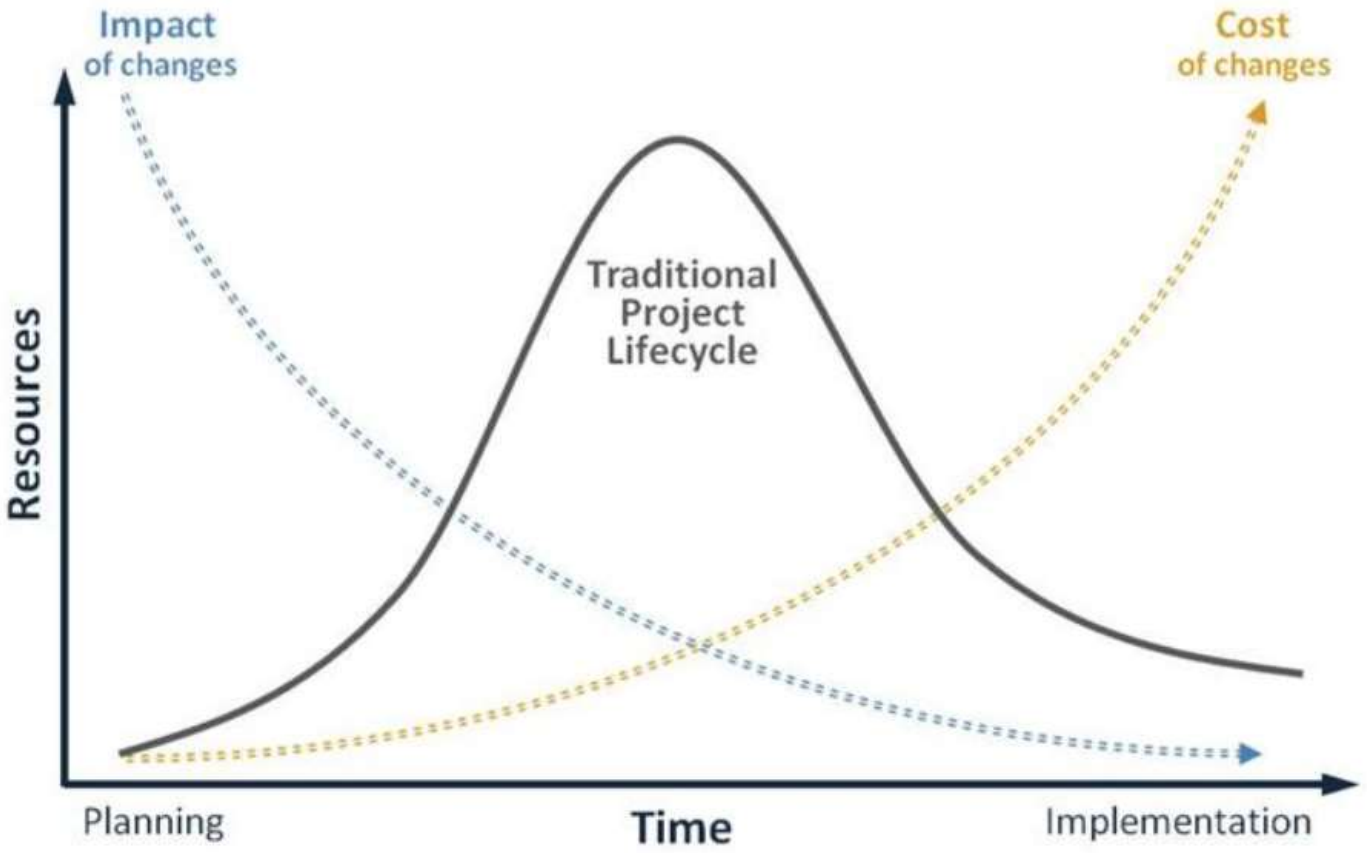
| Average Daily Flow Range (MGD) | Energy Use Intensity (kWh/MG) | Water Main length (miles) | Distribution Pressure (psia) | Source Water Distribution | | |
|---|---|---|---|---|---|---|
| | | | | Ground Water | Surface Water | Purchased Water |
| < 3 | 2,000 | 126 | 67 | 32% | 41% | 27% |
| 3-5 | 1,400 | 138 | 69 | 31% | 32% | 36% |
| 5-20 | 1,600 | 346 | 72 | 28% | 39% | 33% |
| 20-600 | 1,500 | 2,700 | 62 | 7% | 68% | 25% |

