

# 2016 STRATEGIC DIRECTIONS: WATER INDUSTRY REPORT

*Black & Veatch Insights Group*



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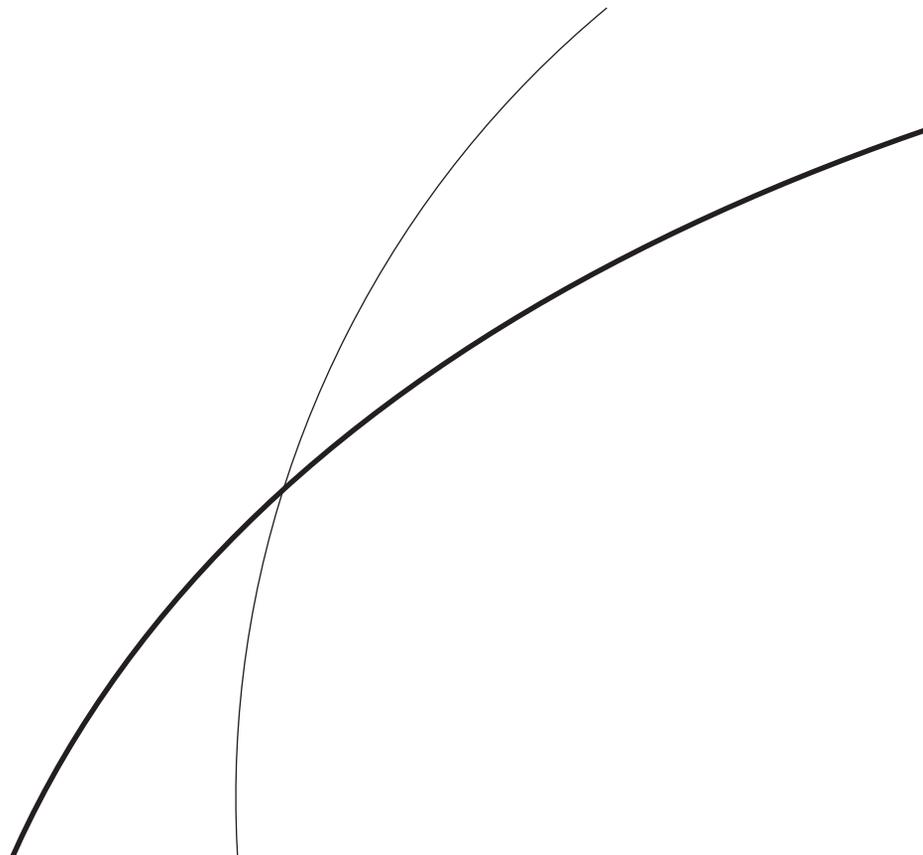
# A NOTE ABOUT DESIGN

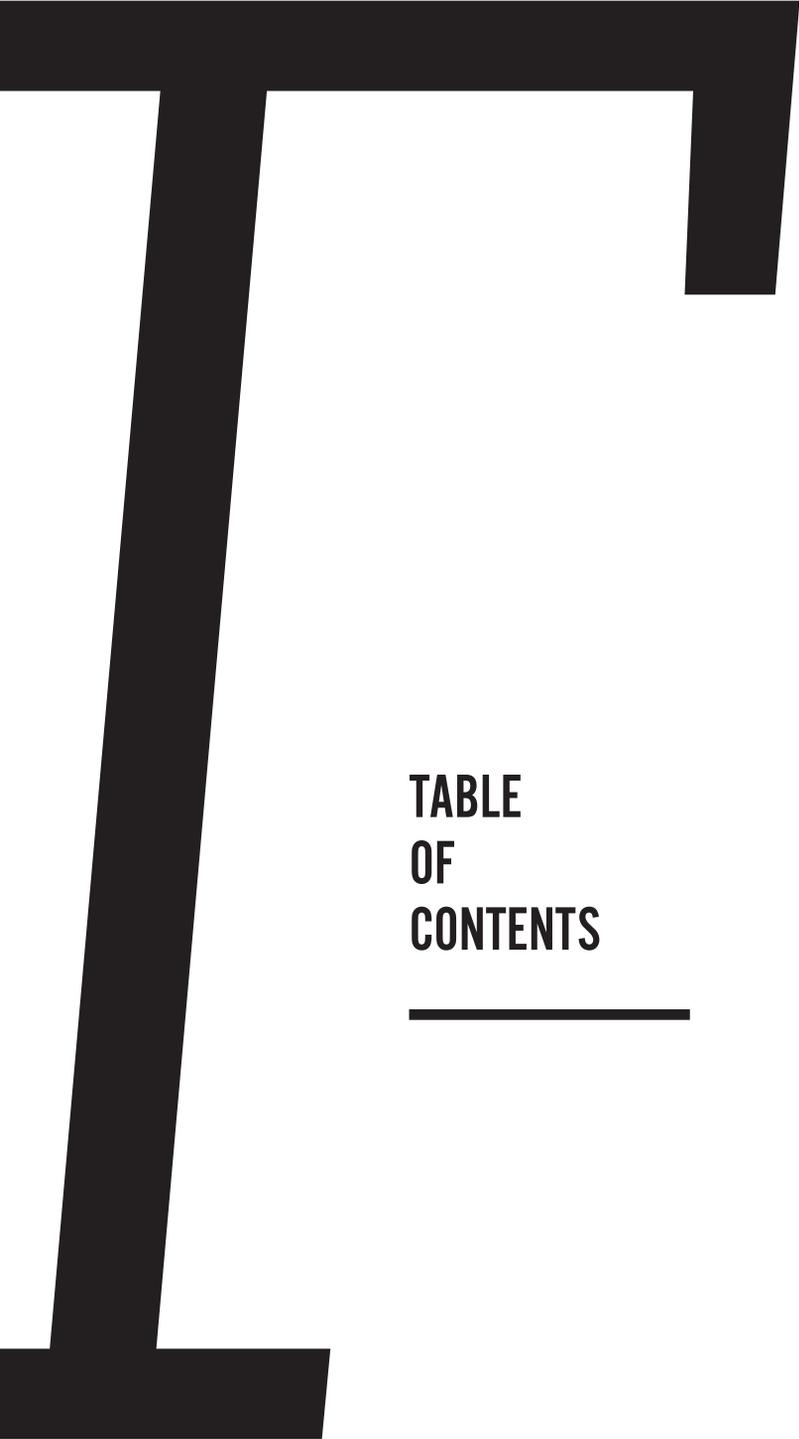
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The annual Strategic Directions series captures Black & Veatch's global engineering and construction thought leadership expertise across key elements of the critical human infrastructure market. Just as advising our clients requires mastery of design, strategy development and project execution, so too does selecting a report theme that reflects the dynamics of change across industries.

For 2016, we continue to explore the theme of distinct yet intersecting galaxies, drawing parallels to the ongoing evolution of utility services. These findings, and the conversations they foster among key stakeholder groups, shine light on the influences guiding the future direction of communities around the globe.

From a design perspective, we seek to inspire the exploration of known entities from a new vantage point, taking readers on an informative and engaging journey. As clarity is gained through the acquisition and sharing of knowledge, the vastness of space is a subtle reminder that there is much more to discover.

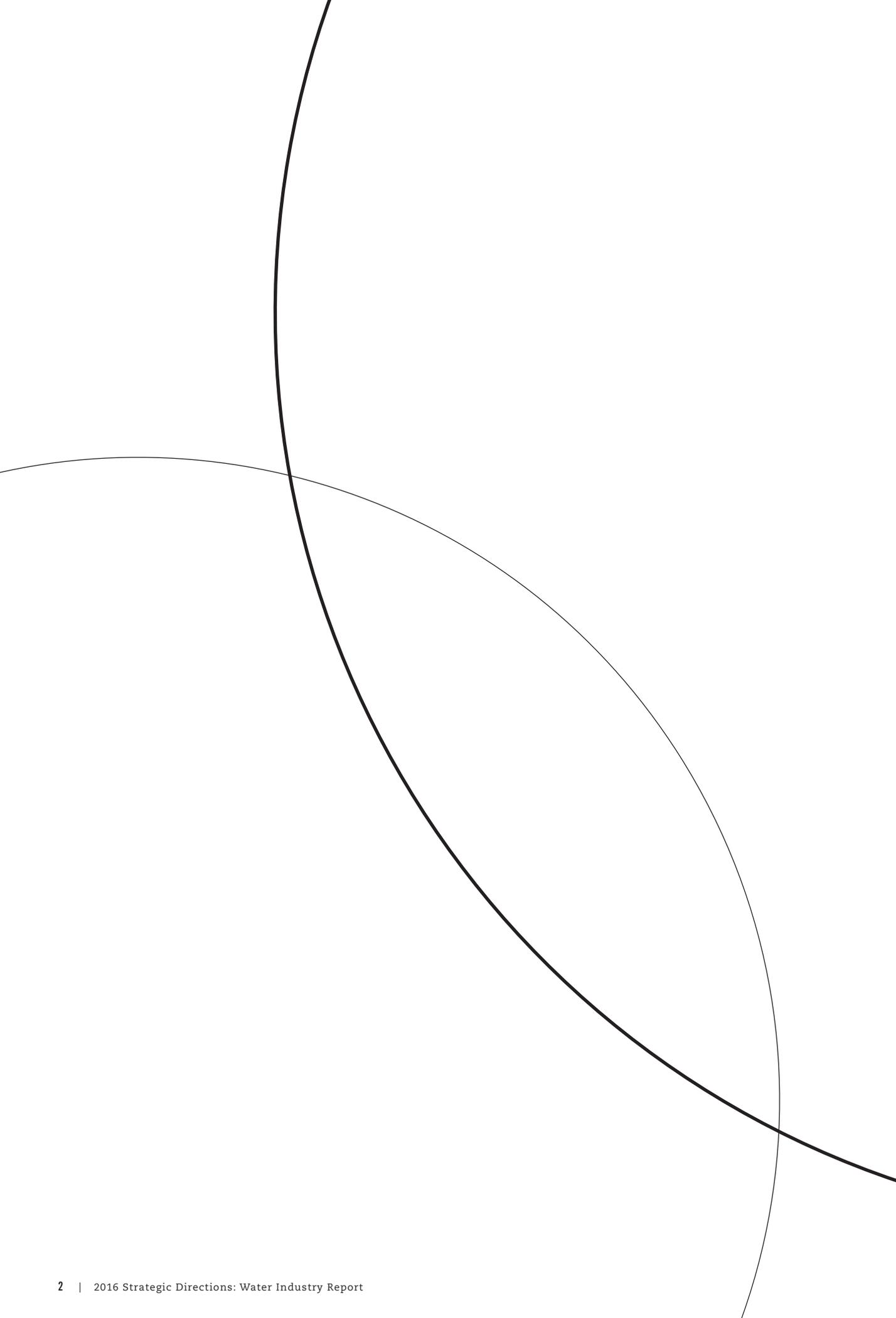




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# ABOUT THIS REPORT

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The Black & Veatch *2016 Strategic Directions: Water Industry Report* finds the sector at the intersection of cost and customer expectation.

Water service providers know that after decades of deferred maintenance, traditional revenue approaches aren't raising enough capital to pay the bill that is now due. A skeptical consumer base, meanwhile, is unnerved by headlines over water safety that have done little to deepen the public's understanding of the true cost of safe and reliable systems. Our report asked U.S. water leaders to rank their significant sustainability issues and, unsurprisingly, more than half of respondents cited the maintenance of asset life as their biggest concern. Maintenance, and the rest of the top five concerns – customer rates, financial viability, maintaining service with limited resources and water conservation/demand management – all have direct ties to revenue and cost.

The themes of cost and customer expectations raise many crucial questions: How can utilities finance the replacement of aging lines? How do systems become safer and more reliable within a rate structure that's acceptable to customers? How resilient is essential infrastructure in the face of extreme conditions and ongoing drought?

Fortunately, there are bright spots of innovation and new approaches in cities that are learning to do more with less. Many are exploring alternative water supply strategies and energy efficiency and others are testing advanced purification technologies. The application of advanced data analytics insights offers opportunities to futureproof their systems.

This report captures both the angst and opportunity confronting water leaders in 2016. Ensuring safe systems for our communities starts with leadership that embraces innovation and alternative financing while engaging customers about the true cost of the infrastructure to provide a safe and convenient water supply.

We welcome your questions and comments regarding this report and/or Black & Veatch services. You can reach us at [MediaInfo@bv.com](mailto:MediaInfo@bv.com).

Sincerely,  
**CINDY WALLIS-LAGE** | PRESIDENT  
Black & Veatch's water business

**JOHN CHEVRETTE** | PRESIDENT  
Black & Veatch's management consulting business

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## The Black & Veatch Analysis Team

**Ralph Eberts** is Executive Managing Director for Black & Veatch's management consulting business. Eberts and his team provide strategic, financial and technological services to the water industry. He is based in San Francisco, California.

**Mike Orth** is Executive Managing Director for the Americas in Black & Veatch's water business. Orth guides the company's growth efforts in supply, storage, treatment, and conveyance, delivering projects for clients through both traditional methods and alternative solutions such as design-build, performance contracting and public-private partnerships. He currently sits on the Board of Directors for the American Water Works Association (AWWA). He is based in Kansas City, Missouri.

### SAFE, RELIABLE WATER SUPPLY

**Clint Robinson** is Associate Vice President of Black & Veatch's government affairs team and works collaboratively with professionals within Black & Veatch's businesses, industry stakeholders, association partners and consultants to build relationships with government officials to achieve Black & Veatch's overall global growth strategies. Based in Overland Park, Kansas, Robinson has over 31 years of experience as a registered professional engineer. He is currently engaged with the U.S. Conference of Mayors, the National League of Cities and the American Council of Engineering Companies as a business partner participating in discussions on sustainable, resilient and smart city concepts.

**Bob Hulsey** (*Water Supply*) is Associate Vice President and serves as a Global Practice and Technology Leader for Water on Black & Veatch's Water team. He leads process engineers dealing with advanced treatment technologies such as oxidation and removal of micro-contaminants, taste and odor control, distribution system water quality, and desalination. Hulsey also works with major technology providers on bid and contracting best practices. He has been involved in the process design, equipment specification, start-up, training, and troubleshooting for many of B&V's premier projects.

**Ann Bui** is Managing Director for water services in Black & Veatch's management consulting business. She has over 25 years of experience working with utilities on more than 250 engagements and has provided financial and business services for public and investor-owned utilities across the U.S. of various sizes ranging from those with only 5,000 service connections to those that serve populations over 3 million. Bui is based in Los Angeles, California.

**Scott Aitken** is Managing Director for Black & Veatch's water business in Europe. He has full management responsibility for the company's design-build and professional services in the region, with more than 28 years of experience. He has held directorships with consultancy businesses as well as design-build alliances and joint ventures. He is based out of the company's Falkirk and Redhill offices in the U.K.

### **ALTERNATIVE WATER SUPPLY**

James Strayer is an Associate Vice President and Director of Planning and Asset Management in Black & Veatch's water business. He has more than 20 years of experience related to water planning, water reuse and alternative water supply development. He is a former Chapter President of the WaterReuse Association and has spoken on water reuse topics at AWWA and WaterReuse Association conferences, as well as local news and print media. He has planned potable reuse programs with capital improvement plans (CIPs) up to \$3 billion, including the iconic 85-million-gallon-per-day (mgd) Pure Water San Diego program. He is based in San Marcos, California.

**Sanjay Reddy** is a Client Director and Associate Vice President for Black & Veatch's water business. He has more than 29 years of experience related to the planning, design, construction and startup of water, wastewater and recycled water facilities. Reddy recently completed the award-winning Silicon Valley Advanced Water Purification Center project and is currently a project manager for the Sacramento Regional County Sanitation District biological nutrient removal (BNR) project. He is based in Walnut Creek, California.

**Vasu Veerapaneni** is Global Practice and Technology Leader in Desalination and Reuse for Black & Veatch's water business. He has more than 26 years of experience related to advanced and emerging separation and desalination processes. He has worked on all aspects of desalination and reuse plants, including feasibility studies, design, procurement and operations. He has also worked on the development of design-build-operate projects for desalination and reuse on both the procurement and execution side. Veerapaneni is based in Kansas City, Missouri.

**Alan Man** is Managing Director of Black & Veatch's water business in Greater China. He has over 35 years of experience in a wide range of waterworks installations, including pipelines, rehabilitation of water mains, water transfer tunnels, service reservoirs, pumping stations and water treatment works. He was Black & Veatch's project director of the Tai Po Waterworks and Aqueducts Project, which was the 2006 Global Grand Prize winner for the design category at the International Water Association's Project Innovation Awards. Man is based in Hong Kong.

**William Yong** is Managing Director of Black & Veatch's water business in Southeast Asia. With 35 years of experience in project management, design, construction supervision, commissioning, as well as business development and management, Yong has worked in Australia, Hong Kong and Singapore. Having previously served as head of business development and strategy, Yong also served as a regional director and project director for Black & Veatch. He is based in Singapore.

## ALTERNATIVE FINANCE STRATEGIES

**Bruce Allender** is Chief Operating Officer of infraManagement Group LLC (iMG), a wholly owned subsidiary of Black & Veatch. He has over 25 years of experience in the water and wastewater sector and has been part of teams that have proposed and implemented public-private partnership schemes in North America, Australia and Asia Pacific for the water and wastewater municipal and industrial marketplace. He is based in Kansas City, Missouri.

**Francesca McCann** is a leader in the U.S. water industry with expertise in investments, public-private partnerships and project development. Before joining iMG, McCann served as CEO for Abengoa Water USA, where she successfully led the team to contracting the \$3.4 billion Vista Ridge Project in San Antonio, Texas. McCann also founded a consulting company, Global Water Strategies, and started her water career in 2003, covering the water sector for Wall Street. She is based in Washington, D.C.

**Will Williams** is an Associate Vice President in Black & Veatch's Asset Management practice. He has more than 25 years of experience in asset management planning, including risk-based capital prioritization, ISO 55001 gap analysis, asset failure analysis, risk assessment, performance benchmarking, maintenance optimization and business change management, among other areas. Williams is based in Atlanta, Georgia.

**Matt Bond** is a Client Services Manager in Black & Veatch's water business. His 32 years of experience include program management and execution of studies, design and construction for water utilities. Bond has specialized expertise in advanced wastewater treatment, wet weather issues and infrastructure asset management. He was President of the Water Environment Federation (WEF) from 2011 to 2012. Bond is based in Dallas, Texas.

**Jason De Stigter** is a Principal Consultant in Black & Veatch's management consulting business. He leads the Budget Prioritization & Optimization suite of solutions within Black & Veatch's Asset Management Practice focusing on evaluation and prioritizing the business case of utility capital and operating plan projects. He is based in Overland Park, Kansas.

**Jeff Stillman** is an Asset Management Practice Leader for Black & Veatch, specializing in asset management and system planning for water and wastewater systems. He is responsible for technical leadership on a variety of master planning and asset management projects throughout the U.S. and is based in the company's Burlington, Massachusetts, office.

## EMERGING TECHNOLOGY

**Andy Trump** is a Director within Black & Veatch's management consulting business. He has over 25 years of experience in energy and utility capital planning and regulatory affairs. During his approximately seven-year tenure with Black & Veatch, Trump has assisted numerous utility clients on their smart grid business cases and capital plans. Trump is based in Philadelphia, Pennsylvania.

**Andrew Chastain-Howley** is a Director at Black & Veatch who specializes in water loss reduction and water demand management. He is based in Fort Worth, Texas, and has 26 years of experience in the fields of water loss control and water conservation.

**Dr. Andrew Shaw** is a Global Practice and Technology Leader in Sustainability and Wastewater for Black & Veatch. He has over 20 years of experience in wastewater treatment design, having worked in the U.K., Australia, Asia and North America. His specialties include nutrient removal, computer modeling, instrumentation, process optimization and life-cycle assessments. He is an active member and chair of several WEF and International Water Association (IWA) task groups and committees. Shaw is based in Kansas City, Missouri.

**Jon Doane** is Director of Water and Energy Services for Black & Veatch's water business. He is responsible for identifying and delivering water services for the electric utility sector and energy services for the water sector. His expertise includes a thorough knowledge of the water-energy nexus, including the interdependencies between electric and water utilities, and the parallel objectives for them to achieve zero liquid discharge and zero net energy. Doane has 35 years of experience in providing water and energy services to utility clients and has been with Black & Veatch for approximately 15 years. He is based in Gaithersburg, Maryland.

**Scott Carr** is a Global Practice and Technology Leader for Biosolids and Residuals Management for Black & Veatch, with 30 years of experience. He has focused his career on biosolids and residuals management, including processing and beneficial use of biosolids. His expertise encompasses all aspects of biosolids management, from master planning through design and construction administration. He is based in Kansas City, Missouri.

**Anand Pattani** is Country Manager and Managing Director of Black & Veatch Private Limited (BVPL), India. Based in Mumbai, he is responsible for developing client relationships, directing bids and proposals, negotiating contracts and executing projects using global teams. Pattani's experience of over 17 years includes planning, development, engineering, designing and implementation of nearly 25,000 megawatts of coal, gas and renewable power plant facilities for utilities, developers, EPC (engineering, procurement, and construction) contractors and financial institutions. He is a U.S.-licensed professional engineer and has a bachelor's degree in chemical engineering from the University of Mumbai, India, and a master's degree in chemical engineering from the University of Missouri-Columbia, U.S.

#### **CLOSING COMMENTARY**

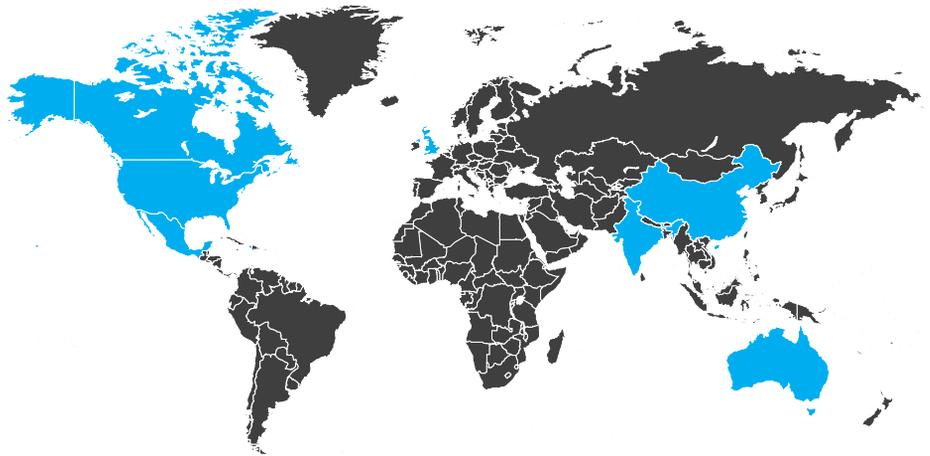
**Cindy Wallis-Lage** is President of Black & Veatch's water business, leading the company's efforts to address billions of dollars in water infrastructure needs around the world. Wallis-Lage joined the company in 1986 and has provided technical and management leadership expertise to more than 100 projects around the globe. Wallis-Lage joined the Black & Veatch Board of Directors in 2012 and is currently on the Board of Directors for the WaterReuse Association and for the U.S. Water Alliance. She is based in Kansas City, Missouri.

