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2014 STRATEGIC DIRECTIONS: U.S. WATER INDUSTRY

A Black & Veatch Report





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Welcome to the 2014 Black & Veatch *Strategic Directions: U.S. Water Industry* report. Our third annual report for the water industry provides essential information for overcoming challenges associated with limited budgets, rising costs, aging infrastructure and the need for critical water systems to have greater resiliency against new weather norms.

As we reviewed survey results and prepared this analysis, two common themes emerged. First and foremost, the industry is in dire need of solutions that bridge the significant gaps associated with utility budgets, resiliency, capital improvement programs, customer education and rates.

The second theme focuses on efficiency for all aspects of water system management and operations, including energy use, water use, capital spending and business process enhancements. This theme was first noted in our 2013 report, where more than 90 percent of industry leaders stated they are adopting/implementing or planning to adopt/implement best practice asset management programs.

New to this year's report are regional viewpoints and analysis. While aging infrastructure remains the top industry-wide issue, each region has its own unique challenges that are intensified as a result of degrading buried infrastructure systems. Our regional perspectives provide potential solutions for noted challenges based on the viewpoints of Black & Veatch subject matter experts living and working within each region.

Bridging existing gaps within the industry, generating efficiencies and building greater resiliency are the hallmarks of the next-generation water utility. Achieving each of these requires new thinking about how we generate revenue; how we plan and finance capital improvements; and how we manage the day-to-day operations of our systems. This report provides recommendations and highlights best practices that can help utilities achieve their strategic goals.

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

Sincerely,

CINDY WALLIS-LAGE | PRESIDENT

Black & Veatch's water business

JOHN CHEVRETTE | PRESIDENT

Black & Veatch's management consulting business



THE ECHO PARK LAKE REHABILITATION PROGRAM IN LOS ANGELES DEMONSTRATES THE VALUE AND BENEFIT OF PRESERVING OR RESTORING WATER HABITATS.

THE BLACK & VEATCH ANALYSIS TEAM

EXECUTIVE SUMMARY

Ralph Eberts is the Executive Managing Director for the Americas region within Black & Veatch's water business. During his more than 30-year career with Black & Veatch, Eberts has established himself as a recognized global water industry thought leader. He has served as Managing Director for the Asia-Pacific region and has overseen notable projects such as the Bundamba Advanced Water Treatment Plant in Australia and the Hyperion Treatment Plant Expansion for the City of Los Angeles. Eberts is based in the company's San Francisco office.

UTILITY RATES AND REVENUES

Michael Orth is a Senior Vice President and Managing Director for the Americas Central Region for Black & Veatch. Orth specializes in developing sustainable solutions that meet or exceed client expectations and needs. He has more than 25 years of experience in designing, managing or otherwise supporting, water treatment projects and programs. This experience includes regulatory evaluation, process modification and alternative disinfection processes. Orth is based in Kansas City, Missouri office.

William Ziebertz is a Director in Black & Veatch's Municipal Rate Consulting Practice. With more than 25 years of consulting experience within the water industry, Ziebertz' diverse experience includes rate, planning, impact fee, valuation and feasibility studies for water, wastewater, stormwater, solid waste, natural gas, and other local government projects. He also provides evaluations of funding alternatives and projections of population and economic growth, among other services. Ziebertz is based in Atlanta.

INTEGRATED WATER MANAGEMENT

Les Lampe, Ph.D., leads Black & Veatch's Global Water Resources practice. With more than 40 years of experience in the field of water resources, Dr. Lampe specializes in all aspects of water supply and flood control. He is currently directing major global water supply planning projects that involve all components of Integrated Water Management. Dr. Lampe is based in the company's World Headquarters located in Overland Park, Kansas.

CREATING AN INTELLIGENT WATER UTILITY

Kevin Cornish is an Executive Consultant and Black & Veatch's Operational Technologies Consulting Practice Lead, supporting technology initiatives for utilities. With nearly 30 years of experience, Cornish focuses on many of the smart technologies and advanced applications that comprise the Smart Grid solution set, particularly smart metering, advanced metering infrastructure (AMI) solutions, data management and the underlying telecommunications networks and related technologies. Cornish is based in the company's San Francisco office.

Jeff Neemann is the Director of Water Treatment Technology for Black & Veatch, specializing in the development and application of advanced water treatment technologies. He is an inventor on two patents for limiting bromate formation during ozonation. With more than 15 years of process engineering experience, Neemann has been involved in the evaluation, pilot testing, design and operation of a variety of treatment technologies and is based in Black & Veatch's Kansas City, Missouri office.

Jeff Buxton is an Executive Consultant at Black & Veatch, specializing in advanced technology solutions for utilities, including AMI, data analytics, MDMS and DMS. Buxton's more than 30 years of experience encompasses strategic business planning, technology roadmap planning, IT

infrastructure management and change and operations management, among other areas. He is based in Philadelphia.

ASSET MANAGEMENT

James Strayer is an Associate Vice President and Department Manager for Infrastructure Planning and Asset Management. He has more than 20 years of experience related to infrastructure planning, asset management and designing conveyance facilities for all types of water systems. Strayer is based in the company's Kansas City, Missouri office.