Data source: Lawrence Berkeley National Laboratories, "Market Profiles Used in Energy Star's Portfolio Manager for Water and Wastewater Utilities", unpublished data from October 2012.

*Source: Steven Jones & Robert Sowby, Quantifying Energy Use in the U.S. Public Water Industry – A Summary; C. Arzbaecher et al, Electricity Use & Management in the Municipal Water Supply & Wastewater Industries*

# State of the Water Sector

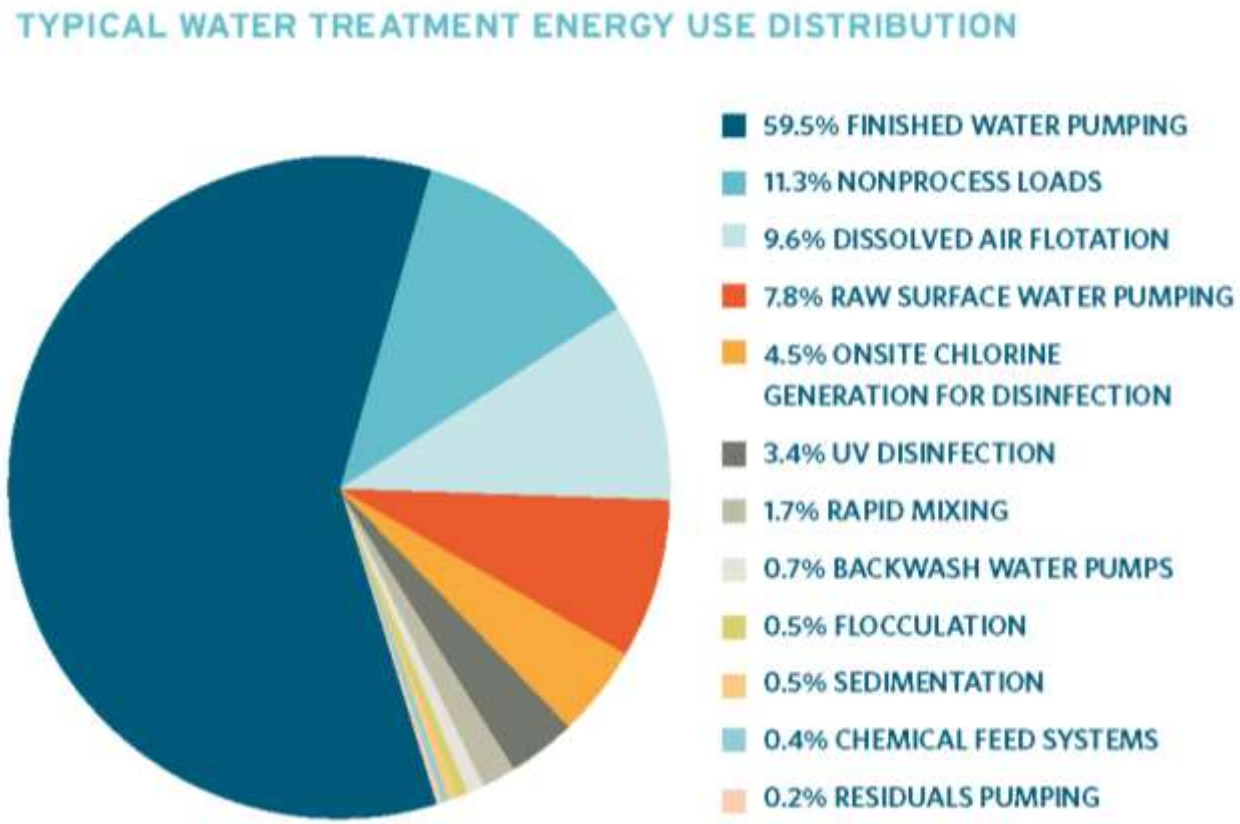
Given that the average plant lasts 40-50 years, failing to optimize energy efficiency will result in a huge “lost opportunity.” It’s much less expensive to design with energy efficiency than to retrofit later.