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## 2016 Report Background

The Black & Veatch *2016 Strategic Directions: Water Industry Report* is a compilation of quantitative and qualitative data and analysis from industrywide surveys. This year's online survey was conducted from 15 March through 1 April 2016 and reflects the input of 358 qualified utility, municipal, commercial and community stakeholders. To supplement the survey and broaden our report focus to regions outside the United States, the Black & Veatch team conducted more detailed surveys with water utility leaders in key Black & Veatch markets abroad.

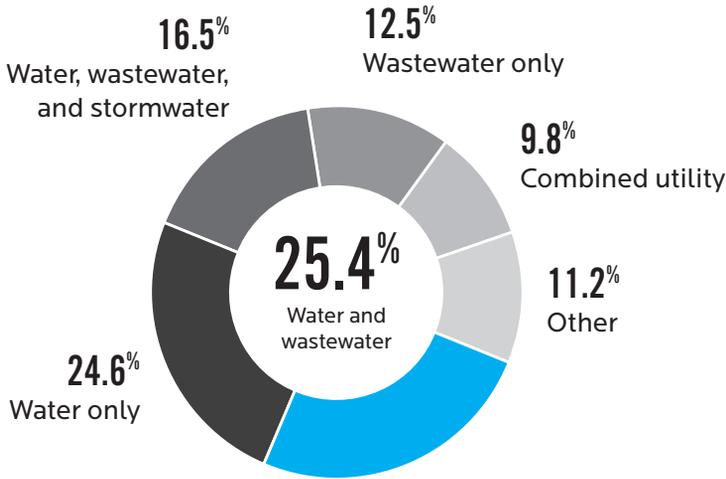
### *Regions Covered in the Report*



*Source: Black & Veatch*

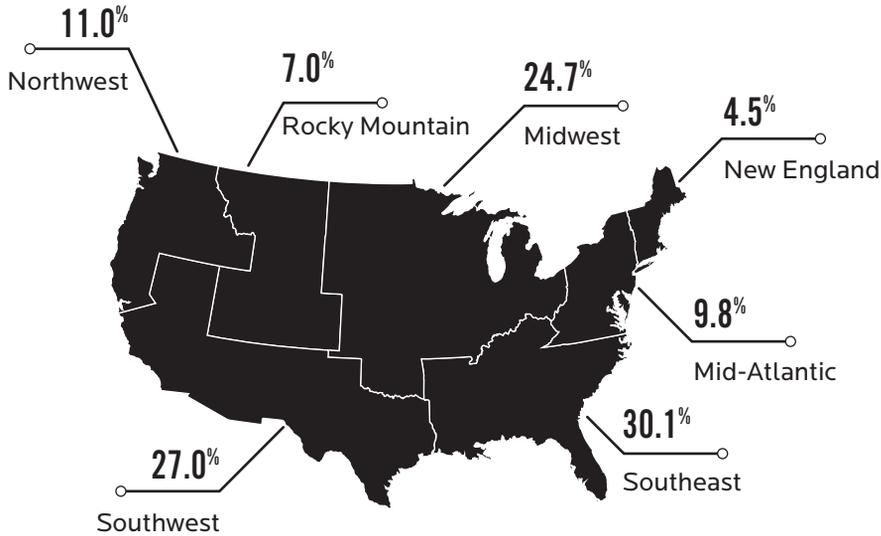
The following figures provide additional detail on the respondents in this year's online survey, which is primarily comprised of U.S. water industry participants. The results of the 358 survey responses have a precision of at least +/- 5 percent at the 95 percent confidence level. The results of the surveys conducted outside the U.S. are more qualitative in nature, and the findings are noted when cited throughout the report.

Organization type



Source: Black & Veatch

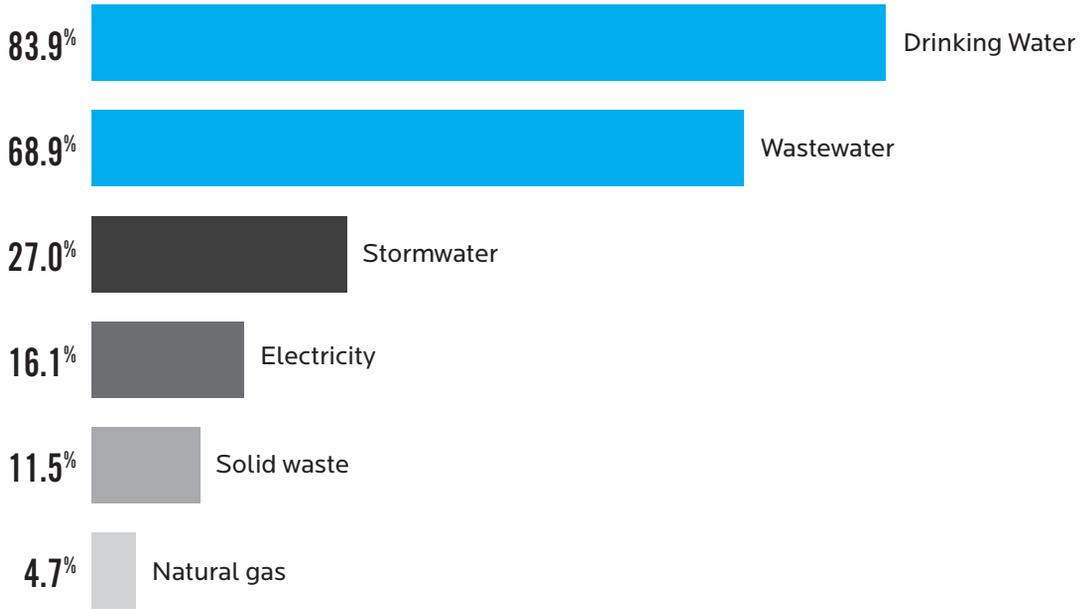
Primary business region



|                           |                      |
|---------------------------|----------------------|
| 4.5% Other U.S. Locations | 2.2% Mexico          |
| 5.1% Canada               | 3.9% Other Countries |

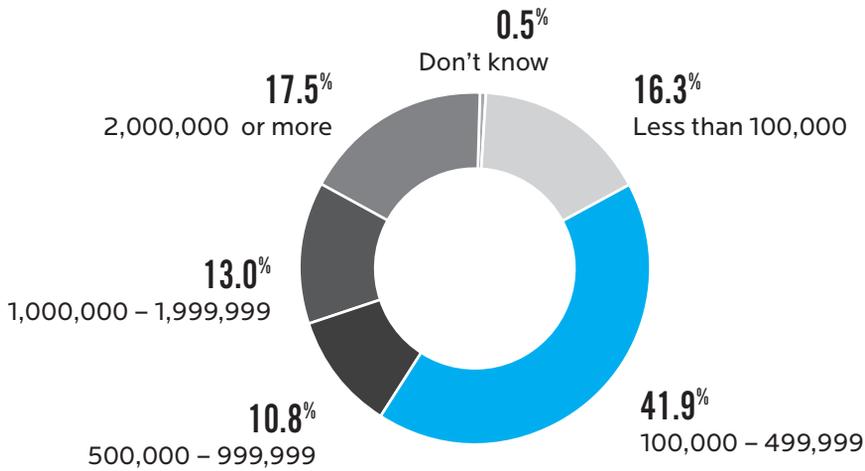
Source: Black & Veatch

Utility services provided



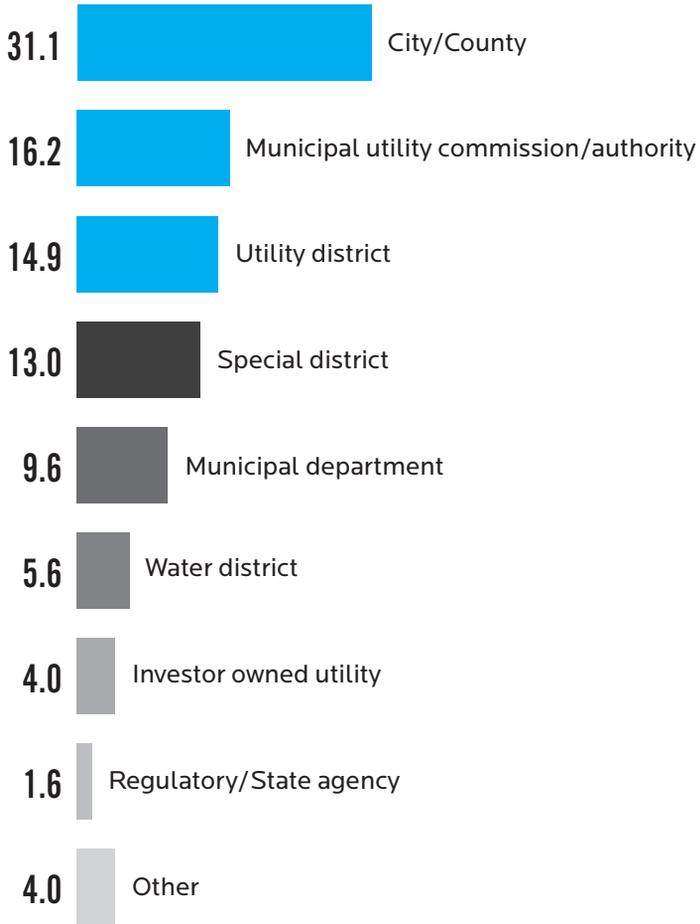
Source: Black & Veatch

Population served



Source: Black & Veatch

Utility type



Source: Black & Veatch

# EXECUTIVE SUMMARY

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## *As Infrastructure Demands Mount, Cost and Customer Expectations Test Water Industry*

By Mike Orth and Ralph Eberts

Many, if not all issues considered most important to the water industry in 2016 appear linked to funding and cost concerns - the cost of addressing outdated systems at a time when traditional revenue streams are drying up and the political cost of pitching rate cases or alternative financing strategies to skeptical stakeholders.

Or, the cost of water as it's widely perceived by the public, whose understanding of the resources needed to treat and deliver a safe supply may compete with the industry's ever-growing – and deferred – maintenance bill.

Concerns reflected in the *2016 Strategic Directions: Water Industry Report* may at first feel overly familiar. Aging water and wastewater infrastructure, questions of capital and operational costs and resilience all echo the worries and priorities of years past (Table 1).

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*There is little doubt that the problems in Flint, Michigan, are fueling new debates over America's water infrastructure.*

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Table 1

*Rate the importance of each of the following challenges to the water/wastewater/stormwater industry. [All Respondents]*

| Top Water Industry Issues                        | By Population Served |                 |                 |                     |                   |
|--|----------------------|-----------------|-----------------|---------------------|-------------------|
|  | Less than 100,000    | 100,000-499,999 | 500,000-999,999 | 1,000,000-1,999,999 | 2,000,000 or more |
| <b>Aging water and wastewater infrastructure</b> | 4.52                 | 4.45            | 4.40            | 4.44                | 4.50              |
| <b>Managing capital costs</b>                    | 4.24                 | 4.39            | 4.17            | 4.44                | 4.34              |
| <b>Managing operational costs</b>                | 4.24                 | 4.32            | 4.21            | 4.58                | 4.40              |
| <b>Justifying capital improvement programs</b>   | 4.22                 | 4.26            | 4.29            | 4.37                | 4.26              |
| <b>Resilience</b>                                | 4.04                 | 4.19            | 4.11            | 4.26                | 4.28              |
| <b>Information technology</b>                    | 3.87                 | 4.12            | 4.17            | 4.12                | 4.03              |

Source: Black & Veatch

Time certainly hasn't cured many of these concerns, and taken individually, any of them would present a challenge for an industry edging closer to the limits of its infrastructure. What is remarkable is that in 2016, new headlines about safe drinking water supplies and lingering concerns over past droughts, and those to come, are energizing a necessary national conversation around how much stakeholders up and down the water chain are willing to spend to ensure a safe, reliable supply.

There is little doubt that the problems in Flint, Michigan, are fueling new debates over America's water infrastructure. Utilities are hearing from customers in the wake of Flint, and utilities are also moving quickly to engage customers about the state of their local systems.

## CLOSING THE FINANCIAL GAP

Changing customer behaviors, drought and the continued slow pace of residential construction all remain drags on utility revenue, respondents said. But a discouraging statistic mirrors larger worries about the ability of providers to meet their obligations using existing revenue levels: only 28 percent said their existing streams would cover maintenance, debt service, capital investment and reserves (Table 2) – a drop from the 36 percent that was reported the year previous.

Table 2  
**My utility's current revenue levels cover: [Water Service Providers]**

| Current Revenue Coverage  | By Year |       |       |
|---|---------|-------|-------|
|   | 2014    | 2015  | 2016  |
| All O&M, debt service, R&R, and capital improvements, plus sufficient funding of reserves   | 33.4%   | 36.4% | 28.0% |
| All necessary O&M plus debt service requirements including principal and interest, coverage requirements and required fund balances | 19.0%   | 13.4% | 20.6% |
| All O&M, debt service, and R&R, plus adequate funding (through debt or cash payments) for required capital improvements             | 26.6%   | 20.1% | 17.8% |
| All O&M and debt service requirements, plus necessary renewal and rehabilitation (R&R)  | 7.3%    | 6.7%  | 15.0% |
| All necessary operations and maintenance, administration, and management (O&M) expenses   | 4.9%    | 6.4%  | 8.4%  |
| Other   | 2.4%    | 1.3%  | 1.9%  |

Source: Black & Veatch

Our report explores the nascent but growing popularity of alternative financing schemes, particularly the rise of public-private partnerships as a way to join eager private investors with increasing public needs. The strategies employed in international markets – particularly Asia, Australia and Canada – may offer lessons for U.S. providers as they strive to balance revenues and infrastructure requirements.

We also analyze one of the foundational blocks against adequate funding of infrastructure: the public's historic undervaluing of water. The American Society of Civil Engineers reported in 2015 that over the next four years, a nearly \$85 billion gap will exist between our current level of spending and needed investments in treatment plants, pipes and wet weather management. The Environmental Protection Agency believes that gap will reach more than \$300 billion by 2036.

History holds some clues about the disconnect over water's valuation among customers. Ann Bui, Black & Veatch Managing Director for Water Services, notes that one in three Americans is older than 50, meaning that roughly two-thirds of Americans may struggle to recall the last federal grant program of the 1970s despite directly benefiting from the facilities built with that money. Simply put: many of today's water customers may not remember having to pay for large infrastructure improvements, which contributes to a public that is accustomed to paying for water at rates that do not reflect its current cost.

## THE PROMISE OF ALTERNATIVE WATER SUPPLIES

Issues of cost also affect the implementation of alternative water supply strategies aimed at building diversified and resilient sources of water. A full 60 percent of respondents listed cost/financial as the biggest challenge holding back projects.

The interest is there, even if the capital isn't. Encouragingly, survey responses signal a new willingness to consider alternative water supplies. Nearly 50 percent of respondents say they either have or plan to develop a master plan for water reuse. Strategies vary by region, but many utility leaders are smartly taking the long-term view on supply and are open to new approaches. How such projects will be financed is the key question.

Recent weather conditions are adding a new wrinkle to source and supply questions. In recent years, California and Texas have been key examples of fighting drought through the development of alternative water supplies, when severe drought led to major water restrictions. However, despite recent rains in California and flooding in Texas, there remains resolve to proceed with drought planning, reflecting an understanding that a single year of abundant moisture likely won't replenish historically depleted water stores.

*Only 28 percent said their existing streams would cover maintenance, debt service, capital investment and reserves – a drop from the 36 percent that was reported the year previous.*

## SMART WATER FOR A SMARTER CITY

This year's report also considers the water industry's place in the movement toward smart cities. While our survey respondents say water utilities have an integral role in developing smart cities, these plans frequently do not include water's role in forging smart city blueprints.

Indeed, water utilities may still be in the first phase of smart city adoption, as many see smart city plans as a set of partitioned programs as opposed to a more unified approach that brings government, the private sector and utilities under an umbrella of an integrated service delivery. Our survey finds that a little more than half of respondents are either at the very earliest stages of smart city planning or are not reporting much progress in smart city coordination with their counterparts from other industries.

## IT AND CYBERSECURITY

The industry is seeing an increase in information technology and cybersecurity concerns as a result of some recent high-profile breaches in water utility information, communication systems, operational technology and increased concern and audits by the Department of Homeland Security. Cybersecurity threats are tightly related to customer service, operations and water quality.

Although strong punitive action with harsh fines or penalties is rarely seen within the water sector for cybersecurity or information technology-related events, the stakes are high. Water-related events, regardless of cause – cybersecurity breach, weather, or water quality – impact consumer confidence in the water's quality. Social media coverage has become extremely critical to public perception, response, and overall state and federal emergency action plans.

Because of the large volume of complex and potentially hazardous chemicals managed by water authorities as well as water's inherent "single points of failure" issues impacted by basic geography and watersheds, a potential cybersecurity breach has the ability to impact a significant amount of consumer and voter confidence. Interestingly, industry concern over cybersecurity and information technology tended to increase together from 2015 to 2016 because of multiple interwoven concerns.

## COST AND CUSTOMER EXPECTATIONS SEEN AS 'GREAT UNIFIERS'

It's true that cost has always been at the center of the water industry's ebb and flow. From an infrastructure perspective, virtually nothing is possible without the base supports of revenue and financing.

But in 2016 and into the foreseeable future, we envision cost and customer expectations to be great unifiers when it comes to forecasting the future of water infrastructure systems. Indeed, determining how to pay for operations and maintenance – let alone capital improvements – and then convincing the public of the necessary costs, have been historical pain points for the industry. This year, however, finds these issues tightly intertwined, perhaps never more so; as water crises hit home, cost and customer expectations become a part of the larger conversation about sustainability, social justice and stewardship (Table 3).

A sustainable future for the water industry includes applying the lessons learned by its electric and natural gas counterparts to address cost and aging infrastructure challenges. It means that the utility proactively collaborates with municipalities and its customers to build longer-term roadmaps. It means exploring alternative finance structures. It also requires embracing innovation.

Water utilities are charged with providing reliable, safe and affordable access to what is arguably the most important resource on the planet. The *2016 Strategic Directions: Water Industry Report* tracks how pricing and planning are evolving to keep pace with the changing perception of water's value.

Table 3

Which items represent the most significant sustainability issues for utilities? (Select your top three choices)  
 [All Respondents]

| Sustainability Issues  | By Organization Type     |                               |                                    |   |                  |                          |
|--|--------------------------|-------------------------------|------------------------------------|---|------------------|--------------------------|
|  | Water Only System/ Plant | Wastewater Only System/ Plant | Water and Wastewater System/ Plant | Water, Wastewater, and Stormwater System/ Plant | Combined Utility | Water Industry Providers |
| Maintaining or expanding asset life  | 58.6                     | 62.2                          | 51.6                               | 51.7  | 42.9             | 32.4                     |
| Customer water rates   | 39.1                     | 22.2                          | 39.6                               | 32.8  | 31.4             | 32.4                     |
| Long-term financial viability  | 34.5                     | 35.6                          | 40.7                               | 24.1  | 34.3             | 35.3                     |
| Maintaining levels of service with declining budgets   | 27.6                     | 28.9                          | 27.5                               | 36.2  | 57.1             | 35.3                     |
| Water conservation/demand management   | 25.3                     | 13.3                          | 20.9                               | 22.4  | 20.0             | 44.1                     |
| Declining consumption  | 33.3                     | 4.4                           | 20.9                               | 20.7  | 28.6             | 5.9                      |
| Reducing sanitary sewer overflows and/or combined sewer overflow occurrences within the system | 1.1                      | 37.8                          | 23.1                               | 29.3  | 8.6              | 17.6                     |
| Energy efficiency  | 9.2                      | 20.0                          | 19.8                               | 20.7  | 28.6             | 14.7                     |
| Climate change   | 18.4                     | 11.1                          | 7.7                                | 17.2  | 8.6              | 29.4                     |
| Distribution system water loss   | 13.8                     | 0.0                           | 15.4                               | 8.6   | 8.6              | 20.6                     |
| Energy recovery/generation   | 2.3                      | 35.6                          | 4.4                                | 5.2   | 2.9              | 14.7                     |
| Chemical use   | 9.2                      | 8.9                           | 7.7                                | 8.6   | 5.7              | 2.9                      |
| Cross-connections or redundancy  | 3.4                      | 2.2                           | 2.2                                | 5.2   | 5.7              | 2.9                      |

Source: Black & Veatch

# COMMUNICATING WITH THE CUSTOMER

## Headline Cases Bring Opportunity to Partner with Customers for Safer Systems

By Clint Robinson and  
Bob Hulsey

Public trust in government and municipal services is a critical, though fragile, construct. Tax and usage fee-paying customers expect that their funds are being used to create and operate reliable, safe and secure water systems. Across much of this report, a common trend is that high-profile events impacting water supply and distribution networks have dramatically raised awareness of operational challenges but also demonstrate an opportunity to change decades-long funding trends.

For example, ongoing drought conditions in the Western and Southwestern United States continue to affect residential and business customers. Flood control challenges also remain a concern for traditional and inland coastal communities. Headline-grabbing water safety issues are driving customers to question service providers' procedures and their regulatory agents, thus changing and increasing consumer interactions with water utility providers (Figure 1).

# MEDIA HEADLINES

## Reshaping Consumer Relationships

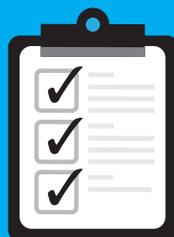
*Utilities combat trust issues through greater consumer engagement*



DO YOU SEE  
THE CUP HALF FULL  
OR HALF EMPTY?

50%

of respondents  
see an increase in  
consumer inquiries.

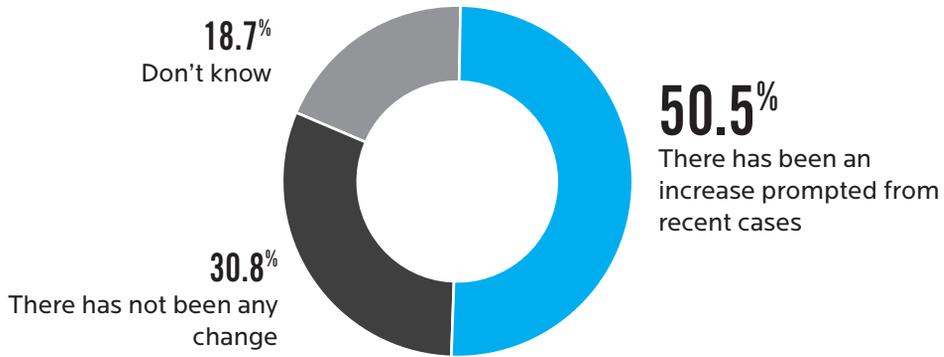


WHAT DO YOU KNOW  
ABOUT YOUR WATER?

*Utilities sharing more  
information about  
quality, testing*

Figure 1

Have recent high-profile water supply issues changed consumer interactions/queries/complaints with your utility? [Drinking Water Services Providers]



Source: Black & Veatch

Public engagement with water utility service providers can ebb and flow with local events such as water main breaks and treatment issues serving as catalysts for community interest. However, the water crisis in Flint, Michigan, appears to represent an inflection point in what has historically been the limited geographic reach of service performance issues.

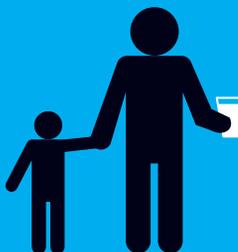


67%

of respondents are implementing customer engagement and awareness programs.

### IMPROVEMENTS FOR THE FUTURE

Caring for the consumers water delivery. Of respondents with lead service lines, 60% will seek to either fully or partially replace LSLs.



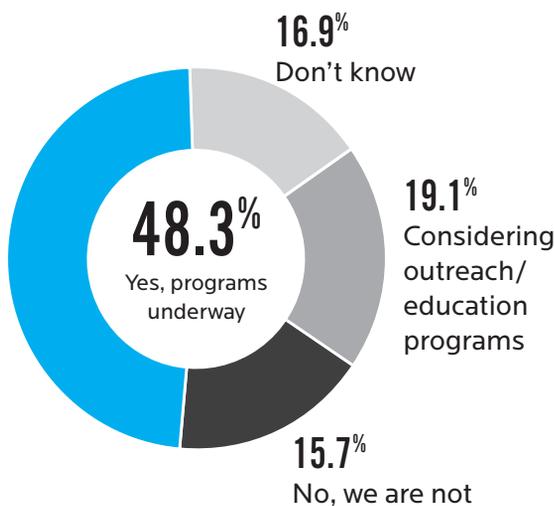
BUILDING SMARTER MORE RELIABLE AND SUSTAINABLE INFRASTRUCTURE for generations to come.

Source: Black & Veatch

To sum up the view of many water utility leaders, their goal is to be recognized as safe and reliable yet relatively low-profile. In light of the Flint situation, many are concerned that their utility may be the next to be examined by investigative journalists and national news interests. In addition, an uptick in consumer inquiries of their current service providers is being accompanied by a similar uptick in inquiries from the authorities that are overseeing utilities, such as regulatory boards, organizational leadership, elected officials and other stakeholders.

As a result, nearly half of respondents indicated they are currently taking steps to communicate measures under way to ensure the safety of the water supply (Figure 2). An additional 19 percent are considering launching similar consumer education programs. This proactive approach to engaging the community and increasing its knowledge base on the security of the water supply and the challenges that need to be addressed bodes well for utilities that need to make long-term investments as their sources and delivery systems change and age.

Figure 2  
**Is your utility undertaking steps to raise customer awareness/restore consumer confidence about water services in light of recent, high-profile lead pipe issues? [Drinking Water Services Providers]**



Source: Black & Veatch

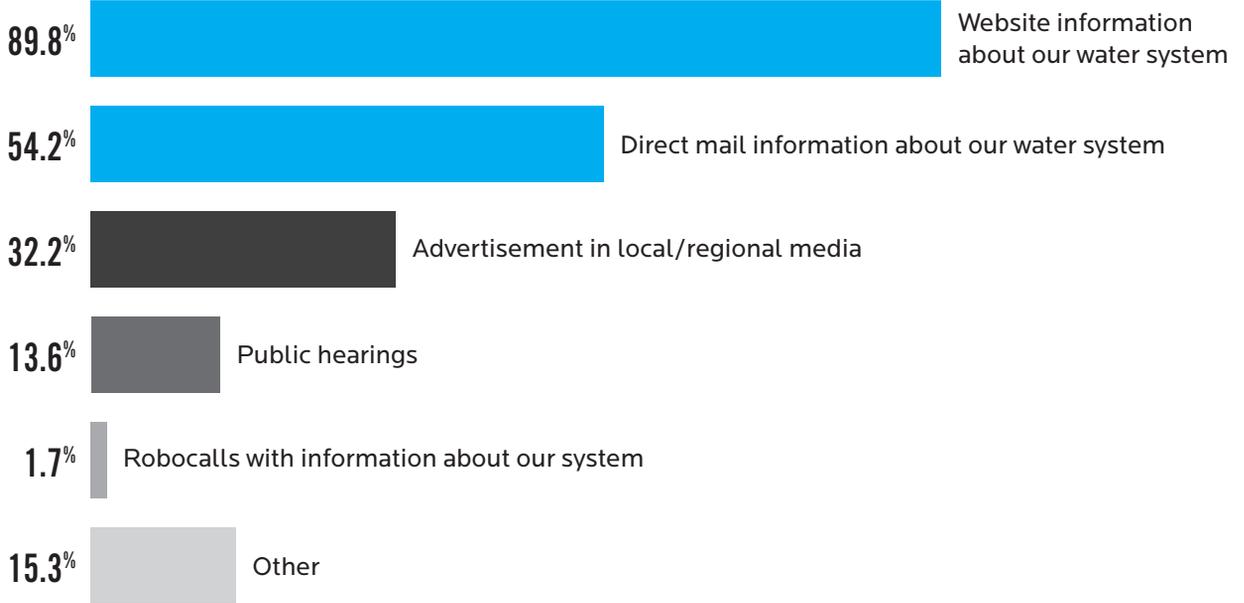
Between active program respondents and those considering outreach plans, nearly 90 percent identified website information as the primary vehicle for increasing customer awareness (Figure 3). Direct mail (54 percent) and advertisements in local/regional media (32 percent) followed at a distance, while public hearings represented a surprisingly low figure at just 13.6 percent. This could be tied to traditionally low levels of attendance and viewership at public hearings

Overall, the volume of activity put forth to raise consumer awareness results in an exceptionally high response rate. This is likely because many of these programs are being launched in response to the Flint crisis or as consumer confidence drops because of increasing concern about lead and copper, especially in our schools, as well as toxic algal byproducts and low levels of pharmaceutical and health care products. With heightened awareness, unusual taste, odor or discolored water instances are referenced with current affairs and create headlines and prompt discussion within and across communities.

With lead being such a major focus of customer and public health concern, it is in some ways reassuring that a high percentage (54 percent) of drinking water service providers indicate an absence of lead service lines (LSLs) in their distribution systems (Figure 4). However, this doesn't mean that those systems are completely lead free. Inside customer homes and businesses, lead can be present – in some cases, through plumbing fixtures and fittings – making optimized corrosion control programs an important issue for all providers. For water utilities with LSLs, the legal issue of responsibility beyond the customer meter is also an issue. Of the 23 percent of respondents with LSLs, 60 percent will be looking to either fully or partially replace that piping. Approximately 40 percent of those with LSLs will rely on optimized corrosion control alone or will need to add capital improvement plan funding to address replacement.

Figure 3

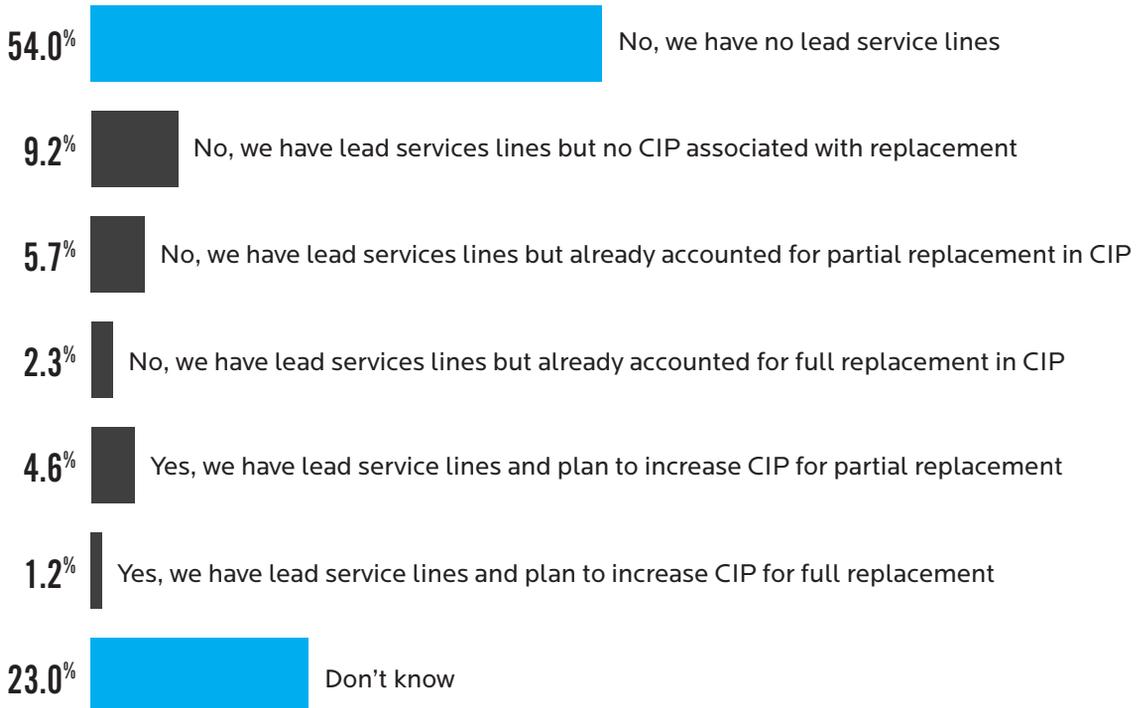
What types of programs are your utility considering to raise awareness? [Drinking Water Services Providers]



Source: Black & Veatch

Figure 4

Have issues surrounding lead service line replacement resulted in a change in your capital improvement plans (CIPs)? [Drinking Water Services Providers]



Source: Black & Veatch

For several years, the Black & Veatch *Strategic Directions: Water Industry* report has found that the success of the water utility industry in providing reliable service through underground/non-visible infrastructure has hampered its ability to adequately finance operations and capital planning. In many communities, lobbying for rate increases has proven to be more challenging than dealing with the political costs associated with aging systems. Lacking tangible evidence of consumer risk, arguments focused on fear – of service disruptions or the high costs associated with deferred maintenance – have been trumped by pressure to minimize impact on ratepayers. The current environment indicates that the political will to raise rates to fund investment in water infrastructure is the strongest it has been in decades (Figure 5).

The emerging political view appears to be that if water utilities don't raise rates, the consequences could be damaging. If these consequences should become more litigious or viewed as the result of criminal negligence, government officials see infrastructure investment as a means of minimizing their risk. This issue is important because addressing lead issues, whether in customers' homes or in systems containing lead, will likely require millions of dollars in remediation costs. Addressing system lead will also require significant municipal coordination as it would likely require closing off streets, disrupting traffic and other possible disturbances to communities.

This rising outlook is critical because aging distribution and treatment systems remain a significant component of, and challenge for, capital planning purposes. In fact, only 23 percent of respondents are working to address their deferred maintenance backlogs by assessing a user fee (Figure 6). More than 21 percent indicate they won't raise rates or user fees. Though shorter term capital costs are minimized when operators do not reinvest in their systems, at some point they will have to borrow (access the debt market) to fund projects. Even in the current low-interest rate environment, the outright replacement of failed systems typically costs more than regular upkeep.

Rising public awareness of the components that make up the water supply system presents an opportunity to better engage the community in support of a vital public asset. A strong case can be made for increased consumer education on water systems to encourage investment in water infrastructure. Focusing on how investments should be made to ensure a safe and reliable water supply for the future will likely be well-received.

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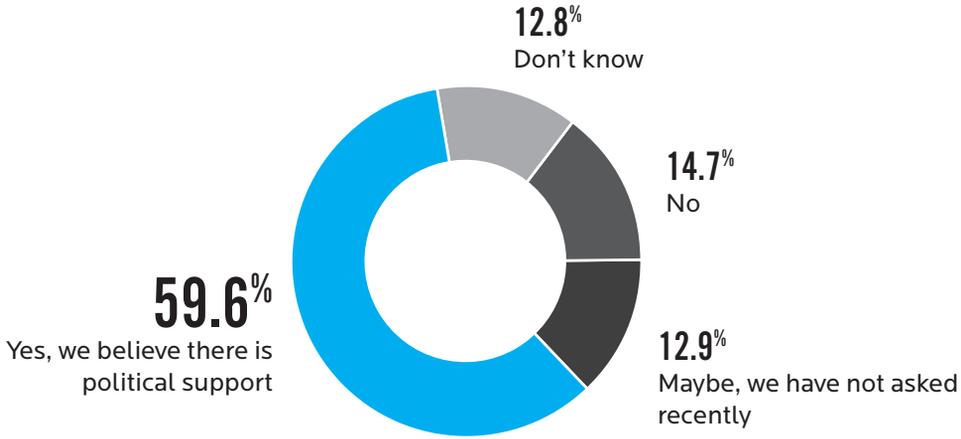
*A strong case can be made  
for increased consumer  
education on water systems  
to encourage investment in  
water infrastructure.*

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These investments also can leverage efficiency and performance gains made possible through deployment of the latest, most efficient systems designed to optimize energy, chemical and labor costs, thus making the best use of resources. There are also opportunities to deploy technology in the form of sensors and data analytics platforms to create value across the entire life cycle of the utility system while improving overall business operations and safety of water utility providers. In short, now appears to be the time to start a transparent and frank conversation with consumers that focuses on how investments in water systems are needed, are beneficial to all involved and can provide a smart, sustainable and resilient water supply for generations to come.

Figure 5

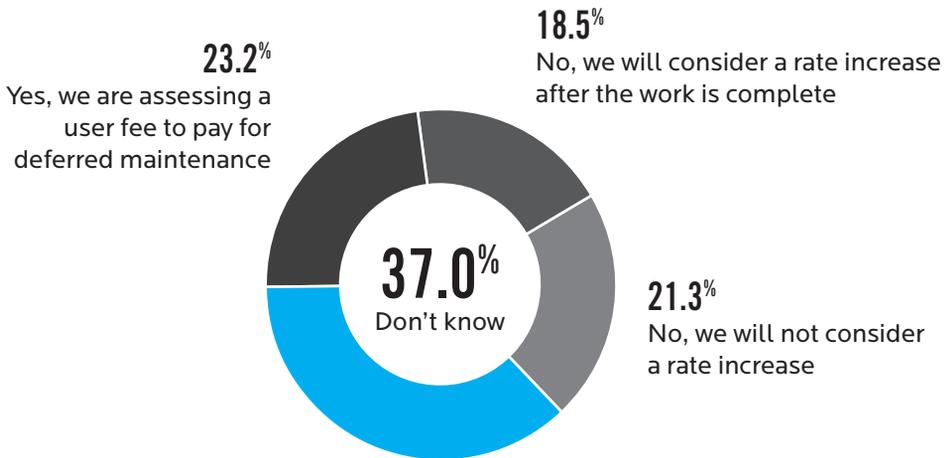
Do you believe that there is political support for rate increases to provide funding for investments in water infrastructure? [Water Services Providers]



Source: Black & Veatch

Figure 6

Are you currently assessing a user fee to pay for deferred maintenance? [Water Services Providers]



Source: Black & Veatch

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## **Valuing Water**

By Ann Bui

The continued decline in water consumption, increase in extreme weather events and combination of aging infrastructure and declining federal and state grants or subsidies have transferred the financial burden of water delivery squarely to utilities and their customers. This confluence of forces is setting the stage for what could be an end-to-end reimagining of the price of water and its value to the community.

That aging water and sewer infrastructure are of perennial concern to water utilities is not new (refer to the Executive Summary). Respondents also say that two of the top three industry issues revolve around managing costs. In essence, water utilities are recognizing that they must manage to do more with less because customers have become more vocal about rate pressure.

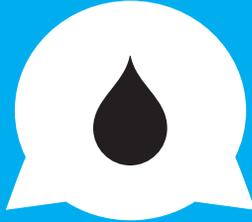
In addition to cost and infrastructure concerns are the unintended consequences of the move toward smart cities and the Internet of Things. Water utilities face demand from stakeholders who are reaping the operational and financial benefits of innovation from their energy and telecommunications providers.

# GETTING ON THE **SAME PAGE**

Utilities and consumers are **MISSING** each other's **MESSAGES**

How am I covering my costs?

What am I paying for?



## THE WELL RAN DRY

Grants and subsidies of the 1970s which covered the cost of water expired and today's generation must foot the bill.



## WATER IS WOEFULLY UNDERPRICED

Two out of three top industry issues concern managing costs.

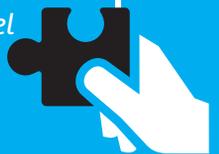


## HOW IS MY UTILITY MEETING MY NEEDS?

Consumers exhibit a healthy dose of skepticism and are questioning utilities about the products and services they receive.

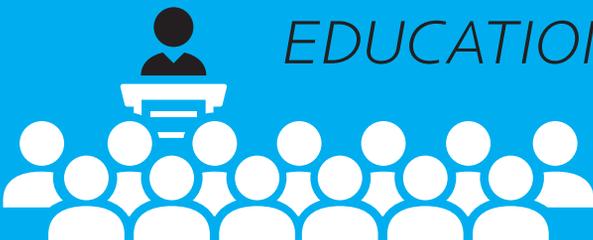
## ONE SIZE FITS ALL model WON'T WORK

Customer engagement programs, transparency, financial assistance options and rate re-structuring are key solutions.



## EDUCATION AND UNDERSTANDING

are critical to **REACHING COMMON GROUND.**



### THE RATEPAYER CONUNDRUM AND AFFORDABILITY GAP

The renewed focus on the price of water infrastructure is, in part, due to declining consumption impacts. As efficient appliances became more prevalent, and regulation was implemented that required new housing stock to include them, consumption per capita decreased. In areas where water scarcity is a major concern, conservation efforts further push the decline in per capita consumption. This long-observed trend does not appear to be ending soon, and utilities are now grappling with how to educate consumers about the fixed costs of convenience – such as having safe drinking water available 24/7 at adequate pressure – and services such as fire protection (much of which goes unnoticed until needed) while customers question rate increases (Figure 7).

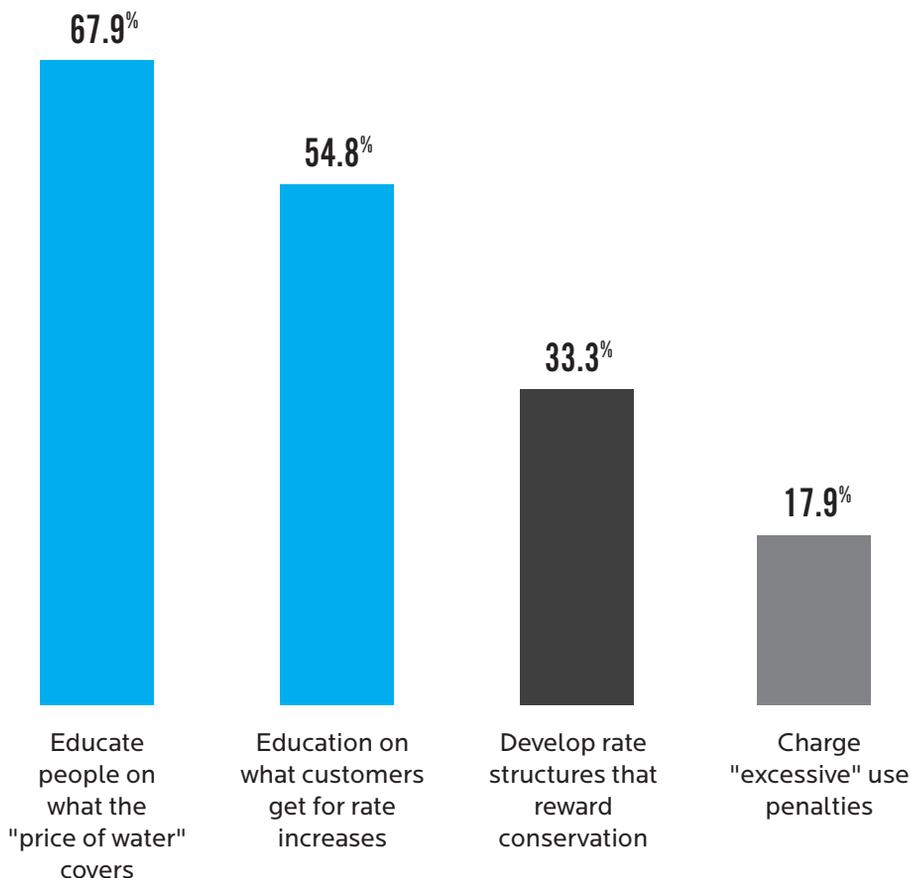
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*For years, those working in the water industry have realized a truth that is now reaching a broader audience:  
Water is woefully underpriced.*

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Figure 7

*Water conservation efforts create difficulty in predicting how much consumption will decline. What methods are your utility using to address the ratepayer conundrum: “We conserve water and rates increase.” [Drinking Water Services Providers]*



Source: Black & Veatch

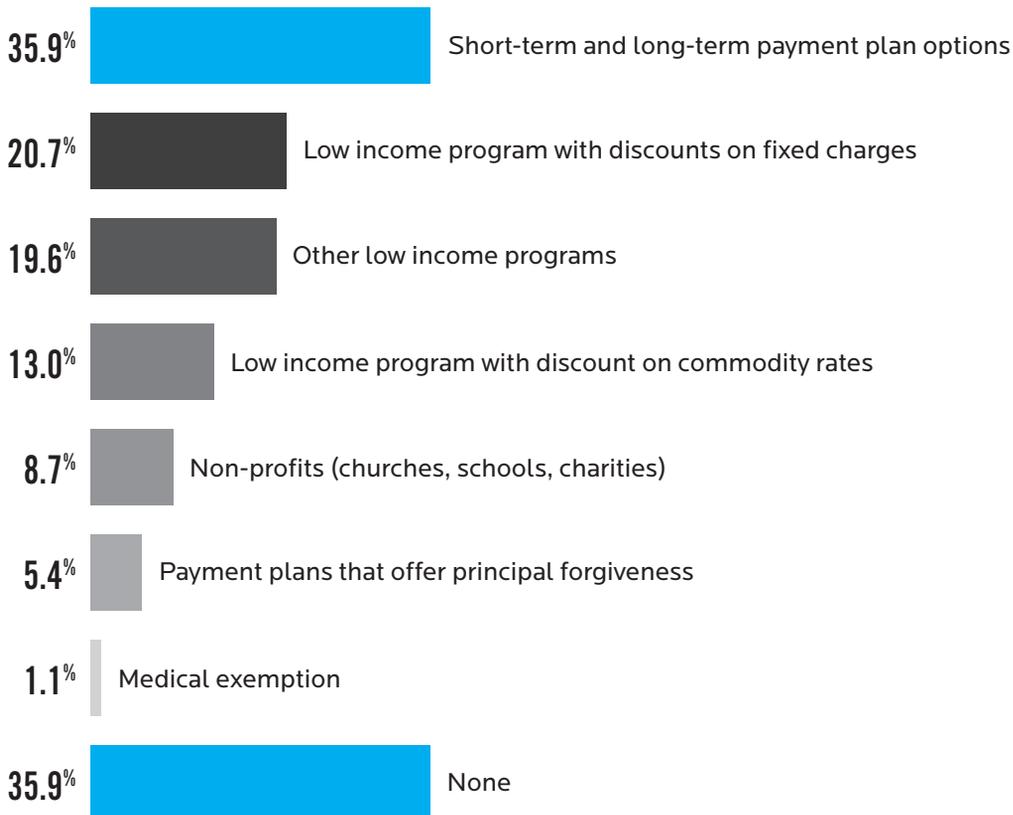
For years, those working in the water industry have realized a truth that is now reaching a broader audience: Water is woefully underpriced.