*Source: Design Charrettes for Platform Projects*

# Water Sector's Savings Potential

The majority of energy in water treatment goes to pumping – finished water, raw water, backwash water, & residuals.




*Source: Energy Trust of Oregon*

# Water Sector's Savings Potential

With pumping representing 86% of total energy use, enhanced pumping technologies – notably high efficiency motors, VFDs, & pump system optimization – provide the greatest savings potential.

## *Water Treatment & Distribution Measures*

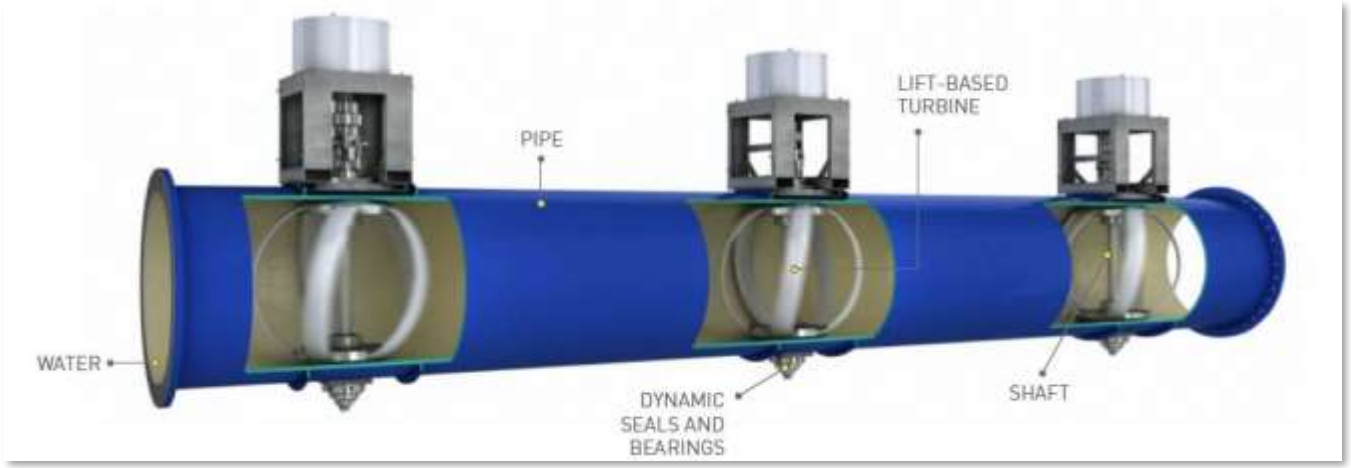
| Applicable End Use | Measure name | Total % savings | % savings of the end use |
|---|---|---|---|
| **Pump / motor** | High efficiency pump/motor system | 1.3% - 7.6% | 10% - 30% |
| | Pump modification | 0.5% - 7.2% | 15% - 30% |
| | Variable frequency drive | 0.4% - 4.2% | 10% - 20% |
| **Distribution** | Pipeline optimization | | 5% - 20% |
| | Advanced SCADA systems | 10% - 20% | |
| | Automatic meter reading (AMR) /Leak detection integration | | 5% - 15% (of water supply energy) |
| **Treatment processes** | Advanced treatment processes (e.g., advanced membrane, UV, reverse osmosis) | | 10% - 50% |
| **HVAC** | Optimized and efficient system | | |
| **Electric demand management** | Electric demand management | 0.7% - 7.3% | |
| **Lighting** | Efficient lighting fixtures (LED) with sensors | 0.5% - 2.9% | |

# Water Sector's Savings Potential

There are also opportunities for the water sector to generate power.