Rate increases alone are often not a solution as implementing an increase can sometimes be problematic. Over the past few years, the issue of affordability has received increased scrutiny, and water utilities are seeking to address challenging social issues around this matter. For example, unlike electricity, in many parts of the country, water accounts stay with the property. Delinquent account balances may be assessed against new property owners who did not incur the charges in the first place.

This gives rise to complex legal and organizational questions such as: What relief is a renter owed when the landlord neglects to pay a utility bill and the tenant's water is shut off? Is the benchmark of 2 percent of household income for affordable rates still valid in today's environment? Does a water utility's business model have to change to address affordability? Water utilities are recognizing that a one-size-fits-all approach may not be the solution. Instead, they are leveraging a combination of payment and discount plan options (Figure 8).

Figure 8

**As the per-unit cost of water increases, affordability becomes an issue. What programs does your utility have to help those in need? [Water Services Providers]**



Source: Black & Veatch

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*From a sustainability perspective, water utilities have a responsibility to anticipate and manage crises before they happen.*

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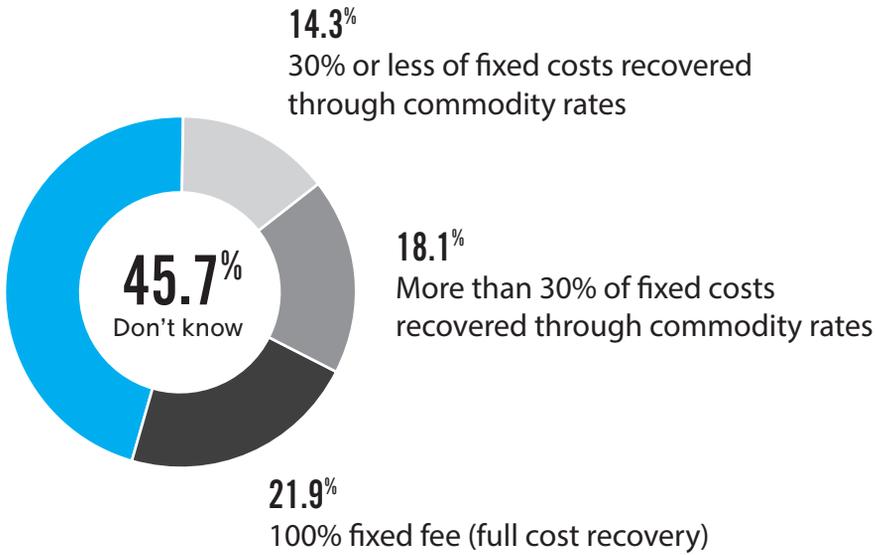
#### **WEATHER EXTREMES AND PRICING RESILIENCE**

Another challenge for water utilities is the increasing frequency of extreme weather events. From a sustainability perspective, water utilities have a responsibility to anticipate and manage crises before they happen. Drought in the Southwestern U.S. and flooding in the Northeastern U.S. are two sides of the same coin. Changes in climate and weather patterns are highlighting the effects of why “kicking the can down the road” approaches to addressing infrastructure and maintenance needs do not work. Natural disasters in New Orleans and Houston, or the events in Flint, should serve as wake-up calls to water providers that resilience requires long-term infrastructure, resources, financial planning, utility leadership and customer engagement.

The best way to save for that proverbial rainy day: putting aside a little every month. To accomplish this, however, means that the unit cost of water must go up to cover operational, maintenance and capital costs – many of which are fixed in nature (Figure 9).

Figure 9

Which one of the following options most closely reflects how your utility recovers its fixed costs? [Water Services Providers]



Source: Black & Veatch

Proactive maintenance and long-range planning will enable water utilities to maintain and build resilient systems. This means extending costs over a 20-year or longer timeframe instead of the traditional five-year approach.

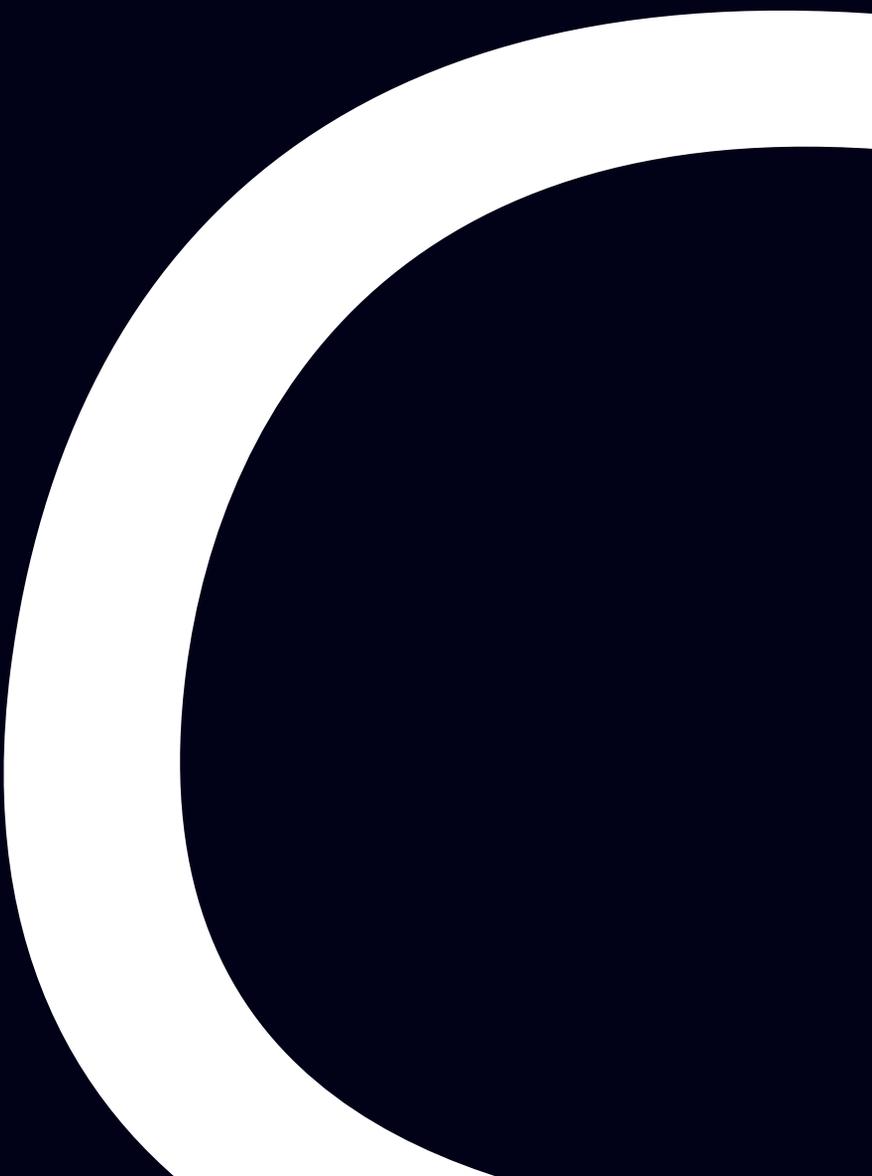
Long-term planning is a key tool for water utilities. Those that proactively engage in planning activities that align with strategic objectives and monitor key performance measures will get closer to achieving parity between increasing the price of water, educating customers with regard to what they are “getting for their money” and guaranteeing their own revenue streams.

# PERSPECTIVE

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## *Moving Past Language*

By Radhika Fox, CEO of the U.S. Water Alliance





Water is both personal and universal.

As we in the water industry strive to solve urgent global issues –water scarcity and drought, water quality challenges, infrastructure resilience in the face of a changing climate – we can never lose sight of the personal and universal nature of these problems. Innovation will be the key to solving some of our most pressing water challenges. But it is not just a matter of breakthrough research and development – the success and failure of these projects also rests on how we communicate them to the public. We need to tell our stories, and we need to make our stories engaging and accessible.

Technological breakthroughs and the stories we tell about innovation are inextricably intertwined. A well-crafted message is critical to breaking through to the public. As an industry, we need to use language that is meaningful to customers and that speaks to their values. We need to strip out industry jargon and be sure not to sanitize the conversation beyond comprehension – effluent quality, anyone?

#### **AN EVOLVING LANDSCAPE**

Water service is rapidly evolving, and it isn't just the technology that is changing. For decades, water and wastewater managers were largely “out of sight, out of mind,” providing affordable and reliable service 24/7. But being invisible no longer serves the industry. As water systems reach the end of their useful life spans and deferred maintenance bills stack up, it can be difficult to explain that significant rate increases are necessary for securing a sustainable water future.

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*As water systems reach the end of their useful life spans and deferred maintenance bills stack up, it can be difficult to explain that significant rate increases are necessary for securing a sustainable water future.*

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In regions facing drought, explaining why rates are going up while consumers are asked to conserve more can be complicated. And, of course, introducing customers to the idea that their water is recycled can raise a lot of concerns if the information is not delivered artfully. Phrases like “toilet-to-tap” and “direct potable reuse” don’t work well when communicating to the public. Toilet-to-tap is certainly evocative and accessible, but it is not appealing. “Direct potable reuse” is pure jargon –strung together, those words hold virtually no meaning to a layperson. Such terminology – especially devoid of context – does nothing to explain the problem that innovation can solve.

## **NEW MESSAGES FOR WATER**

The first thing we always need to do when communicating to the public is to remind people that water is essential to everything we do and have in our lives, and then educate them about the problems facing the water sector.

Regardless of where you live, there are challenges: scarcity, flooding, affordability. In our recent Value of Water Coalition national poll on attitudes about water, we found that 84 percent of respondents were concerned about treating wastewater in an environmentally responsible way, and 76 percent were concerned about being able to drink water straight from the tap. That is a large plurality of Americans and a helpful place to start the conversation about why investment is needed.

After the problem is defined, you can pivot to the solution: innovation. Once you’ve communicated the problem, the public or a stakeholder audience should be primed to see it isn’t innovation for innovation’s sake. It is an investment in solving problems and securing a sustainable water future.

As the industry shifts its operational strategies and is often asked to do more with less, it must also shift its communications strategies. It is time to lift the veil and bring the public along on the journey. Transparency and public engagement have to be baked into every plan, not an afterthought. Projects thrive when they have community support and stakeholder buy-in, from public officials to environmental groups. The conversation cannot be limited

to project managers and engineers – projects have to be understood and embraced by people far outside the water sector, and that means communicating to them in terms they can understand and with values that resonate.

In the Value of Water Coalition national poll, we found that a few key messages resonated the most with a majority of Americans. First, people were persuaded by the idea that we are all dependent on a strong and reliable water infrastructure.

This makes sense, because, as previously stated, water is universal and personal. Second, people were moved by the idea that an investment in water infrastructure was important for avoiding public health tragedies. The next most effective message was that water infrastructure is aging. These key ideas affirm our message that water infrastructure is at risk and in need of investment.

The final most effective message was that we owe it to our children to maintain and update these systems, and that is key to closing the deal with the public. Stakeholders must be emboldened to visualize the future: either one with safe and secure water access or one without. Investments in water are investments in safety, public health, quality of life and economic development. It is critical that we capture the public’s imagination and present a future that aligns with its values.

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## *Stakeholders must be emboldened to visualize the future: either one with safe and secure water access or one without.*

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### **ONE VOICE, ONE FUTURE**

Using the strongest narrative framework will only get the industry so far, however. We also need to deliver the same message in unison. The truth is, fragmentation in the water sector hampers our ability to effectively communicate with the public. Instead of making our aperture smaller and smaller, we need to appreciate that success will come with a broad coalition consistently delivering an inclusive message.

With that in mind, there are lessons to draw on from successful campaigns outside of water. Studying national presidential or issue campaigns, for example, we see some themes emerge: a simple message, repeated over and over. Great messaging holds no value if it isn't delivered by an army of messengers prepared to deliver it. Our hope for the future of messaging and communications in the water sector is that we can coalesce behind messages that effectively communicate with the public and deliver those messages in unison.

We have to realize that the industry is in the middle of a paradigm shift. Careful preparation and organization are critical now, so that when the entire country does wake up and realize we're facing serious water challenges, the industry can quickly pivot to underscore the necessity of investing in innovative solutions.

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***Radhika Fox is the CEO of the U.S. Water Alliance, a national nonprofit organization advancing policies and programs that build a sustainable water future for all. The Alliance educates the nation on the value of water, accelerates the adoption of one water policies and programs and celebrates innovation in water management. Fox also serves as Director of the Value of Water Coalition, a national campaign dedicated to communicating how water is essential, invaluable and needs investment.***

# THE ART OF FINANCING THE FUTURE

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## Addressing Industry Challenges through Public-Private Partnerships

By Bruce Allender and Francesca McCann

As utilities are challenged to minimize rate increases while balancing limited budgets with competing projects, chronic underinvestment, deferred maintenance and compliance mandates, one solution to consider is the public-private partnership (PPP) model.

The PPP model can restructure and/or provide capital and resources to help the utility manage its existing system assets or implement projects within or outside its capital improvement plan. Additionally, it allows the transfer of risk from the utility to the private sector, protection of the ratepayer and, most importantly, provides for the optimization of life-cycle costs and alternative management of these costs. PPPs provide a generational payback on the assets.

Another variation on the PPP model is leveraging the water and wastewater assets of a city to fund citywide needs, such as economic development initiatives or unfunded pension liabilities, or to clear debt from the city's balance sheet.

A PPP delivery model, if structured correctly, can provide the flexibility to address some, if not all, of the top concerns voiced by utilities in our 2016 *Strategic Directions: Smart City/Smart Utility* report (Figure 10).

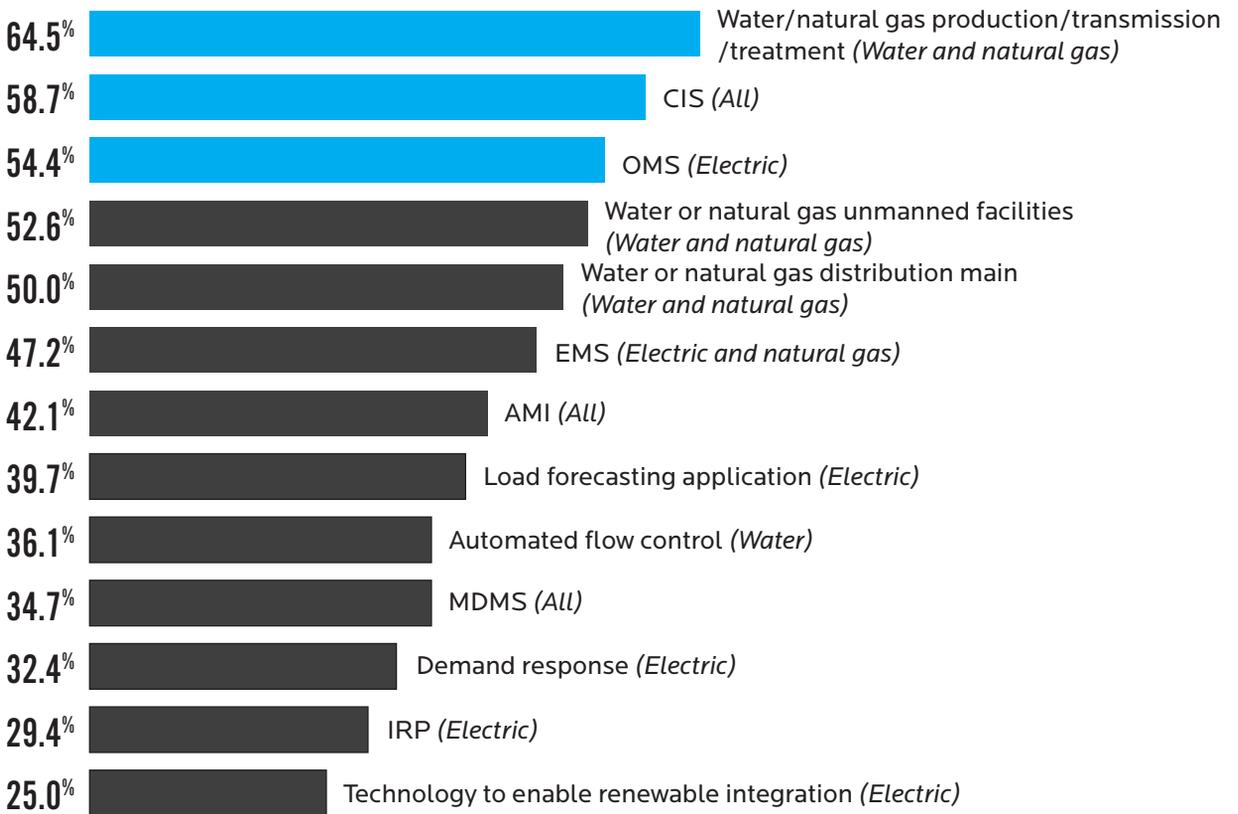
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The PPP model can restructure and/or provide capital and resources to help the utility manage its existing system assets or implement projects within or outside its capital improvement plan.

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Figure 10

Which of the following systems is your organization currently using for automation and data analytics?  
[Question audience shown for each item]



Source: Black & Veatch

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## *PPPs are truly a partnership between the public and private sector, not an asset sale.*

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### **UNDERSTANDING THE PPP MODEL**

The most significant hurdle in broader PPP adoption is the lack of understanding of the model and subsequent uncertainty and distrust. Education is the key to help “best-in-class” through to “distressed” utilities and cities understand how they can leverage the PPP model to support their cost of service and mitigate risk for their ratepayers. More industry associations and federal and state government initiatives are aimed at supporting cities to understand the benefits of a PPP for their utility.

There are varying definitions of PPPs, which often create confusion in the market. A broader and more meaningful definition of a PPP is that of a delivery model that joins the need of public infrastructure with the capital, risk transfer, life-cycle asset management, optimization of life-cycle costs and flexibility provided by private investors. The PPP model can be tailored to fit specific utility and/or city needs.

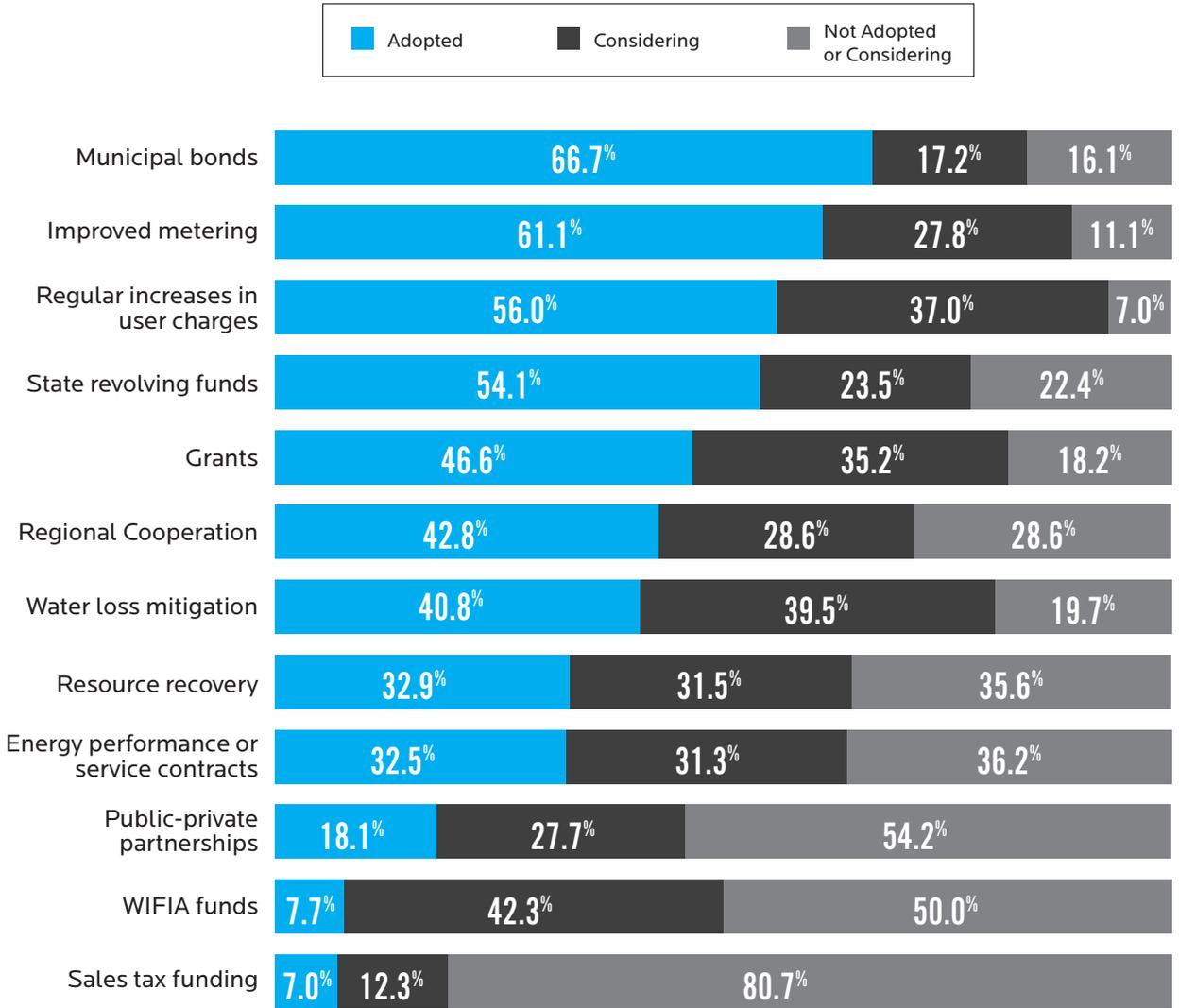
It is important to distinguish PPPs from outright privatization. Privatization implies selling the entire assets of a given entity, while through a PPP the government entity retains ownership of the assets – facilities, pipes, right-of-ways, pumps, etc. Depending on the specific agreement, the government can then turn over the operations, maintenance, investment and/or finances of the organization. PPPs are truly a partnership between the public and private sector, not an asset sale.

Moreover, it is possible to provide ratepayer safeguards and allow reasonable returns on private investments under PPP arrangements through the implementation of an asset management framework.

A critical area of education for the PPP model is stakeholder engagement. Having unified support from all parties involved – the utility (staff, leadership and board), the city, ratepayers, environmental and social groups and other local and state politicians – is essential to the momentum and success of a PPP project. Currently, there are no programs that specifically help guide a utility in this area, but as more PPPs manifest in the market, there will be a greater number of case studies and examples. The PPP model is not ideal for every utility or project, but most utilities should assess whether the approach is appropriate for upcoming projects.

Figure 11

Has your utility adopted, or is it currently considering, any of the following strategies and tactics to help finance and/or deliver services and major capital programs? [Water Services Providers]



Source: Black & Veatch

*While municipalities are still relying heavily on traditional funding mechanisms, including ever-declining state revolving funds and grants, there does appear to be an increasing receptiveness to new management models, such as PPPs.*

### CURRENT STATUS OF PPP MODEL USAGE

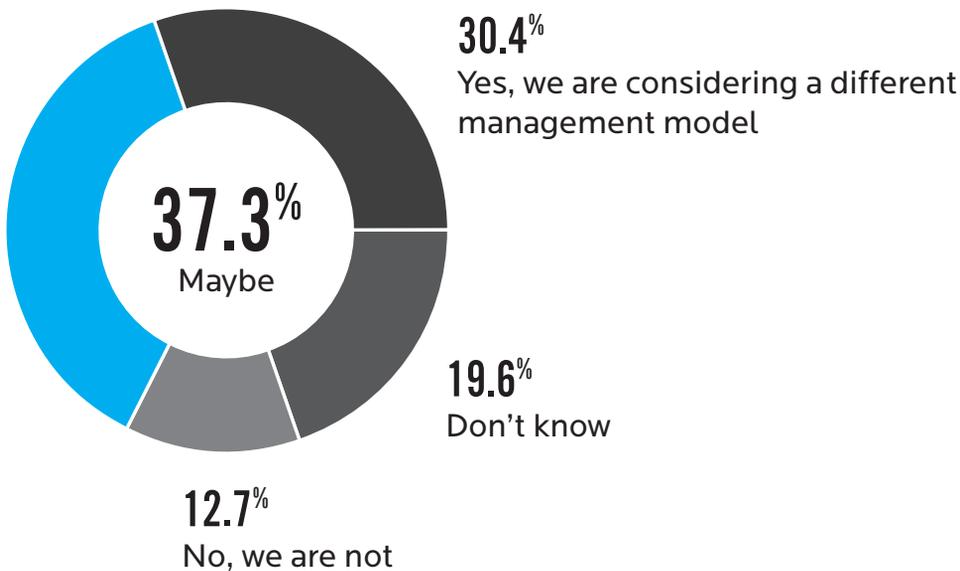
While use of the PPP model in other sectors, particularly transportation, is common, the market for PPPs in water and wastewater is still relatively nascent in the U.S. Despite successful implementations globally, in the U.S. large-scale, privately financed water and wastewater projects are few and far between. However, there is a growing trend toward consideration of the approach.

Provincial and political constraints – often based on misdirected skepticism of privatization – have kept PPP solutions largely at bay in the U.S. even as the industry openly questions how conventional financing strategies such as higher rates or municipal bonds can meet a ballooning bill for system replacement and expansion. The American Water Works Association has conservatively projected that tab at more than \$1 trillion over the next 25 years. (The figure is considered conservative because it reflects drinking water assets and doesn't account for systems such as wastewater and stormwater.)

While municipalities are still relying heavily on traditional funding mechanisms, including ever-declining state revolving funds and grants (Figure 11), there does appear to be an increasing receptiveness to new management models, such as PPPs (Figure 12).

Figure 12

**Would you consider a different management model to help you manage and fund your assets? [Water Services Providers]**



Source: Black & Veatch

## **WHY A PPP?**

Having a well-structured, long-term partnership with a private sector organization that is willing to have “skin in the game” with a city or utility results in an array of commercial and technical options for providing a better cost and an improved level of service to ratepayers over the asset life cycle .

There has been a significant movement in PPP models over the past few years that is beginning to address the traditional barriers that have prevented PPPs from being more commonly used by the water sector. Key attributes of various models include:

- Protect and manage risk for ratepayers but allow the private sector to get a marketplace return on its services and investment;
- Provide generational payback for system improvement and individual projects to ensure that the burden of these investments is borne by the ratepayers over the full life cycle of the assets;
- Have fair and optimal risk allocation;
- Allow the city to remain the owner of the asset;
- Allow the city to stay in control of the operations and maintenance, if specific standards are met;
- Provide competitive financing structures;
- Implement management partnerships that optimize the cost of service through life-cycle asset management frameworks and capital prioritization that link individual assets to long-term business and utility planning;
- Supply the capability to design, build, finance, operate and maintain system expansion;
- Utilize existing assets and introduce technology to provide additional revenue and improved customer service;
- Provide upfront or annual funds that address other city funding priorities. These could include pension liability, economic development, transportation repairs or expansion, or general connectivity of the public infrastructure across the city.

By providing education on PPPs, the industry can address generational funding gaps using life-cycle solutions, while addressing the industry's biggest current concerns.

# TEAMING UP TO FIND SOLUTIONS FOR AGING INFRASTRUCTURE CHALLENGES



PUBLIC UTILITY



PRIVATE SECTOR

Publi-Private Partnerships

## TIME FOR A NEW APPROACH?



Estimates suggest the U.S. will need at least

**\$1 TRILLION**

in system replacement and expansion over the next 25 years.

TRADITIONAL SOLUTIONS MAY BE **FALLING SHORT**



TWO-THIRDS of respondents are receptive to **NEW MANAGEMENT MODELS** like PPPs

## WHAT IS A PPP ANYWAY?



A **DELIVERY MODEL** that joins the **NEED** of public infrastructure with the **FLEXIBILITY** provided by private investors.



**IT TAKES MORE THAN ONE**

**UNIFIED SUPPORT** of PPPs from **ALL PARTIES** involved is key

PPPs Can Help Address the **TOP CONCERNS**

Voiced by Utilities by Providing

**FLEXIBLE** and **TAILORED**

Long-Term Solutions

Managing capital and operational costs

Resilience

Justifying improvements/rate requirements

Aging water and wastewater infrastructure

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## ***Case Study: Finding Balance Between Asset Risk and Investment***

By Matt Bond, Jason De Stigter and Jeff Stillman

Every year, utility leaders across the country must answer difficult questions regarding where to spend capital and maintenance budgets. Few have the luxury of a fully funded capital and maintenance program that covers all areas of need. In Tulsa, Oklahoma, the Tulsa Metropolitan Utility Authority (TMUA) is using advanced analytics and improved collaboration to make more informed investment decisions to the benefit of its customers and overcome these challenges.

“Every utility leader must make hard choices when developing annual budgets and programs,” said Joan Arthur, Asset Manager for TMUA. “Most have a general idea of what programs can be pushed back, but we don’t always have a clear picture of how deferred projects or programs affect our overall risk levels. This process quantifies risk and enables us to prioritize based on our risk tolerances, budget and available resources.”

TMUA’s capital prioritization implementation is now in its fourth annual cycle. It has grown from its initial pilot of 55 projects to full analysis of all water and wastewater projects within the 5-year capital improvement plan (CIP). Throughout the program, Black & Veatch has worked with TMUA leaders to build in-house capability with robust business case development, software tools and processes. This year, TMUA is leading the capital prioritization process with Black & Veatch support.

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*“Every utility leader must make hard choices when developing annual budgets and programs,” said Joan Arthur, Asset Manager for TMUA. “Most have a general idea of what programs can be pushed back, but we don’t always have a clear picture of how deferred projects or programs affect our overall risk levels.”*

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**RESULTS:**

- The pilot study identified \$11 million of cost-saving benefits by delaying 18 projects and maintaining risk tolerance levels.
- Year 2 evaluated the full wastewater CIP and identified \$48 million in cost savings by delaying projects outside of the 5-year CIP. This also reduced TMUA’s total Risk Weighted Cost by nearly \$8 million.
- Year 3 evaluated the full water and wastewater CIP and identified \$49 million in cost savings by delaying projects outside of the 5-year CIP. This also reduced TMUA’s total Risk Weighted Cost by nearly \$4 million.

“Capital prioritization and optimization answers the question, ‘Where is my next dollar best spent?’” said Jason De Stigter, Principal, Black & Veatch management consulting. “TMUA is proactively addressing its aging infrastructure challenge in a manner that slows the pace of customer rate increases without creating additional risk.”

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## **Asset Management – Putting the 'Partnership' into PPP**

By Will Williams

The U.S. water industry currently finds itself between a rock and a hard place – trying to balance the competing needs of large-scale critical infrastructure replacement with the need to finance that investment while minimizing impact on ratepayers.

While the traditional methods of debt financing such as general obligation or revenue bonds still make up the bulk of capital raised by utilities, there have recently been signs that alternative funding methods are increasingly being considered, and in some cases adopted. In fact, recent Black & Veatch *Strategic Directions* reports have shown increasing consideration of public-private partnership (PPP) arrangements, ranging from design-build (and operate-finance or both) through concessions to operations and maintenance type contracts.

A key concern for any of these forms of PPP is that the duration of such arrangements is relatively short compared to the expected life of the assets and they tend to incentivize expenditure in the first part of the PPP term, at the expense of investment toward the end of the term. In other words, what's best for the life-cycle management of the assets may be compromised if the PPP terms do not incentivize good "asset stewardship." There is, therefore, a considerable concern on behalf of ratepayers and municipalities that any form of PPP will lead to rate increases and diminished service with an overall deterioration in the general condition of the asset base over the PPP term.

However, it is possible to provide ratepayer safeguards and allow reasonable returns on private investments under PPP arrangements through the implementation of an asset management framework. Frameworks such as International Organization for Standardization (ISO) 55001 ensure that utilities/municipalities adopt a life-cycle approach to the management of their assets, establishing a clear strategy for the asset base and detailed life-cycle plans for the various asset classes. The benefits of implementing good practice asset management are well documented and include better management of risk; effective prioritization of investment; breakdown of organizational silos with increased collaboration and alignment around asset life-cycle management; documentation of key processes and procedures; and structured training and retention of key skills.

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*Recent Black & Veatch Strategic Directions reports have shown increasing consideration of public-private partnership (PPP) arrangements, ranging from design-build (and operate-finance or both) through concessions to operations and maintenance type contracts.*

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Implementing an ISO 55001-compliant asset management framework helps set the performance boundaries of the PPP and enables both the asset owner and asset manager to understand the life-cycle imperatives of the asset base. Under such a framework, key performance indicators are established and aligned with the strategy (which, in turn, is aligned to the organization's overall strategic plan). A risk-based approach is typically used to identify the magnitude of capital expenditure required and to prioritize it. Maintenance expenditure is targeted based on the condition and performance of the assets rather than being based on set time intervals. Overall, the management of the assets moves from reactive to proactive, and the focus becomes obtaining the optimal value from the assets across their life cycle. Planning is long-range and well-organized.

As well as benefiting the utility by ensuring good asset stewardship, the asset management framework also ensures the protection of the developer's investment by lowering risk of failure and life-cycle cost, while providing reliable asset performance through the term of the agreement to meet the obligation of the PPP contract. Private investment in water infrastructure can be mutually beneficial to investors and ratepayers. The key is customer communication and awareness and an overarching asset management framework that requires whole-life stewardship. Managing investment across the life of a system and partnership can help utilities address significant aging infrastructure needs and water resource requirements in an effective and sustainable manner.

Establishing an asset management framework at the start of the PPP ensures that there is a plan in place for the maintenance and proactive replacement of assets throughout their life cycle and that this plan is adequately funded, quelling skepticism on these types of agreements.

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## **UK Brings New Focus to Balancing Water Efficiency, Customer Cost**

By Scott Aitken

Efficiency, affordability, customer service and competition are among UK water companies' greatest challenges. Although the companies' responses differ – they are not a homogenous group - data is a common thread of many strategies: more data, better data and most importantly, better data analysis to allow better informed decisions.

Since their creation in 1989, the privatised water companies which serve England and Wales have invested £120 billion in water and wastewater treatment and carriage infrastructure. To help understand the scale of the industry's asset base, consider Yorkshire Water. One of the middle-size water companies, Yorkshire Water manages more than 700 water and sewage treatment works, 120 reservoirs and 62,000 miles of water and sewerage networks. Yorkshire is one of 12 UK water and sewerage companies.

English and Welsh utilities are regulated by Ofwat; Scotland's regulator is the Water Industry Commission for Scotland. To meet national water quality and environmental standards, and customer service levels set by regulators - at cost acceptable to the customer – water companies' assets need to be operated and maintained with ever-increasing efficiency.

This is at a time when climate and demographic changes are affecting assets' resilience and ability to meet demand. Southeast England, for example, now has less water available per person than Sudan or Syria. These pressures are exacerbated by static revenue, in real terms, and – in most cases - the need to generate value for shareholders or owners.

To attain the required levels of efficiency, water companies need to understand, in greater detail than ever before, how their assets are performing and be able to analyse scenarios into the future. This can be achieved by implementing smart water programmes.

Water and wastewater systems comprise thousands of data-generating components. Intelligent equipment can gather and process data, often at the component level. Smart integrated infrastructure (SII) is the combining of intelligent equipment with data analytics, leading to actionable information. For example, SII allows performance data for single pieces of equipment, or entire systems, to be combined with external data such as energy tariff information, to identify the lowest cost of operation providing greater opportunities to optimise on the basis of actionable information such as true cost of supply.

The ability to obtain and analyse data from individual pieces of equipment and entire treatment and carriage systems allows water companies to assess with ever-greater accuracy the capacity and resilience of their assets. This, combined with the ability to catalog data at lower costs, allows the implementation of smart programmes that use predictive data to help optimise asset performance and minimise risk.

“We have brought together our data and analytics teams to have a new asset intelligence team to maximise the value of data we collect and to enable better decision making, we are rolling out lean management systems across the business to better understand and manage the impact system changes have on our processes,” is how one of our survey participants assessed their response to the data challenge.

The real-time insights and intelligent decision making that smart programmes support has great potential to help water companies move away from capital expenditure- (CAPEX) or operational expenditure (OPEX)-based assessments and reporting, and towards TOTEX-based (CAPEX+OPEX) assessments. This is vital as the move to TOTEX reporting was a requirement of Ofwat's 2015 price review. The goal, according to one survey respondent is, “Data and insight driven outperformance of financial and operational targets utilising TOTEX to enable the right whole life costs for the long term sustainable operation of the business.”

It is a sign of data's ascendancy in water companies' priorities that, in addition to consulting engineers and construction companies, Thames Water appointed IBM as a delivery partner for its 2015-2020 programme.

Improving customer service is another area in which SII will have an increasing role. Ofwat's Service Incentive Mechanism (SIM) assesses the service that water companies provide customers against a range of qualitative and quantitative measures. The resulting SIM scores have a direct impact on the amount of money Ofwat allows water companies to charge their customers.

Qualitative measures assessed under the SIM include communication and customer engagement. Quantitative measures include the speed with which water companies respond to customer contacts, the number of customer complaints, and the speed with which they are resolved. To give context, Thames Water has circa 80,000 customer contacts per week. Ofwat will sample 200 of these as part of its SIM assessment.

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## *SII can help water companies identify high-risk areas, understand the condition of the assets that serve them, and plan maintenance accordingly.*

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The importance of SIM scores means water companies need to plan and react in ways that will reduce the number of customer contacts. Targeting network maintenance on high-risk areas, in which interrupted supplies will generate the most complaints, for example. SII can help water companies identify high-risk areas, understand the condition of the assets that serve them, and plan maintenance accordingly.

Understanding asset condition in detail will also help prioritise maintenance and ensure it is executed in a lean, efficient manner. Maintenance teams arrive onsite prepared to execute planned work, rather than having to assess asset condition before performing maintenance work reactively.

All respondents to our survey cited meeting customers' and regulators' service level expectations among their top three challenges. This comment is typical, "Utilities are very good at managing issues and events but as we become more highly performing our customers expect us to predict that events will happen and manage them before they have any customer impact."

In 2020 English and Welsh water companies' domestic customers may, for the first time, have the opportunity to switch their supplier. The need for water companies to compete to retain, or attract customers - by providing a high level of customer service for instance - will be another stimulus for SII programmes. Water companies will also need to understand their transactional cost base - the unit cost of everything they do - in order to structure their business for the era of competition. This is another area in which the understanding of assets afforded by SII programmes will be vital.

Using, "data and insight-driven service improvement in setting a service promise that delights," is how one of the utilities surveyed articulated the role of data in the era of competition. Ofwat is currently consulting on how wholesale competition will be implemented.

Ahead of wholesale competition, however, water companies in England and Wales will be able to compete for retail customers in 2017. Ofwat believes 1.2 million businesses will be able to choose their water and wastewater services provider following the introduction of retail competition.

As well as adding impetus to the drive for efficiencies and improved customer service, retail competition is ushering in the most significant structural changes since privatisation.

Water companies are assessing their core strengths, and how well these attributes will serve the need for processes that separate wholesale and retail customers. Companies are deciding whether to continue offering the services they provide currently, reduce their offering, or invest or partner to secure new sources of revenue in their own operating regions, or those of other water companies.

The latter is manifest in undertakings such as the recently announced joint venture by Severn Trent and United Utilities – two of the biggest water companies - to combine their non-domestic water and wastewater retail businesses. The former is illustrated by Portsmouth Water's decision to exit the business retail market when competition is introduced.

Retail competition will also see new licensees, some of which will be in essence water brokers rather than suppliers, competing with the established water companies. Scottish supplier Castle Water, for instance, has already announced it will take on Portsmouth Water's business customers.

The extent to which these processes will be amplified with the introduction of domestic competition is unclear. We can be sure, however, that the role of SII programmes in the UK's water industry will only grow.

*Ofwat believes 1.2 million businesses will be able to choose their water and wastewater services provider following the introduction of retail competition.*

# TOOLS TO CLOSE THE GAP

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## *Drought Still Leads to Alternative Water Supplies, But Other Drivers Gaining Traction*

By James Strayer,  
Sanjay Reddy and Vasu  
Veerapaneni

The importance of alternative water supplies, such as water reuse, brackish groundwater and desalination, continues to grow as organizations look to build diversified, resilient water supplies. This year's survey affirms two overarching conclusions: (1) that interest in alternative water supplies, particularly water reuse, has grown across the U.S. and (2) that the approaches, issues and adoption of alternative water supplies are regionally specific.

Certainly in the Southwest United States, Texas and Florida, the emphasis is on developing potable reuse. Non-potable reuse continues to be broadly employed, and desalination is being implemented in select applications where cost and environmental permitting can be overcome. Importantly, this year's survey also revealed a broader interest across the nation in alternative water supplies. Even in "wet" states, the topic is showing up on the radar for reasons other than drought.

For some states, particularly in the Southwest and to a degree the Southeast, limited water supplies are not a new topic. Those states would be considered at a "high maturity level" in the area of understanding and implementing alternative water supplies. These would include California, Texas and Florida – all coastal states – which means they at least have the option to consider ocean desalination.

Other states with extensive alternative water supply experience include Arizona, Nevada, New Mexico, Colorado and, in specific regions, Georgia.

*A broader interest  
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than drought.*

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*Non-potable reuse for landscaping or industrial use enjoys solid public support, and respondents to the survey indicated a strong outlook for this type of program.*

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### **INDUSTRIAL REUSE GAINS IN POPULARITY**

From the survey results, we can see that non-potable reuse is finding its way as a good “middle ground” for utilities and the public to consider. Non-potable reuse for landscaping or industrial use enjoys solid public support, and respondents to the survey indicated a strong outlook for this type of program.

For instance, nearly 25 percent of water utilities that serve power plants are implementing non-potable water reuse, a figure expected to rise another 10 percent over the next three years (Figure 13). Use of recycled water in cooling towers is expected to nearly double in the next three years, from 16 percent to 30 percent, and data center reuse will fully double in usage, according to respondents’ three-year outlook.

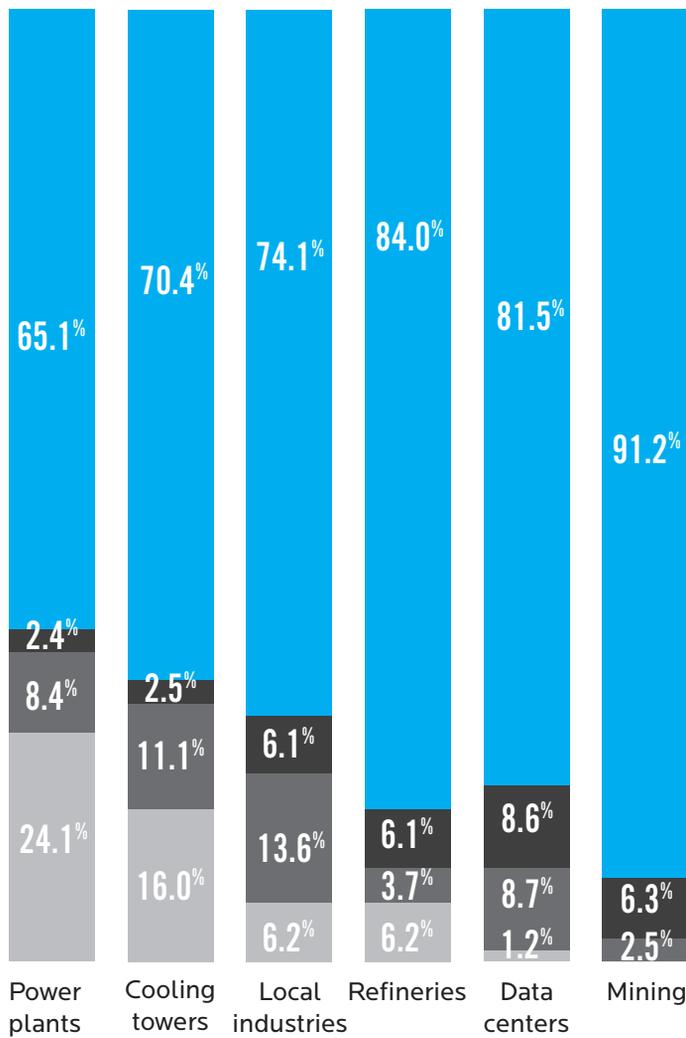
Three very important aspects come to mind from these responses: (1) there is a lot of interest in industrial reuse, (2) there is a lot of room for growth, and (3) utilities are demonstrating that they are willing to take on new areas that they’ve not delved into in the past. Given that these results are based on responses from the entire country, and not just regional responses from arid states, they highlight that utilities are making plans for strong expansion efforts.

In fact, master planning for water reuse is another way to look at the broader acceptance of alternative water supplies. Nearly 50 percent of respondents say they either have or plan to develop a master plan for water reuse, which shows a broad consideration across the country, even in non-arid markets (Figure 14). Of those respondents, 12 percent will be implementing plans for the first time.