### *Floating Photovoltaics*

### *Power Generating Watermains*



# Water Sector's Savings Potential

The water sector's energy savings potential is significant.

**10% to 35%**
energy savings

**9,000 to 31,000 GWh**
savings potential nationwide

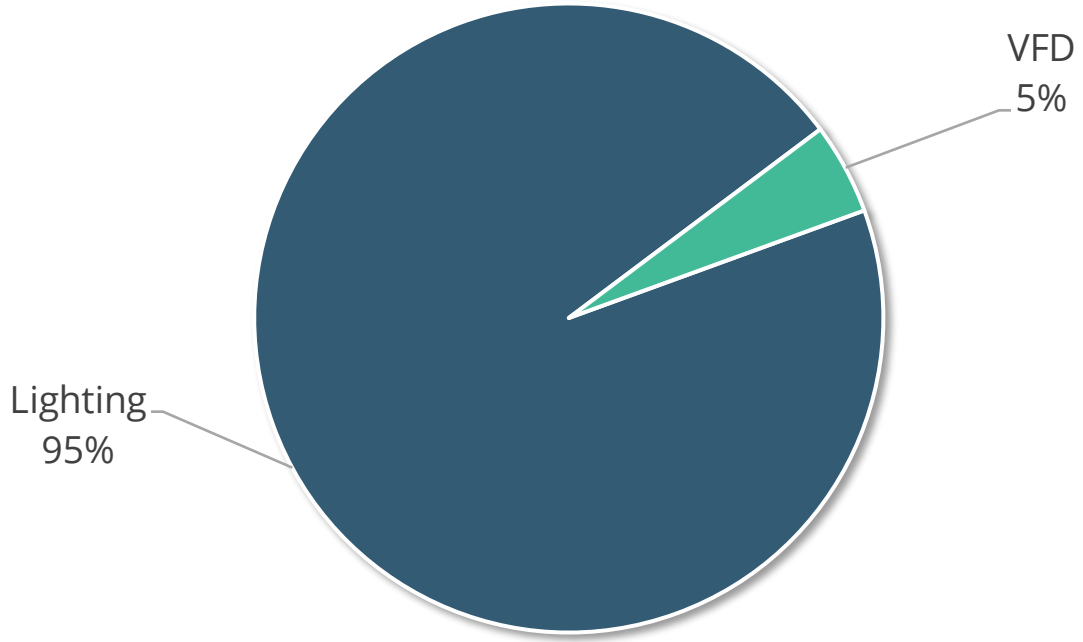
Equivalent to powering
**1.0 to 2.9 million**
American households annually

*Source: Steven Jones & Robert Sowby, Quantifying Energy Use in the U.S. Public Water Industry – A Summary; EIA's 2015 Residential Energy Consumption Survey; KCP&L's Water-Energy Nexus Study (unpublished)*

# Barriers to Capturing Full Savings

Most energy efficiency programs are focused on “standard” / “prescriptive” savings.

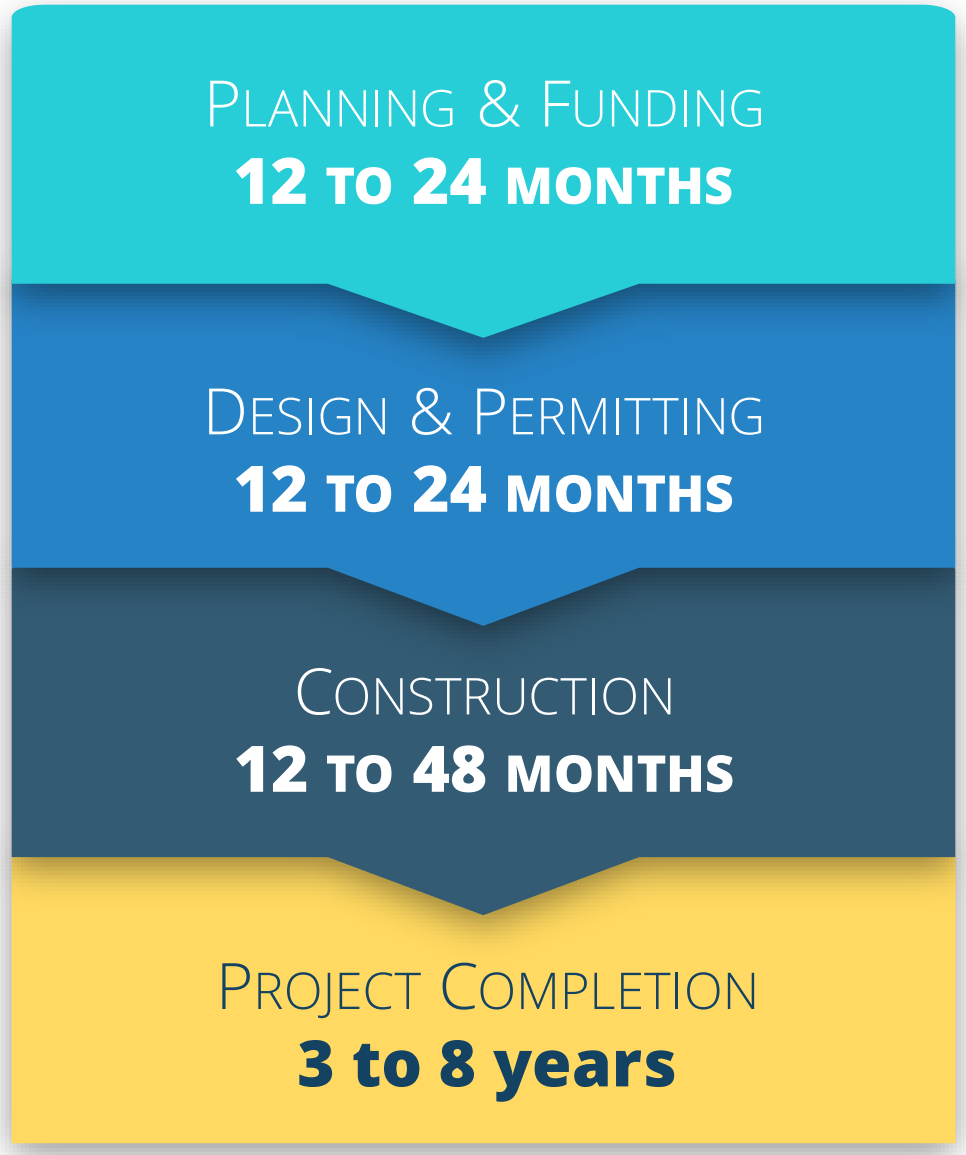
***KCP&L’s program history savings – from water customers***