# Interest is evolving around environmental support, green initiatives, public image and reputation purposes.

Figure 13

What is your organization's current level of usage and its future plans for the following types of non-potable industrial reuse? [Drinking Water Services Providers]



Source: Black & Veatch

**DIVERSE DRIVERS FOR ALTERNATIVE WATER SUPPLIES**

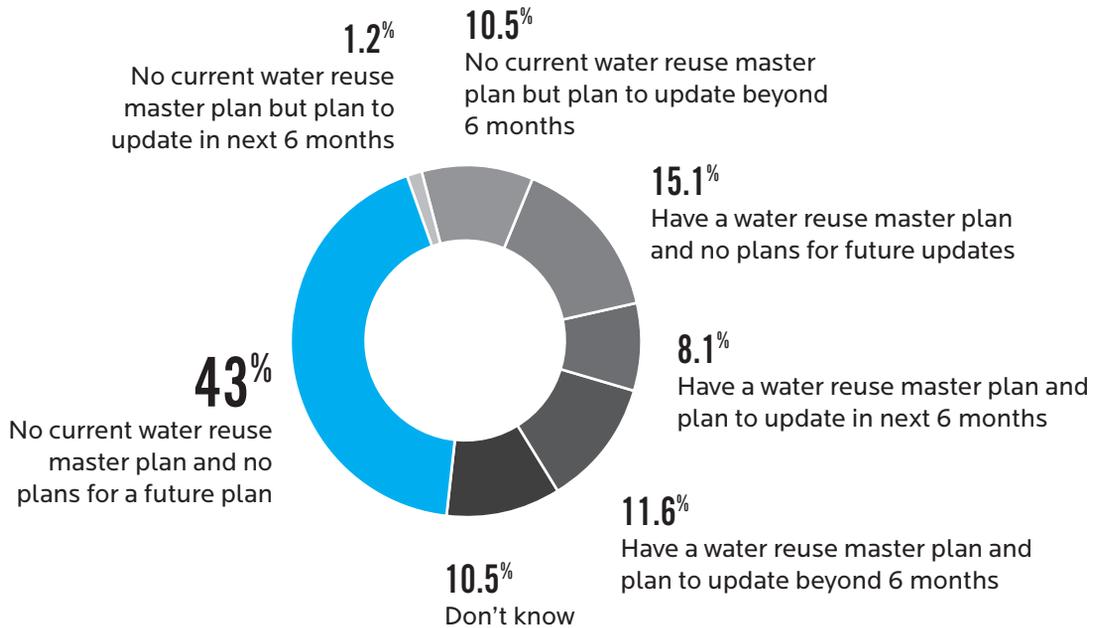
The primary drivers of alternative water supplies are diverse and regionally different, but drought is a dominant motivator that is unlikely to abate despite recent rains in water-scarce areas like California and Texas (Figure 15). Utility leaders, especially in drought-affected states, recognize that now is the time to address water supplies that are independent of rainfall.

An important takeaway from survey responses is the growing sentiment toward drivers that demonstrate more holistic water supply practices. Resource recovery and treatment targeted to specific water uses (fit for purpose water) had relatively strong support as drivers, showing a broader dedication to sustainable practices.

Resilience also posted strong sentiment, and again, scoring was higher from wet states versus the Southwest. While this could be affected by the Southwest’s current heavy focus on dealing with drought, it does help to answer why more and more wet states are looking at alternative water supplies – and reuse in particular. This finding corroborates recent inquiries for studies on alternative water supplies that have come from some of the northern Midwestern states. Interest is evolving around environmental support, green initiatives, public image and reputation purposes.

Figure 14

**What types of water reuse plans does your organization currently have in place? [Drinking Water Services Providers]**



Source: Black & Veatch

## DEALING WITH FINANCIALS

So if the desire is there, what is holding the projects back? No surprise – it is the cost of implementation! But what is surprising is the magnitude that cost has become compared to all other listed challenges. A full 60 percent of respondents listed costs/financial as the biggest challenge, while regulations and stakeholder support (public opinion) drew a mere 11 percent each (Figure 16). This is a surprising result, since several studies have shown that alternative water supply sources are as cost-effective as traditional sources, particularly if conveyance of water over vast distances is taken into account. This means that the industry has some serious work to do to address the financial challenge, and there is no simple solution.

Overcoming the cost of alternative water supplies requires leaders willing to work to gain cooperation and invest in systems that will support generations to come. This can be equated to the visionaries and leaders of the past who built the major infrastructure projects that we currently rely on.

Today's alternative water supply leaders should move forward in many important areas related to costs, starting with a focus on communicating the value of water. Stakeholder involvement at the planning and development stages is also needed. Broader coalitions should be created to promote sustainable and secure water supplies and to show policymakers there is support to push onward. Technological innovation should be advanced at both the treatment and monitoring levels to produce safe water at a reasonable cost.

Without these efforts, it is tough to move forward, if the context is strictly a unit cost stacked against existing water costs. As the dry states have discovered, it doesn't matter what the cost of existing water is, if there is less and less of it each year.

## DOES NEW MOISTURE CHANGE THE OUTLOOK?

In recent years, California and Texas have been key examples of fighting drought and developing alternative water supplies. The states had severe droughts, which led to major water restrictions being enacted. The past year, however, has seen some relief in California and periods of significant rain and even flooding in Texas. So, how will the public, elected officials and water industry leadership react? Will there be a push to ease some of the restrictions and lessen the move toward implementation of alternatives?

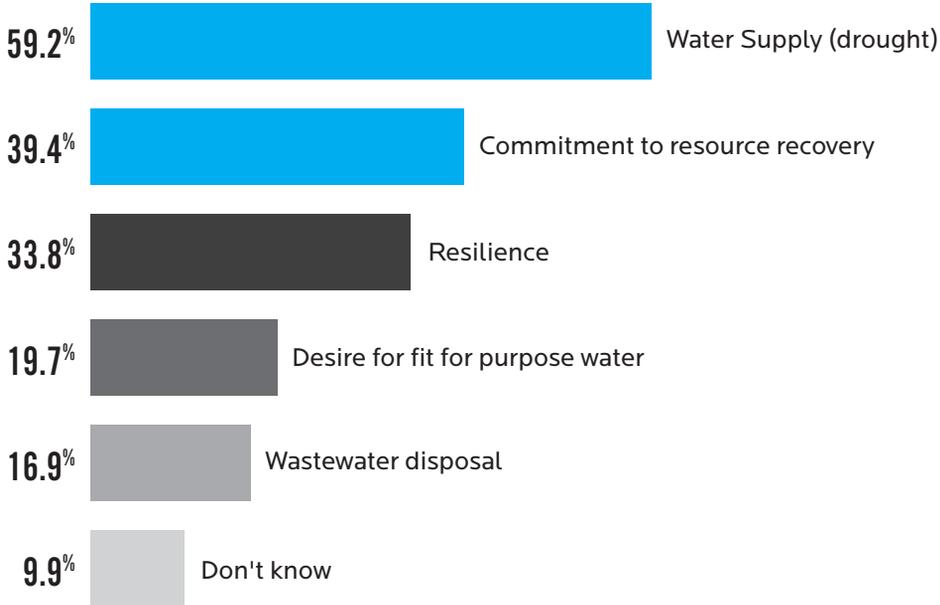
Those who see the big picture know the answer: Nothing really changes. One good year of moisture is a welcome reprieve, but doesn't negate the past. California and much of the Southwest would need many years of abundant moisture just to begin to replenish what has been lost in reservoirs and the ground water table. For example, the Central Valley section of California is estimated to have lost one cubic mile of ground water, or approximately 1.1 trillion gallons of water – a staggering amount!

In Texas, rainfall has certainly slowed the urgency of some reuse projects, but the results of the survey and our knowledge of regional projects show a continued commitment to developing alternative water supplies.

The reality is that the on-again, off-again pattern of moisture is likely the new normal. A new age means that communities need to make resilience and sustainability a key focus and, therefore, begin planning and implementing alternative water supplies – and, of course, to do so in ways that are specific and appropriate for their locale.

Figure 15

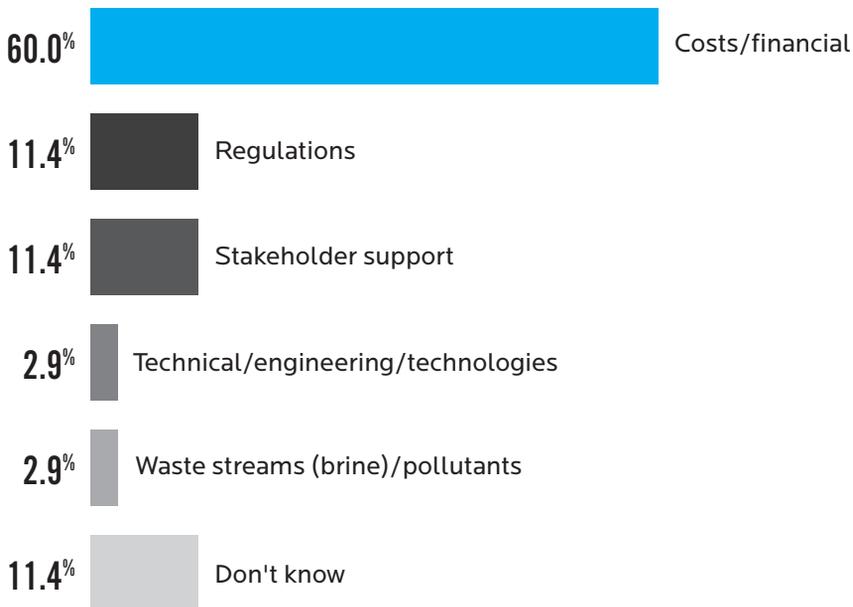
**What are the main drivers for alternative water supplies in your community? [Drinking Water Services Providers]**



Source: Black & Veatch

Figure 16

**What is the biggest challenge your organization faces in developing new alternative water supply projects? [Drinking Water Services Providers]**



Source: Black & Veatch

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**Asia's Water Supply:  
Managing Finite  
Resources and  
Growing Demand**

By Alan Man and  
William Yong

Modern Asian cities are feeling the pressure of growing populations, improved economies and a rising middle class. And these factors are impacting their water supply and water infrastructure.

Interviews with regional water utility executives highlight that regional governments, communities and water system providers are prioritizing water issues such as securing an adequate water supply and ensuring clean catchments and waterways. "They are also busy tackling the rising costs of water production," said one Southeast Asia water leader.

Their aim: reinforcing new and existing infrastructure with more flexibility and resilience.

**FINDING: GROWING ACCEPTANCE OF ALTERNATIVE WATER SUPPLY**

Despite facing different geographic and economic challenges, many of Asia's water industry leaders interviewed for this report indicate a clear acceptance of alternative water supply that is independent of rainfall. PUB, Singapore's national water agency, expects the country's total demand for water to double by 2060. Recognising that it will have to find and treat more of this resource drives PUB to continuously look for new innovations that will help it produce water in a simpler, more cost-efficient way.

Over the years, Singapore has built a diversified and sustainable water supply from four different sources, referred to as the Four National Taps: water from local catchment areas, imported water, reclaimed water known as NEWater and desalinated water. NEWater, an alternative water source introduced as far back as 2003, is produced by further purifying treated used water with advanced membrane technologies. It is ultra-clean and safe to drink. NEWater meets up to 30 percent of Singapore's water needs and there are plans to triple this capacity to meet up to 55 percent of future water demand by 2060.

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*Over the years, Singapore has built a diversified and sustainable water supply from four different sources, referred to as the Four National Taps: water from local catchment areas, imported water, reclaimed water known as NEWater and desalinated water.*

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In 2005, Singapore introduced another alternative water supply with the opening of the nation's first seawater desalination plant. This was followed by a second and larger desalination plant in September 2013. A third desalination plant is being built. In September 2015, Singapore announced plans to build a fourth desalination plant. In line with its goal to be water resilient, the plant will also have the capability to treat water from Marina Reservoir. PUB is also exploring the potential of building a fifth desalination plant on Jurong Island. PUB aims to expand its desalination and NEWater capacities to meet up to 85 percent of Singapore's water needs by 2060.

Similarly, Hong Kong is facing challenges on its freshwater resources, including increasing water demand arising from population and economic growth; a trend of greater fluctuation in the local yield, occurrence of extreme weather and severe drought; and rising competition for the China-mainland Dongjiang water resource due to the rapid population and economic growth in the Pearl River Delta Region in Guangdong Province.

#### **FINDING: INFRASTRUCTURE SYSTEMS WORKING HARDER TOGETHER AND YIELDING GREATER BENEFITS**

Hong Kong's Water Supplies Department (WSD) has also set out to build its first modern desalination plant to provide an extra source of water, independent of climate change. The project not only represents a shift to making the water supply more resilient through alternative supply but also explores opportunities to harness green energy that could reduce electricity costs. An industry source notes that this represents a shift to making the water supply more resilient through alternative supply. "The project is also exploring opportunities to harness green energy that could reduce electricity costs."

This trend to derive additional, tangential benefits from existing infrastructure is captured in Hong Kong's Total Water Management (TWM) strategy. For example, seawater for toilet flushing represents a historic repurposing of limited water supplies that saves about 270 million cubic metres of freshwater every year. The use of seawater for this purpose has today increased to about 85 percent coverage of the population.

In addition, Hong Kong is rethinking how recycled water could also be used within this system. WSD is exploring whether wastewater after tertiary treatment can be used for that purpose for areas that are far from the sea, hence conserving drinking water while reducing the load pumped out to sea and effectively increasing the use of freshwater for potable use.

In Singapore, this trend is also reflected in the planning for the next phase of its used water management infrastructure, the Deep Tunnel Sewerage System (DTSS). The DTSS is a long-term solution that ensures that all used water is collected for treatment and available for reuse. Phase 1 of the DTSS project was completed in 2008 while Phase 2 is ongoing and will extend the system to cover the western part of Singapore.

DTSS Phase 2 will also see the co-location of the National Environment Agency's Integrated Waste Management Facilities alongside the PUB's Tuas Water Reclamation Plant to reap the benefits of energy and resource recovery synergies, such as sharing water, biogas and electricity between the facilities. It is the first such co-location facility that has been planned from the ground up.

In China, the State Council issued a guideline in October 2015 on building sponge cities, which would enable buildings, streets and wetlands in cities to absorb, store and release rainwater like a sponge to better serve the country's urban development. "The aim of constructing such cities is to flexibly control the rainwater, address waterlogging in cities, thus achieving a city development mode during which the rainwater can be naturally stored, permeated and purified," a water leader explained. Under the guideline, cities in China will collect and utilise 70 percent of rainwater, with 20 percent of urban areas meeting the target by 2020. The proportion will increase to 80 percent by 2030.

#### **FINDING: OPTIMISING LIMITED, HIGH VALUE LAND**

Regional cities facing space constraints view these limitations as opportunities to explore compact technology as well as cavern and land reclamation developments, according to common observations by respondents.

With the upgrading of sewage treatment works, Hong Kong's Drainage Services Department (DSD) is looking into cavern design and compact technologies that are suitable. It plans to start constructing the Sha Tin Sewage Treatment Works plant in 2017-2018 and complete it in 2026-2027. In addition, DSD will be moving two other plants to caverns, effectively releasing 1.2 hectare (ha) and 1 ha of land, respectively, for alternative use including residential and commercial.

"With limited land area, Singapore faces a continuous challenge to come up with innovative solutions to create spaces for a range of uses, while keeping the island livable," said an industry leader. The implementation of the entire DTSS will result in a 50 percent reduction in land taken up by used water infrastructure once it is fully completed.

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*By 2018, Choa Chu Kang Waterworks will become the first waterworks in Singapore to use ceramic membrane technology to increase the plant's operating efficiency and reliability and one of the largest ceramic membrane plants for drinking water treatment in the world.*

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Survey respondents pointed out that one strategy is to retrofit existing water infrastructures with new technologies to optimize the space and increase the capacity of output. When the upgrading works are completed in 2018, Choa Chu Kang Waterworks will become the first waterworks in Singapore to use ceramic membrane technology to increase the plant's operating efficiency and reliability and one of the largest ceramic membrane plants for drinking water treatment in the world. Supported by rigorous studies, PUB will consider implementing both polymeric and ceramic membranes in its other waterworks when they are due for upgrade.

#### **FINDING: RETHINKING UNDERGROUND SPACES**

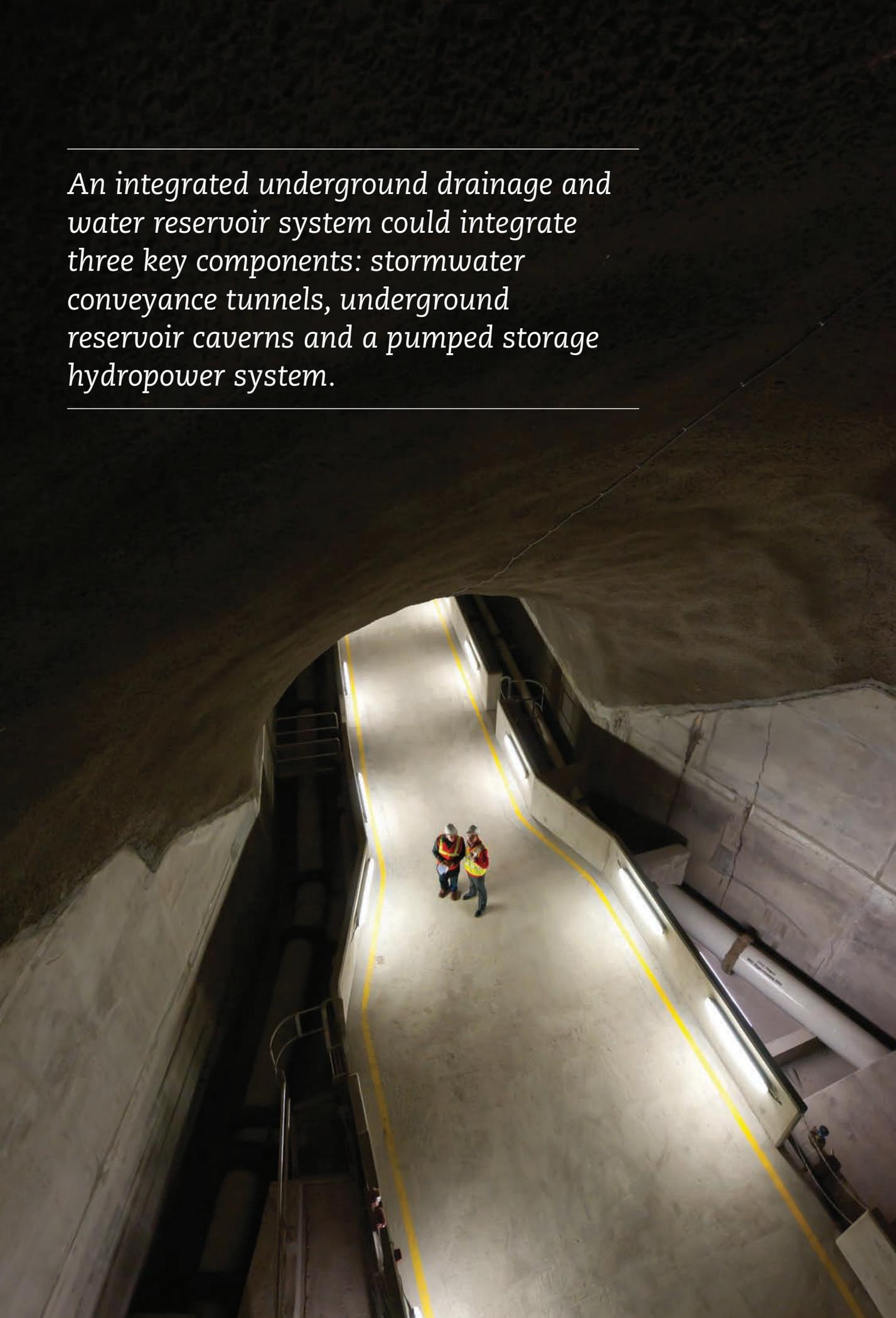
Southeast Asian water leaders say underground spaces is the other strategy identified by Asian cities. Singapore is one example where PUB is studying the feasibility of developing an integrated underground drainage and water reservoir system. This study will look into the design options for an underground drainage and reservoir system, which could integrate three key components: stormwater conveyance tunnels, underground reservoir caverns and a pumped storage hydropower system.

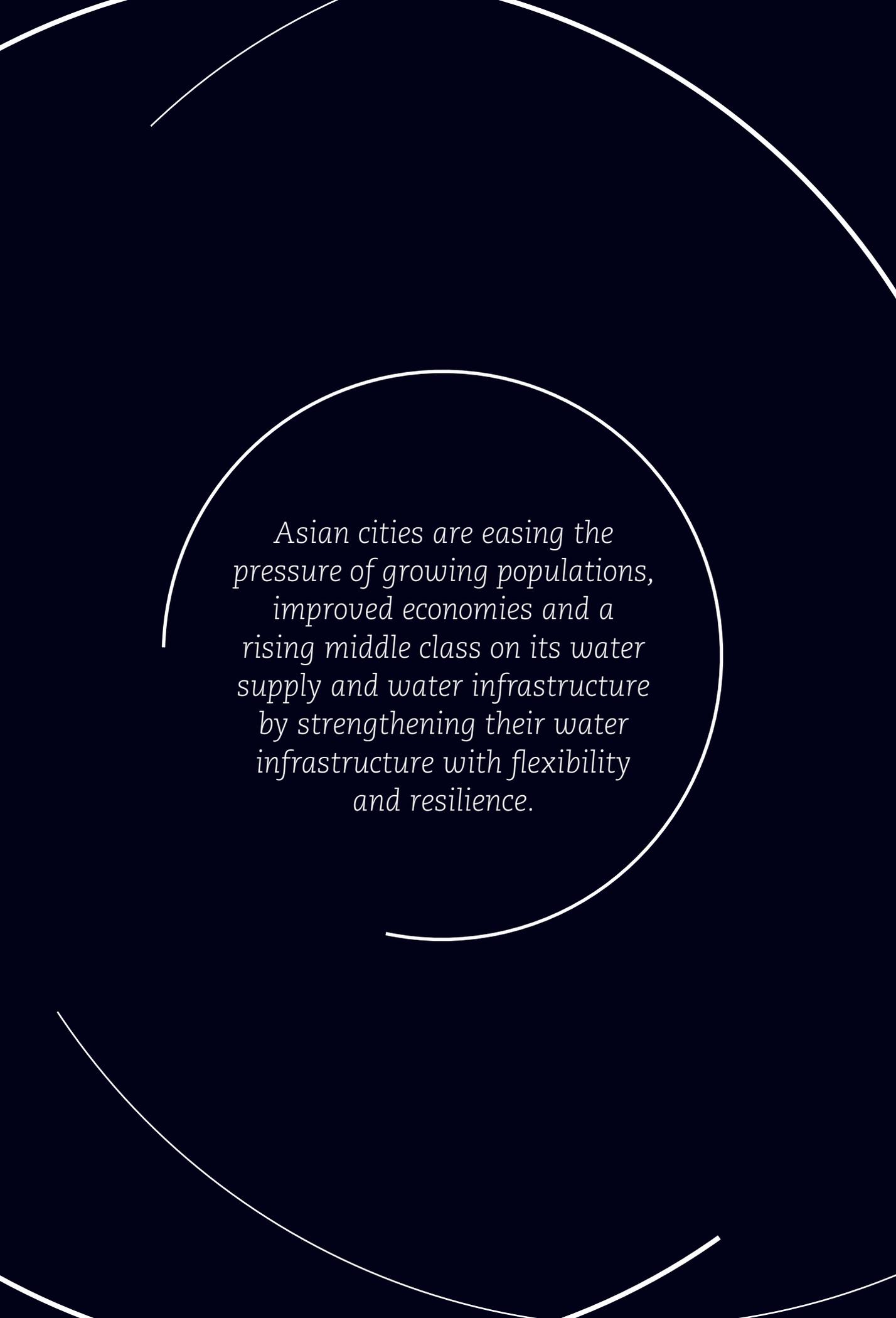
One option is to have the tunnels convey excess stormwater to underground caverns for storage. The caverns can add to Singapore's reservoir water storage and strengthen drought resilience. In addition, the study will explore the possibility of having a pumped storage hydropower system to recover energy from the flow of water from surface water bodies to the underground caverns. The study is expected to be completed in late 2017.