*Source: KCP&L, unpublished report*

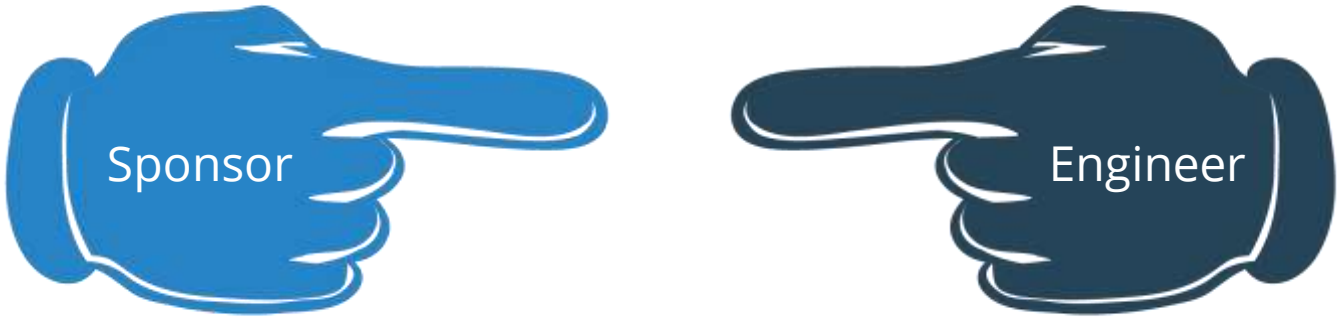
# Barriers to Capturing Full Savings

Water infrastructure projects involve long project cycles that can range from 3 to 8 years in total.



# Barriers to Capturing Full Savings

The bidding process for water projects can discourage the inclusion of efficiency measures, which leads to a “blame game” between the municipality sponsoring the project & the engineering firm hired to design it.



# Barriers to Capturing Full Savings

Primary driver in the water sector is public health & infrastructure replacement – energy costs are less critical.

## *Issues facing the water industry in 2017 – Ranked in order of importance*

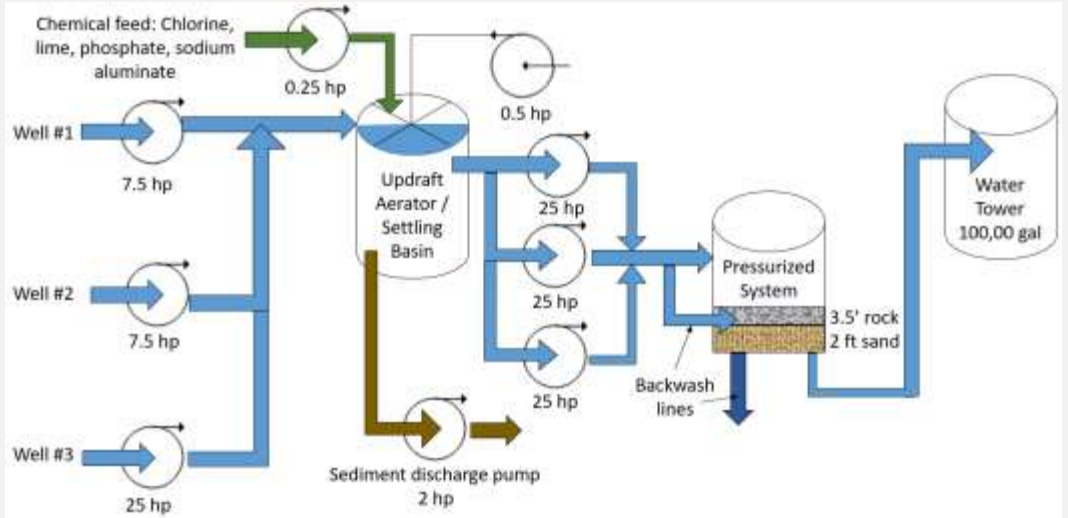
| Rank | Category | Score | % Ranked Critically Important |
|---|---|---|---|
| 1 | Renewal and replacement of aging water and wastewater infrastructure | 4.53 | 63% |
| 2 | Financing for capital improvements | 4.42 | 59% |
| 3 | Long-term water supply availability | 4.39 | 57% |
| 4 | Public understanding of the value of water systems and services | 4.34 | 54% |
| 5 | Public understanding of the value of water resources | 4.22 | 45% |
| 6 | Watershed/source water protection | 4.18 | 46% |
| 7 | Emergency preparedness | 4.10 | 37% |
| 8 | Cost recovery (pricing water to accurately reflect its true cost) | 4.04 | 35% |
| 9 | Public acceptance of future water and wastewater rate increases | 4.01 | 34% |
| 10 | Water conservation/efficiency | 4.00 | 36% |
| 11 | Groundwater management and overuse | 3.98 | 35% |
| 12 | Aging workforce/anticipated retirements | 3.98 | 40% |
| 13 | Asset management | 3.91 | 26% |
| 14 | Talent attraction and retention | 3.91 | 30% |
| 15 | Improving customer, constituent, and community relationships | 3.91 | 29% |
| 16 | Data management | 3.91 | 29% |
| 17 | Governing board acceptance of future water and wastewater rate increases | 3.91 | 32% |
| 18 | Drought or periodic water shortages | 3.90 | 33% |
| 19 | Water loss control | 3.90 | 26% |
| 20 | Compliance with current regulations | 3.87 | 26% |
| 21 | Compliance with future regulations | 3.85 | 26% |
| 22 | Energy use/efficiency and cost | 3.82 | 22% |
| 23 | Certification and training | 3.81 | 24% |
| 24 | Expanding water reuse/reclamation | 3.79 | 31% |
| 25 | Water rights | 3.72 | 30% |
| 26 | Cyber-security issues | 3.70 | 25% |
| 27 | Financing for water research | 3.64 | 23% |
| 28 | Physical security issues | 3.59 | 19% |
| 29 | Water quality issues from premise plumbing systems | 3.57 | 20% |
| 30 | Climate risk and resiliency | 3.53 | 23% |

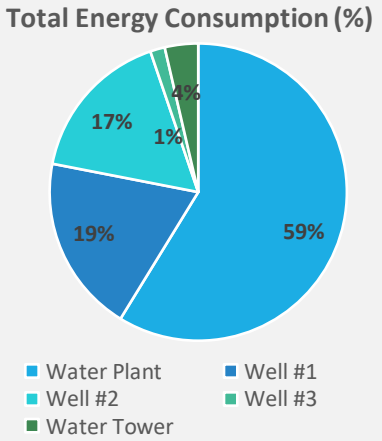
*Source: AWWA's 2017 State of the Water Industry Report*

# Case Studies

## Market Study: **Kansas City Power & Light**

- **Context**: KCP&L wanted to explore the savings potential associated with the water-energy nexus across multiple market segments.
- **Solution**: KCP&L teamed with AIQUEOUS to perform a water-energy nexus market study, which included a case study on the energy efficiency opportunities at a 1 MGD water treatment plant.
- **Results**: AIQUEOUS recommended the replacement of pumps & motors (average efficiency of 73%) with high efficiency alternatives to achieve a possible 90% efficiency. These efforts would translate to 30,103 kWh savings per year (or 17.8% of total plant energy consumption).




*Source: KCP&L, unpublished report*

# Case Studies

## Energy Audit: **Missouri American Water**

- **Context:** As part of its rate case, Missouri American Water agreed to evaluate energy efficiency opportunities across its water treatment & distribution systems.
- **Solution:** Missouri American Water teamed with AIQUEOUS to perform ASHRAE Level 1 energy audits at four water systems & identify specific efficiency opportunities to help cut operating costs.
- **Results:**

| Energy Efficiency Opportunities Identified by AIQUEOUS |
| --- |
| • Replace pumps and motors to high efficiency motors/pumps to achieve a possible 90% efficiency<br>• Install variable frequency drives to increase pumping efficiency on wells<br>• Optimize pump operation by trimming the impellors or using a pump system optimization control system<br>• Optimize piping to limit energy consumption due to friction (e.g., increase pipe diameter, plastic instead of steel pipe, use of long-radius elbows instead of 90 degree angle fittings)<br>• Install turbines within the piping system to recover energy from excess pressure in the pipeline<br>• Eliminate winter energy overconsumption |