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*An integrated underground drainage and water reservoir system could integrate three key components: stormwater conveyance tunnels, underground reservoir caverns and a pumped storage hydropower system.*

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*Asian cities are easing the pressure of growing populations, improved economies and a rising middle class on its water supply and water infrastructure by strengthening their water infrastructure with flexibility and resilience.*

## **FINDING: DEPARTMENTS WORKING TOGETHER**

To drive these water projects, survey respondents indicate that many cities are rethinking the synergies between government departments. Hong Kong's TWM programme is based on an integrated strategy that better prepares the city for uncertainties such as acute climate changes. The strategy focuses on water conservation and developing new water resources that are less susceptible to climate change. By 2017, WSD aims to substantially complete the TWM Review, which will extend the forecast and planning horizon to 2040.

River revitalization is one of the components of the TWM programme. "The river revitalization program aims to refresh water channels by re-creating them to look like natural rivers while having higher discharge capabilities," said a water leader. In addition to the river revitalization programme, DSD is identifying rivers that can be improved for flood capabilities and revitalization for the whole of Hong Kong. It is teaming up with WSD to work on the TWM strategy. By 2020, DSD expects to have completed some river revitalization projects and to have started more remote water management assignments.

Since Singapore launched its Active, Beautiful, Clean Waters (ABC Waters) Programme in 2006, PUB has completed 32 projects at waterbodies and waterways across the island, turning Singapore's network of waterbodies and waterways into community and recreational areas. Another 54 ABC Waters-certified projects were completed by private developers and other public agencies, while over 350 organizations have adopted the blue spaces by organising activities such as learning trails and cleanups.

Survey findings conclude that through multifaceted projects and rethinking existing resources, Asian cities are easing the pressure of growing populations, improved economies and a rising middle class on its water supply and water infrastructure by strengthening their water infrastructure with flexibility and resilience.

ASIA PACIFIC  
**COUNTRIES ARE INVESTING**  
in **WATER RESILIENCE**

**CHINA**

Hong-Kong

Singapore

**AUSTRALIA**



**October 2015:**

China's "sponge" cities will enable buildings, streets and wetlands in cities to absorb, store and release rainwater like a sponge to better serve the country's urban construction. China plans to collect and use 70 percent of the rainwater, with 20 percent of urban areas meeting the target by 2020.

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China

**March 2016:**

Hong Kong is building its first modern desalination plant in Tseung Kwan O (TKO). The first stage of the proposed desalination plant will adopt reverse osmosis technology and have a water production capacity of 135,000 cu m/day.

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Hong Kong

**April 2016:**

Singapore has called for a tender to build a fourth desalination plant. To be completed by 2019, the plant will add another 137,000 cubic metres a day to Singapore's water supply. The plant will also have the capability to treat water from Marina Reservoir. It plans to have desalination and water recycling meet 85% of the nation's demands in less than 50 years.

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Singapore

**April 2016:**

Western Australia will be refurbishing 4.2 km of wastewater pipe. The A\$3.5 million project will extend the life of the pipes by at least 50 years. Trenchless technology will be used to reduce impact on the community.

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Australia

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## Smart Cities, Smart Water

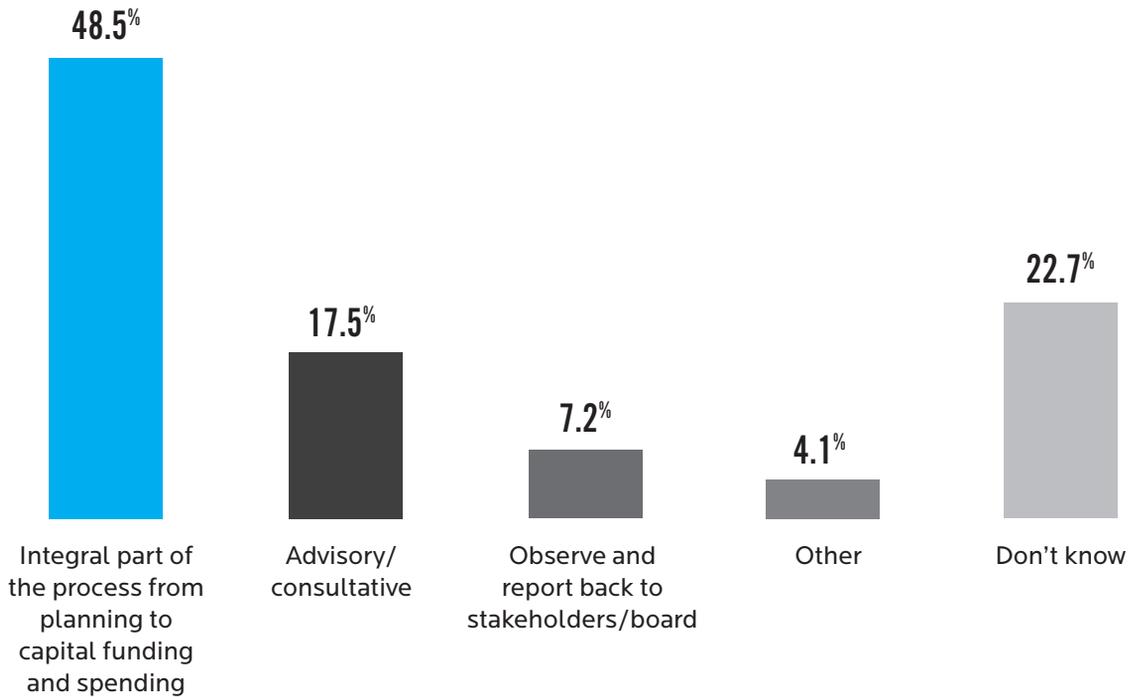
By Andrew Chastain-Howley and Andy Trump

Across the United States, smart city programs are moving beyond press releases, pilot programs and demonstrations. Municipalities are collaborating with industry and utilities to create roadmaps defining their approach to regional integrated smart infrastructure. Proactive utilities, for their part, benefit from pushing for smart city programs in ways that align with their strategic goals and investment plans. Water utilities, however, are lagging in the planning process, and risk losing their seat at the table with electric and gas utility peer companies as the smart city programs advance.

Water's current place in the smart city conversation seems out of sync with its important role in communities. Water utilities provide essential services, have a wide distributed network of facilities and assets and support numerous functions tied to electric generation, sanitation and construction among other key city services. For some utilities in drought-prone areas, municipalities have implemented advanced metering infrastructure (AMI, a component of the smart city) as a way to support conservation. Survey respondents also agree that water utilities have an integral role in developing smart cities (Figure 17). Why then, are electric utilities leading the way for utilities in smart city planning and partnerships?

Figure 17

What do you see as the water utility's role in developing "smart cities"? [All Respondents]



Source: Black & Veatch

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## *Utilities are looking at the smart city as a patchwork of siloed programs as opposed to a holistic endeavor.*

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### **DEFINING SMART WATER**

There are thousands of water utilities in the U. S., reflecting a variety of operational dynamics and circumstances that differ on the basis of region, business structure, regulatory concerns, customer culture and other drivers. In fact, something as simple as the location of a meter may help explain a utility's approach to data monitoring, collection and analysis – a key impact to smart city programs. These dynamics may also help explain why there hasn't been as much coalescing around the definition of a smart city as in other utility sectors. Instead, a few utilities with adequate investment resources act as early adopters and collaborators. These early adopters act while other utilities largely remain on the sidelines.

Water utilities may still be in the first phase of smart city program adoption. They are looking at the smart city as a patchwork of siloed programs as opposed to a holistic endeavor that aims to bring city governments, the private sectors and utilities under an umbrella of an integrated reliable, efficient and smart service delivery system. Only about 30 percent of survey respondents indicate that they are leveraging integrated systems and networks or are aggressively planning to do so. Slightly more than 50 percent are at the beginning of, or have not made much progress in, coordinating with their city counterparts on smart city plans (Figure 18).

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*Opportunities lie in coordinating with local agencies to identify what others have learned, and to leverage data collection networks and tools built by others.*

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**WHERE TO BEGIN**

Near term, water utilities indicated the biggest opportunities lie in coordinating with local agencies to work with them in identifying what others have learned, and in leveraging the data collection networks and tools that others have built (Figure 19).

Utility respondents across the board listed strong business case support and return on investment for a “smart city” initiative as among the biggest motivators for engagement in a smart city initiative. For many water utilities solving issues associated with aging infrastructure, a business case can be made that updating old resources with those capable of integrating with new, smart technologies addresses both needs at once.

There has been some progress on the innovation front. Still in the conception stage, smart water hydrants may signal the beginning of a larger trend of smart water tools. Today, AMI is the best first step. With optimal deployment, utilities can better predict customer water use to develop active and accurate water consumption information.

Financing concerns are still somewhat on the horizon. While some combined utilities have considered piggybacking water services on their private electric networks, successes are few. To date, it has not been a cost-effective solution for water-only utilities. Costs of service charges are being considered in an abstract way, but not to the extent as in the electric utility sector.

**NEXT STEPS**

Water utilities must decide to make smart city involvement a priority. This begins with education. Industry groups can play a role in educating their members so that they can understand smart city opportunities and challenges. Trade groups, for example, can play a meaningful role in coordinating the interests of members in commission-sponsored explorations, such as those being carried out by the California Public Utilities Commission in its water-energy nexus proceeding.

In Black & Veatch’s experience, proactive utilities that leverage data and innovation are better able to adapt and thrive during times of transition.

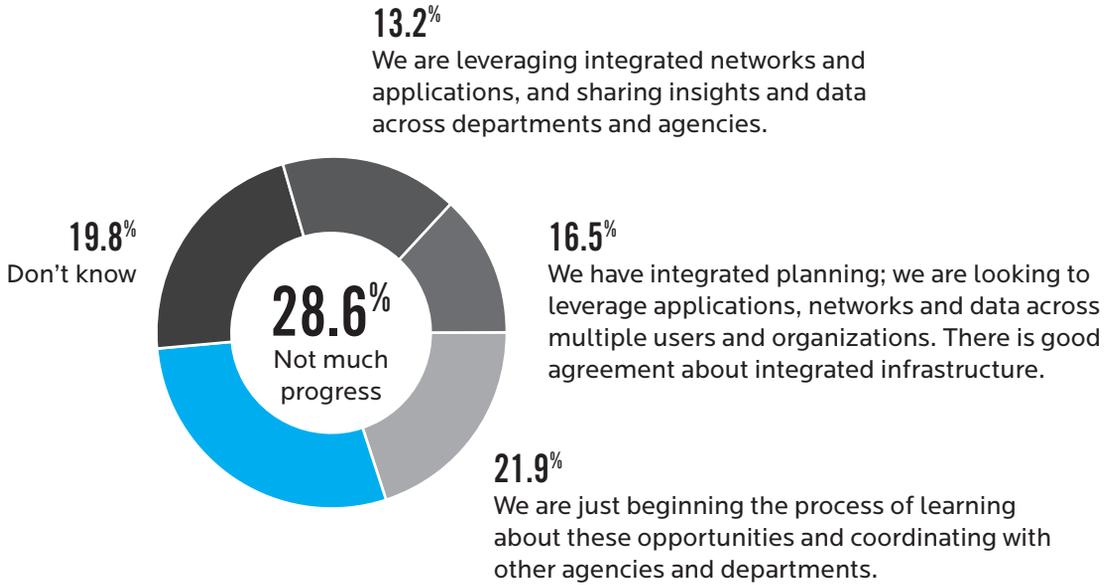
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*Solving aging infrastructure issues by updating old resources with those capable of integrating new smart technologies addresses both needs at once.*

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Figure 18

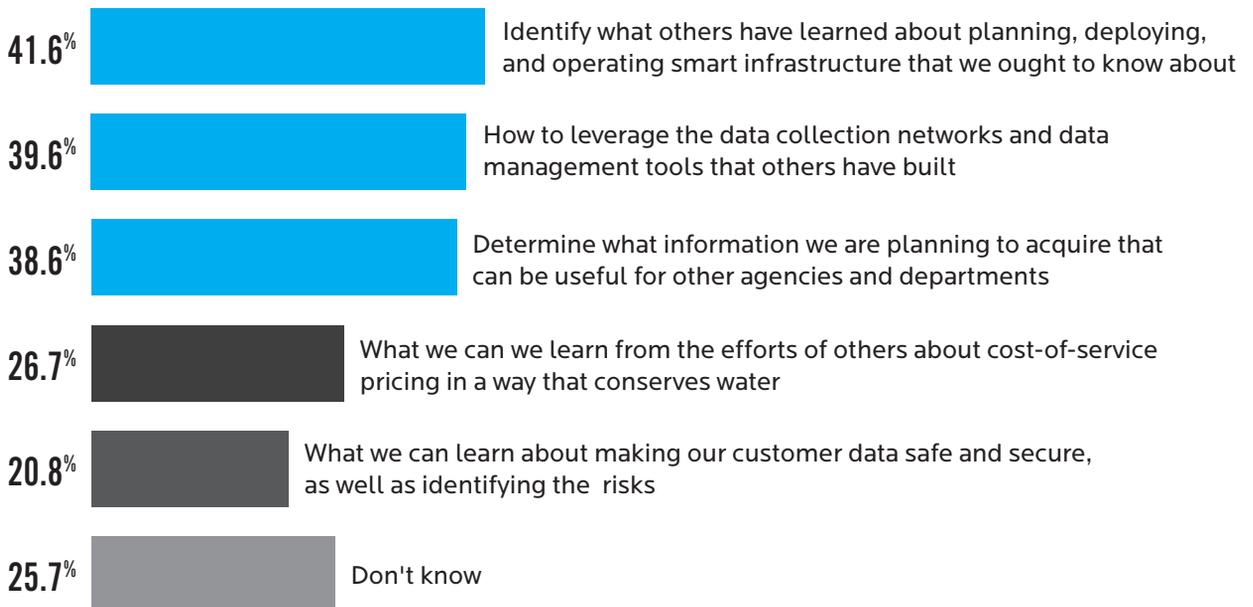
Are you working with your city/other city departments/other agencies as part of an overall “smart cities” infrastructure plan? [Water Services Providers]



Source: Black & Veatch

Figure 19

What are some of the biggest near-term opportunities for coordination with local city agencies/departments and/or other nearby utilities? [Water Services Providers]



Source: Black & Veatch

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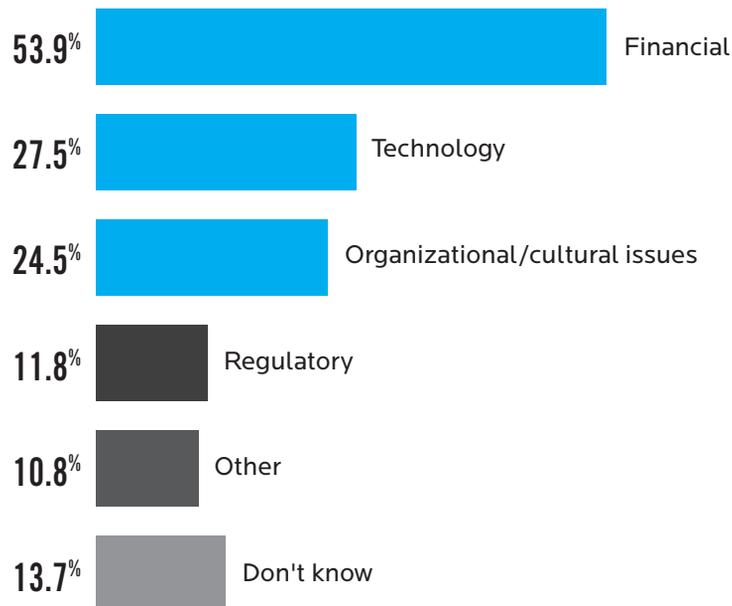
## Overcoming Barriers in Achieving Water Utility Goals for Energy Use Reduction

By Jon Doane, Scott Carr  
and Andrew Shaw

This year's *Strategic Directions: Water Industry* report shows that many utilities have high aspirations to move towards energy neutral operations, but barriers are plentiful. Costs to overcome legacy technology limitations, changing customer behaviors and variances from demographic calculations are among the key factors that impact the flexibility of existing water infrastructure systems. Fortunately, there are approaches that can help system operators make significant progress in overcoming these obstacles.

More than half of the survey respondents cited financial issues as being their major barrier to achieving energy neutrality (Figure 20). Given the age, location and complexity of many water systems, operators often feel compelled to allocate limited capital resources to address immediate needs such as leaks or regulatory mandates in lieu of investments in energy efficiency. This likely is because these responders don't believe that the return on investment in making this commitment is achievable or justifies the initial capital outlay.

Figure 20  
**What are the major barriers to achieving your energy neutrality goals? [Water Services Providers]**



Source: Black & Veatch

This finding directly ties in with technology being the second highest rated barrier as concern over a lack of high-impact energy efficiency technologies persists. However, advances in technology, both small and large scale, are making incremental energy reduction steps more accessible while lowering operating costs and expanding system resilience. Similarly, the demonstrable results of pilot programs for energy reducing blowers, valves, automation systems and data analytics platforms are building strong cases for investments. Energy-related projects are increasingly being assessed using a business case evaluation approach to determine the financial investment and the anticipated return before moving forward with implementation.

A number of major water utilities across the United States have initiated programs to advance their operations to a higher level of energy management. These programs include assessing energy efficiency master planning; developing new renewable power generation assets including biogas resources; and implementing supply-side purchasing strategies to pay less for electricity purchased from the grid. With energy costs as much as 30 percent of operating budgets and often the second largest expense behind staff, financial returns can be a compelling case for action.

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*With energy costs as much as 30 percent of operating budgets and often the second largest expense behind staff, financial returns can be a compelling case for action.*

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Cultural factors can also play a significant role in moving towards an energy neutral future. About 25 percent of survey respondents rated organizational and cultural issues as major barriers to achieving their energy neutrality goals. This may reflect resistance from utility personnel who have been operating plants for several decades, have strict mandates to meet or exceed water and effluent quality standards, and are not eager to move on to new technology that can introduce risk to their operation.

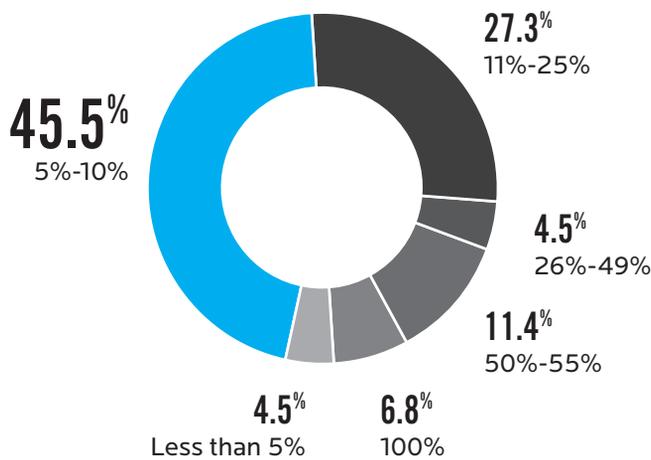
Yet, the organizational/cultural issues barrier shows that more focus is needed on communicating how smart analytics and smart integrated infrastructure improve operating performance and drive energy efficiency. This data can be used to allow the existing control systems to optimize the plant performance. As a result, it's important to provide utility management with additional information on these tools as they work to make cultural changes in their organizations.

Similarly, customer behavior can have a dramatic role in impacting the efficiency of water utility systems. Decades-old supply, treatment and distribution systems were often designed with expectations for population growth.

12 percent of respondents view regulatory issues as a barrier in reaching energy neutrality. This may reflect that their capital spending must be prioritized to meet mandated regulatory compliance programs. Additionally, some utility operators are concerned about the regulatory hurdles they face relating to required air emissions permits when running a generator using biogas. Therefore, their inclination is to invest capital in other areas of the water utility and not take the necessary steps toward energy neutrality.

In the survey, more than half of the respondents say they have energy reduction goals in place. However, the survey also shows that 46 percent of the respondents (Figure 21) have cited 5 to 10 percent energy reduction as a realistic goal. This reflects that many respondents have high aspirations but what they believe is achievable is fairly modest. However, if utilities focus on taking incremental energy reduction steps annually at even 5 percent, the cumulative savings will be very significant.

Figure 21  
**What percent reduction is your utility targeting for your energy efficiency goal? [Water Services Providers]**



Source: Black & Veatch

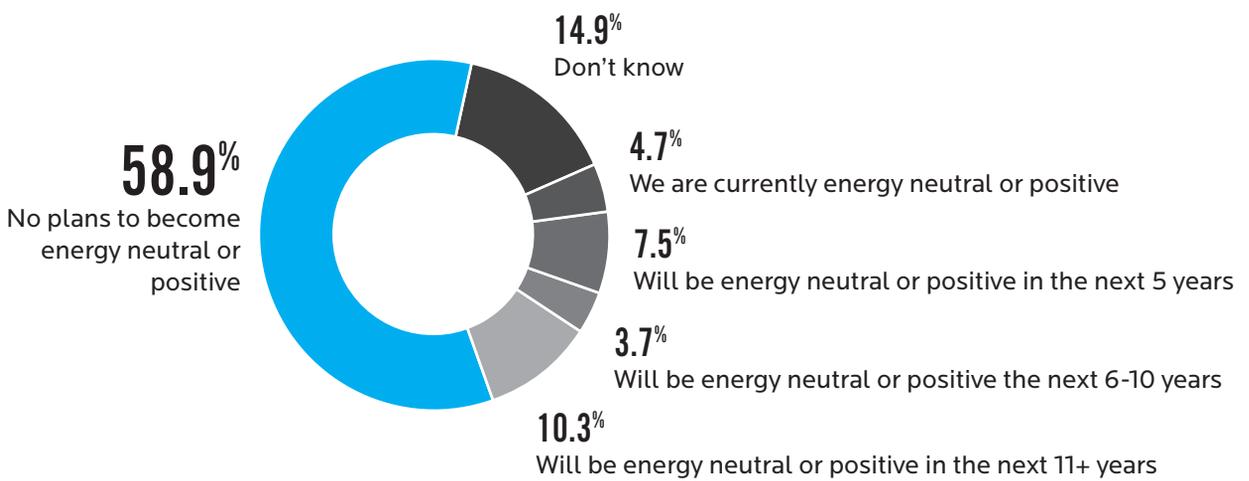
The opportunities in energy neutrality and net zero targets are central to the utilities' ability to enhance the resiliency and reliability of their operations. If a utility makes the needed changes to generate or recover some of its own power, the resiliency of its operations increases and it reduces its reliability on the electric utility that serves it.