*Source: Missouri American Water, unpublished report*

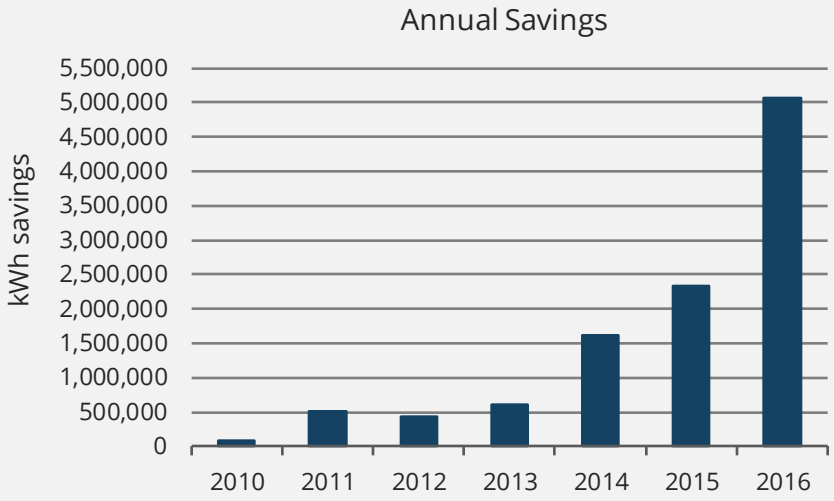
# Case Studies

Program Design:
**AEP Ohio's Water / Wastewater Treatment User Group**

- **Context:** AEP Ohio saw limited participation from the water & wastewater sector in its efficiency programs.

- **Solution:** AEP Ohio created the Water / Wastewater Treatment User Group to help educate the segment on efficiency technologies & energy savings potentials. Workshops and webinars were held to engage with system operators, municipal decision-makers, engineering firms, & trade allies.

- **Results:** AEP Ohio achieved a considerable increase in program participation over the first 6 years. Forming a user group was critical to the utility's success.




*Source: AESP's Strategies, Monthly Member eMagazine (August 2014)*

# Case Studies

Technology Vendor:
**Specific Energy (Georgetown, TX)**

- **Context**: Specific Energy worked with Aqua Water Supply Corporation in Texas to improve the operational efficiency of several of the system's VFD pumps.

- **Solution**: Specific Energy employed its Optimization software technology to maximize efficiency of the pumps by continually adjusting their speeds based on system conditions.

- **Results**: Aqua saw a 25% reduction in energy consumption of one its well pumps. Aqua also achieved a 16% energy reduction at one of its pump stations.

*Source: Specific Energy, Inc. – Well Pump Case Study & Pump Station Case Study*

# Tips for Driving Savings in the Water Sector

## Work with Energy Utilities & Agencies

### Electric utility efficiency programs need to be cost-effective in terms of savings as compared to incentives

- In Texas, Transmission & Distribution Utilities offer energy efficiency programs in deregulated markets
- Find out what programs and services your utility offers
- Bring them in ***early & often*** to talk about incentives & savings approaches

### State agencies offer financial assistance for reducing energy costs

- State Energy Conservation Office's LoanSTAR program
- TWDB's "green elements" for Drinking Water State Revolving Fund Loans

# Tips for Driving Savings in the Water Sector

Create an Energy Management Framework in your organization

## Conduct a Facility Energy Assessment

- Establish a benchmark of energy use systemwide
- Begin dialogue with energy provider on efficiency opportunities & available resources/assistance programs

## Develop an Energy Management Plan

- Perform an energy audit to identify efficiency opportunities
- Develop specific targets: efficiency measures, efficiency goals, budgets, financing options, procurement schedule, etc.

## Implement an Energy Management Program

- Ensure RFQs properly address energy efficiency objectives
- Develop process for monitoring program progress
- Develop metrics for assessing energy savings & program success

*Source: Water Research Foundation, Energy Efficiency Best Practices for North American Drinking Water Utilities; Energy Sector Management Assistance Program's A Primer on Energy Efficiency For Municipal Water & Wastewater Utilities*

# Tips for Driving Savings in the Water Sector

Work with your engineering team

- Remember that energy savings interact with system performance, & your design engineers focus on system performance
- Look for successful case studies
- Put in place the right pilot or test conditions to compare energy savings with treatment & distribution effectiveness
- Build energy management into your capital projects

# QUESTIONS

AIQUEOUS

Smarter Utilities. Smarter Cities.

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