### GOING ALL IN ON NET-ZERO ENERGY

26 percent of respondents in the survey said they are or will aim to eventually produce, on-site, all the energy needed to meet or exceed the energy required to operate their facility (Figure 22). This fits with the emerging paradigm of treatment facilities being seen as resource recovery facilities where there is more energy embedded in the wastewater than is required to simply treat it.

Figure 22

**Does your utility have a long-term goal to become energy neutral or positive (the ability to produce all energy needed to meet or exceed the energy required to operate your facility on-site)? [Water Services Providers]**



Source: Black & Veatch

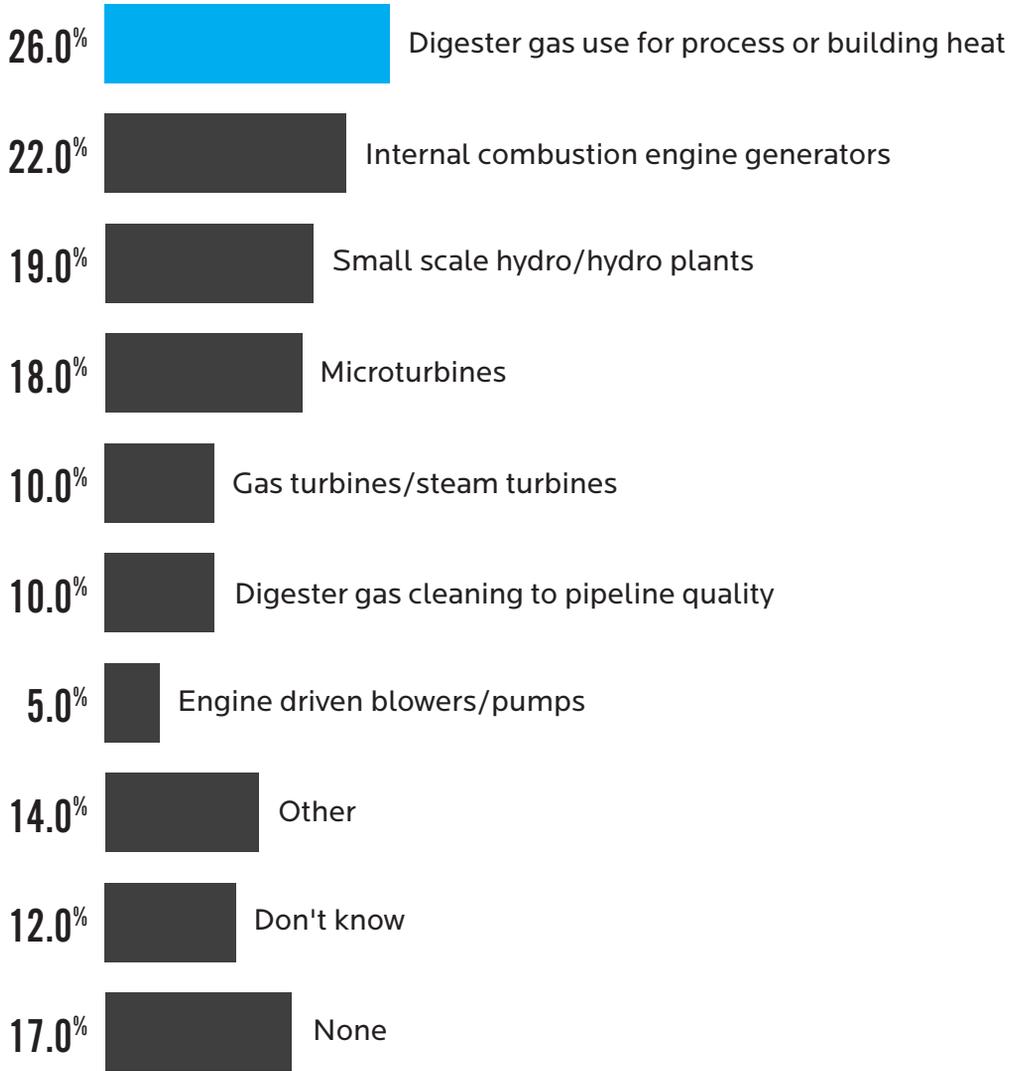
The commitment to energy neutrality will entail broader and more costly efforts that target all aspects of the utility plant. That means upgrading to more highly advanced equipment including the latest in blower technologies and aeration control valves.

Many utilities with more modest energy efficiency targets are counting on digester-gas technologies to drive their future energy recovery plans. Wastewater companies that plan to incorporate or are using microturbines to improve energy use rose to 18 percent from 12 percent in 2015 (Figure 23).

Many utilities are turning to public-private partnerships to provide much-needed funding in their drive toward energy neutrality. Black & Veatch has provided Energy Savings Performance Contracting (ESPC) for utilities such as the Upper Occoquan Service Authority, which saved approximately \$500,000 each year through work on an ESPC. The improvements included installation of cogeneration facilities and replacement of aeration blowers with high-efficiency gearless, turbo blowers, all delivered using a progressive design-build approach. Benefits to this approach to implementing energy savings include a single-source responsibility combined with the ability to adjust the final project to meet the utility's specific needs. Additionally, guarantees unique to an ESPC provide the utility certainty in the performance of the improvements and the savings generated.

Figure 23

What energy efficiency/energy recovery technologies are your organization considering or implementing?  
[Drinking Water and Wastewater Services Providers]



Source: Black & Veatch

## CONSIDERING PHOSPHORUS RECOVERY

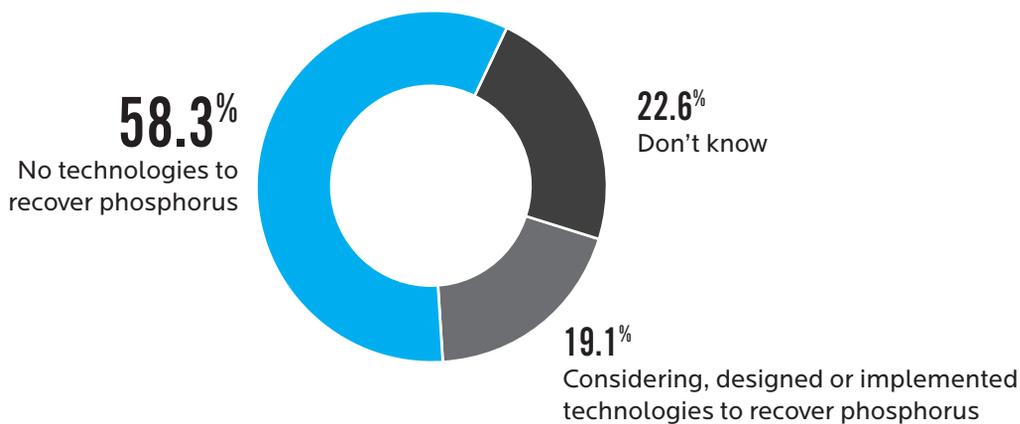
A small but steadily increasing number of utilities are considering, designing or implementing a phosphorus recovery system amid an evolving and more stringent regulatory environment on the state level (Figure 24). More than two-thirds (69 percent) of those surveyed said the main driver for implementing a recovery system is to reduce effluent phosphorus loads, and 56 percent cited the need to address environmental concerns such as sustainability.

At the Stickney Water Reclamation Plant near Chicago, for example, Black & Veatch carried out a design-build project for the Metropolitan Water Reclamation District of Greater Chicago (MWRD) to construct the world's largest nutrient recovery facility as part of the district's plan to reduce and beneficially reuse phosphorus loads at the plant. The plant uses nutrient recovery technology as a solution to manage the overabundance of phosphorus and create a revenue stream through the sale of fertilizer, the product derived from the recovery of phosphorus. The nutrient recovery facility became fully operational in mid-2016.

In a recent Insight Report, BlueTech Research investigated the market and drivers for phosphorus recovery. They concurred with the findings of this SDR, that environmental protection is the main driver for phosphorus recovery. They also highlighted that there are technology gaps in the market and that "no one solution fits all and the decision to adopt a technology or a combination of technologies will depend on local legislations, the nature of the treatment works and the needs of the company and/or its operators."

Figure 24

**Is your organization considering or has it designed or implemented technologies to recover phosphorus? [Water Services Providers]**



Source: Black & Veatch

## **FINANCING FOR THE FUTURE**

Many survey respondents also cited their concerns about declining customer water use and the resulting lower revenues to recover fixed base operating costs. Energy use reduction or energy neutrality offers the opportunity to effectively help address these financial issues.

In many cases, utility finances are structured with 80 percent being fixed costs such as plant operations, pipes and labor, among other costs. The remaining 20 percent are variable costs that depend on such factors as water use and power costs. This points to the need for taking steps toward energy neutrality even on an incremental basis.

An emerging water industry trend is a stronger recognition that the cost of system water loss is greater than the lost revenue. The energy used in water treatment and conveyance for non-revenue water volumes is essentially wasted energy. Especially in areas with high electricity costs, water utilities need to account for energy inefficiencies associated with non-revenue water as they determine the threshold for cost-effective remedial action. For many utilities, achieving lower water loss percentages can be vital for improving energy efficiency and increasing revenues.

The top three costs for water utilities are power, personnel and chemicals, with power costs often topping the list. Any steps that can be made toward reducing power costs are going to be very important in a utility's financial viability.



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## India: Ambitious Plans to Address Complex Challenges

By Anand Pattani

In developing and developed nations, a cocktail of urbanisation, changing rainfall patterns and increased affluence is putting pressure on water resources.

The scenario is common to India. A survey respondent from a major municipal water authority commented, "It is being observed due to rapid urbanisation, the water source is depleting and also contaminating. It is going to be a major concern in the coming years."

On a national level, it is estimated that India has seen a 60 percent decline in per capita availability of water in the last 50 years; while Ernst & Young predicts industry's demand for water will grow from 40.86 billion cubic metres (Bm<sup>3</sup>) in 2010 to 91.63 Bm<sup>3</sup> in 2030.

Against this backdrop, a number of government policies are influencing India's water sector. In March 2016, the central government announced R3,679 crore (U.S. \$2.466 billion) funding for a National Hydrology Project (NHP). The aim is to create a system for reliable water resource data acquisition, storage, collation and management. Unlike earlier hydrology projects, which only covered 13 states, the NHP aims to bring a more holistic approach to water management by addressing the issue at a national level.

The Smart Cities Mission is an ambitious programme to create 100 smart cities. Because the circumstances of India's cities differ greatly and the mission covers so many cities, the government has not given a prescriptive definition of a smart city. Rather it has identified common attributes that the mission seeks to foster. By including adequate water supply and sanitation in the attributes of a smart city, the Smart Cities Mission has put water centre stage.

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*The smart cities programme is brimming with potential for smart water solutions to India's urban water challenges. These include turning wastewater from a problem into a resource via water reuse.*

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The smart cities programme is brimming with potential for smart water solutions to India's urban water challenges. These include turning wastewater from a problem into a resource via water reuse. Advanced treatment technologies are used to convert wastewater streams into renewable sources of reusable water, thus relieving pressures on stressed surface and ground water resources.

Using treated wastewater for non-potable applications is a good way of introducing the concept of reuse. In recognition of this, the government is creating a market for treated wastewater. Developments include a memorandum of understanding with the Ministry of Railways to adopt reused water for cleaning rolling stock and other non-potable uses. In addition, it is now mandatory for power plants to buy effluent wastewater from treatment plants, where two plants are within a 50-kilometre radius of each other. This is significant when you consider that, typically, 2,650 litres of water per megawatt-hour (MWh) are needed for coal-fired generation; and that coal accounts for more than 75 percent of India's energy mix.

Wastewater is also an abundant source of energy. Advanced digestion of sewage increases the amount of biogas produced as a byproduct of the treatment process. The gas can be used as fuel to generate heat and power for use in the treatment process or to export to local power grids. Generating energy from wastewater supports the Smart Cities Mission's sustainability goals by increasing the use of renewable energy. Generating energy from biogas is a component of many new wastewater treatment projects.

Smart meters also have a role in preserving strained water resources. Currently, 40 to 50 percent of the water entering India's distribution networks is lost. This is largely due to leakage and illegal connections. As well as wasting a precious resource, these losses are also non-revenue water, for which the utility is unable to recover the costs of treatment and supply. High levels of non-revenue water hamper investment in India's water infrastructure.

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## *Smart metering is a highly successful way of accurately identifying water loss.*

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Smart metering is a highly successful way of accurately identifying how much water is being lost, where leaks are occurring, and the location of unauthorised connections to the distribution network. This information helps preserve a stressed natural resource and increase the income available to invest in water infrastructure. And the investment is badly needed.

Sustainable urban drainage systems (SuDS) have a potential role to play in the sanitation and sustainability components of the smart cities programme. SuDS can help mitigate flood risk and reduce the amount of pollution entering ground and surface water resources. The creation of new urban infrastructure under the Smart Cities Mission offers the opportunity to incorporate SuDS.

The intent is to mimic nature and manage the rainfall close to where it falls. SuDS usually slow water down before it enters rivers, and the slower water moves the less pollutants it carries. SuDS include land to store water in natural contours, allowing runoff to soak into the ground or evaporate – once again preventing pollutants from being carried into rivers. Incorporating reed beds and wetlands allows SuDS to filter out even more pollutants at the source.

Pollution of water bodies is widespread and dealing with it extends beyond the Smart Cities Mission. As one respondent to our survey noted, "It is becoming a problem to avoid wastewater entering streams before treatment. Whatever the precautions taken, the wastewater is polluting the lakes and other water bodies. Stringent action for discharging the wastewater directly has to be taken."



The Swachh Bharat, or “Clean India,” Mission will also help reduce levels of pollution entering water bodies. Although Swachh Bharat encompasses all aspects of waste and refuse, there is a strong focus on sanitation. This includes providing more homes with toilets, and more community toilets, to reduce the amount of domestic sewage entering water bodies through direct dumping or runoff.

In an indication of the scale of the sanitation challenge, Union Minister M Venkaiah Naidu recently announced plans to address a shortage of around 4,000 public toilets in Delhi, the national capital. The programme will be funded as part of the Swachh Bharat Mission.

Namami Ganga, the government programme to restore the River Ganga, is an even more ambitious attempt to restore and protect water body quality. Ganga, India’s most sacred river, in many ways encapsulates the water challenges, and opportunities, facing the country. At times, flows are insufficient to meet the needs of communities, agriculture and industry. At other times, flows are overwhelming, causing devastating floods. Indians venerate Ganga, recognising water is essential to life, at the same time many stretches of the river are heavily polluted.

According to the Union Water Resources Ministry, 70 to 75 percent of the pollution in Ganga is municipal sewage, with the rest coming from domestic refuse and industrial effluent. To help address the latter sources of pollution, the Union Water Resources Ministry signed a joint memorandum of understanding (MoU) in February 2016, with seven other ministries that have a role in rejuvenating the river. The MoU’s remit includes implementing zero liquid discharge systems for polluting industries such as tanneries, chemicals, pharmaceuticals and textiles.

To tackle municipal sewage, in the first phase of Namami Ganga, 118 towns were tentatively identified for the provision of new wastewater treatment works (WwTWs). In light of slower than anticipated progress for these projects, the government announced a new finance model for the WwTW programme in March 2016. Hybrid annuity-based public-private partnership funding is to be used for the WwTW programme. Under this model, part of the capital investment (up to 40 percent) will be paid by the government through construction-linked milestones and the balance will be paid through an annuity over the contract duration of up to 20 years.

India's water challenges are large in scale and complex in nature. So are the ambitious NHP, Smart Cities Mission, Swachh Bharat and Namami Ganga programmes through which the government is seeking to tackle them. As a result, the pace of progress can be slow. But change is happening, and meaningful steps towards sustainable progress are being taken.

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# CLOSING COMMENTARY

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## *Familiar Problems Carry New Urgency*

By Cindy Wallis-Lage

The world's water challenges defy borders. From Singapore and Sub-Saharan Africa to southern California and Texas, the symptoms of aging global water infrastructure create familiar but no less unsettling questions about our world's most precious commodity.

How sustainable are our systems, many of which are well past their anticipated lifecycles? How safe are they? How plentiful is our water supply?

The *2016 Strategic Directions: Water Industry Report* contains some echoes of reports past. In the United States, aging water and sewer infrastructure is again the industry's biggest challenge. And though they may rank lower, energy efficiency, the effects of climate change and energy recovery are all important issues to the industry as well. But another statistic within the report recalls a larger historic industry narrative: cost and the profound undervaluing of water among consumers.

We asked U.S. water leaders to rank their significant sustainability issues and, unsurprisingly, the maintenance of asset life is by far the top concern, with more than half of respondents citing it as their biggest concern. Maintenance, and the rest of the top five – customer rates, financial viability, maintaining service with limited resources and water conservation/demand management – are all hardwired to revenue and cost. Where does the money come from to replace aging or lead-laden lines, to keep rates palatable to consumers, to maintain reliable service?

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*The symptoms of aging global water infrastructure create familiar but no less unsettling questions about our world's most precious commodity.*

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## *How we meet the moment will determine our ability to create resilient and futureproof water delivery systems.*

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How we meet the moment will determine our ability to create resilient and futureproof water delivery systems. This starts with leadership that embraces innovative technology and financing while fully and transparently engaging customers about the economics and criticality of a safe water supply.

### **GLOBAL DEMAND RAISES EXPECTATIONS FOR SUSTAINABILITY, RELIABILITY**

These are not U.S.-only challenges. Across the world, climate change, upward demand from growing population centers and intense debates over how to properly value water are compelling industry leaders toward a new era of collaboration and innovation.

For our 2016 report, we interviewed leaders of some of the world's leading water services providers. Their responses suggest efficiency and sustainability are at the center of their thinking:

- In Singapore, the national water agency, PUB, projects the country's total demand for water will double by 2060. Recognizing that it will have to find and treat more of this resource, PUB is continuously looking for innovations that will help it produce water in a simpler, more cost efficient way. The result of that effort has been a diversified and sustainable supply that taps water in four key ways: catchment areas, desalination, imported water and reclaimed water.
- India, the world's second most-populous nation, is faced with both rural and urban population surges that are applying new urgency to the provision of clean water and sanitation services. As one of the nation's water industry leaders told us, water tables are falling as water quality issues are rising. Contamination, scarce funding options and overextended resources are but a few of the challenges in India, and similar issues affect regions like Sub-Saharan Africa, where modern water infrastructure remains in the nascent stages of development.
- Water providers in the UK are turning to data analytics and smart water programs to chart consumption, manage assets and plan for the future. It's happening amid climate and demographic changes that are affecting assets' resilience and ability to meet demand. There are parts England that now have less water available per person than Sudan or Syria. As one UK water leader told us, "We and many other utilities face the same challenge of how to build an infrastructure that is resilient to climate change, asset failure, peak demands and human interaction yet affordable to customers."

The aggressive embrace of alternative solutions in international markets may be instructive to a world whose population hubs are only getting bigger. The United Nations has projected that by 2050, roughly 2.5 billion people will live in urban areas. North America is expected to see the highest level of urbanization, with an estimated 81.5 percent urban population by 2050. Lower-to-middle income cities in Asia and Africa are expected to experience the fastest growth, while megacities of 10 million or more residents have tripled since 1990 and are expected to grow from today's 28 cities to 41 by 2030.

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## *For many utilities and municipalities, funding challenges mean long-term capital investments are sacrificed.*

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### **IN THE U.S., A STAGGERING BILL FOR DEFERRED MAINTENANCE**

In the United States, water industry leaders face another year with much of their infrastructure operating well beyond its shelf life, a problem exacerbated by extreme weather and revenue streams that can't keep pace with necessary maintenance. For many utilities and municipalities, funding challenges mean long-term capital investments are sacrificed.

Decisions to delay infrastructure replacements and improvements have led to staggering estimates of the United States' maintenance bill. According to the American Water Works Association's (AWWA) landmark study "Buried No Longer," buried infrastructure alone will require more than \$1.7 trillion in funding through 2050. This has serious implications for governments and utilities, with some communities facing a three-fold rise in their household water bills, according to the AWWA.

Impacts on customer rates alone are enough to force a drastic reshaping of the utility-to-customer relationship. If concerns over aging infrastructure sound familiar, so do calls for engaging customers as partners in the process of building safe and resilient systems. Providers have an opportunity – and, increasingly, a consumer-safety imperative – to educate stakeholders on the real value of water. This effort will require finesse, given the fact that, in many regions, water utilities are already having to do more with less amid customer fears about spiraling rates.

As painful as this year's headlines have been around water safety, and as entrenched as the deferred-maintenance approach has been, there may at last be a public mandate to address the nation's infrastructure. In the wake of Flint, consumers appear more interested than ever in how their water supply is maintained and improved.

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## *In the wake of Flint, consumers appear more interested than ever in how their water supply is maintained and improved.*

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The decades-long gap between the last federal government grant program that paid for water infrastructure improvements and today's post-recession financial climate has ushered in a new interest in financing innovation. Goldman Sachs, for example, helped structure a first-of-its-kind financing strategy for DC Water. Its 100-year bond -- issued with an independent option in the U.S. market -- may be the first of many alternative financial solutions explored by municipalities in the years ahead. It is also an example of giving customers the opportunity to invest in the infrastructure that serves them. Other cities are actively exploring public-private partnerships, which pairs the public need for upgraded systems with private investor capital.

## A CALL TO ACTION

While customer engagement on this crucial issue of cost carries risk on many levels, it is a conversation that must happen if the nation is to finally address its outdated systems.

The scale and nature of the challenges in the water industry – from climate change to legacies of underinvestment – call for alignment, leadership, shared responsibilities and collaboration that goes beyond business-as-usual. Water leaders from governments, cities, utilities, international organizations, financiers, solutions providers, and end-users must now address – in tangible, collaborative ways – how the industry can come together more effectively and overcome water challenges faced by cities throughout the world.



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