Will Williams is the Director of Black & Veatch's Asset Management consulting practice. He has more than 20 years of experience in asset management planning, including asset failure analysis, risk assessment, performance benchmarking, maintenance optimization and business change management, among other areas. Williams is based in Atlanta.

Jeffrey 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 United States and is based in the company's in the Burlington, Massachusetts office.

Martin Jones is a Principal Consultant within Black & Veatch's Asset Management practice, specializing in water utility asset management, regulatory audit and wastewater engineering. Throughout his 15-year career, Jones has undertaken a variety of asset management projects, including asset maturity assessments, asset valuations, PAS 55 implementation and strategy development. Jones is based in Atlanta.

REGIONAL VIEWPOINTS

Kyriacos Pierides is an Associate Vice President at Black & Veatch and has more than 25 years of experience. Pierides specializes in wastewater treatment facility design and is based in New York City.

Rafael Frias is a Client Director at Black & Veatch and has more than 15 years of experience. Frias specializes in the management of water resources projects, including water supply, water treatment, hydropower and stormwater planning and design. He is a national Board member of the America Water Resources Association (AWRA) and is based in Sunrise, Florida.

Bruce Allender is the Chief Operating Officer of the infraManagement Group (iMG), a wholly owned subsidiary of Black & Veatch. Allender works with utilities to develop public-private partnership (PPP) opportunities and to identify alternative financing options that support sustainable water infrastructure development. He is based in Kansas City, Missouri.

COMMENTARY

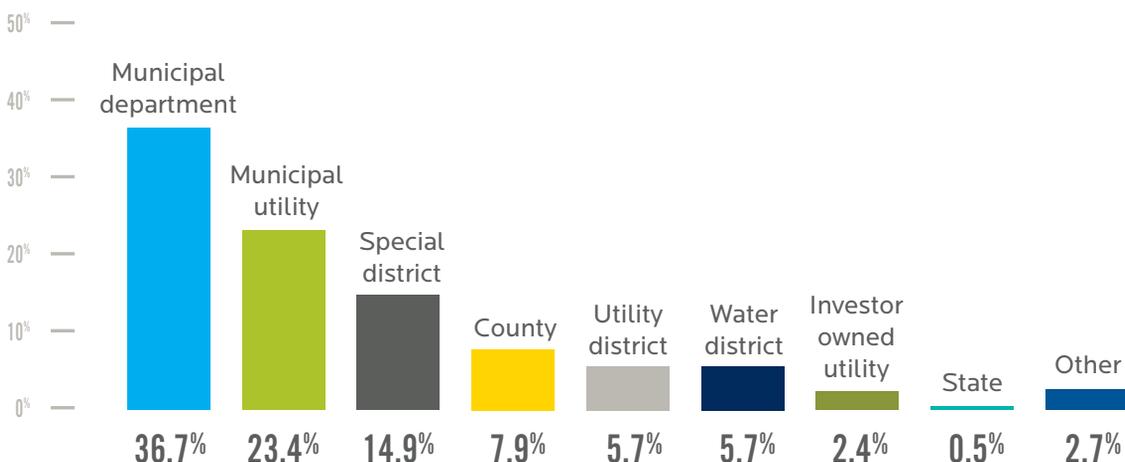
Cindy Wallis-Lage is President of Black & Veatch's water business, leading the company's efforts to address billions of dollars in water infrastructure needs around the world. Wallis-Lage joined the company in 1987 and has provided project and leadership expertise to more than 100 municipal and industrial facilities throughout the United States, the UK and Asia Pacific. Wallis-Lage joined the Black & Veatch Board of Directors in 2012. She is currently on the Board of Directors for the WateReuse Association.

2014 REPORT BACKGROUND

The third annual Black & Veatch *Strategic Directions: U.S. Water Industry* report is a compilation of data and analysis from an industry-wide survey. This year's survey was conducted from March 3 through April 4, 2014. A total of 368 qualified water industry participants completed the online questionnaire.

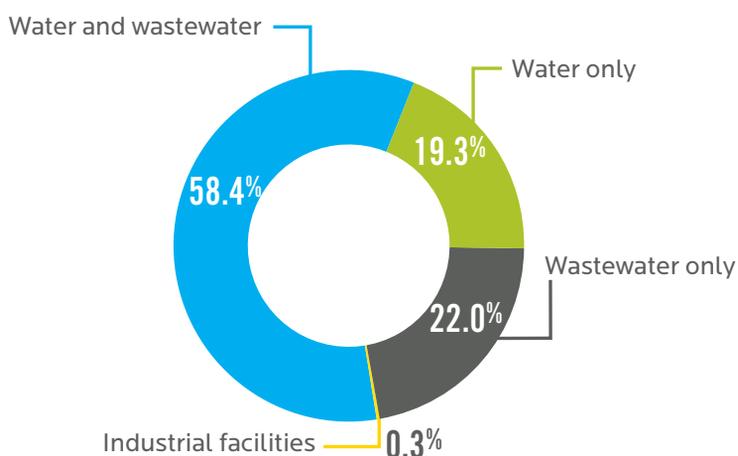
Statistical significance testing was completed on the final survey results. Represented data within this report have a 95 percent confidence level. The following figures provide additional detail on the participants in this year's survey.

RESPONDENTS BY TYPE OF ORGANIZATION



Source: Black & Veatch

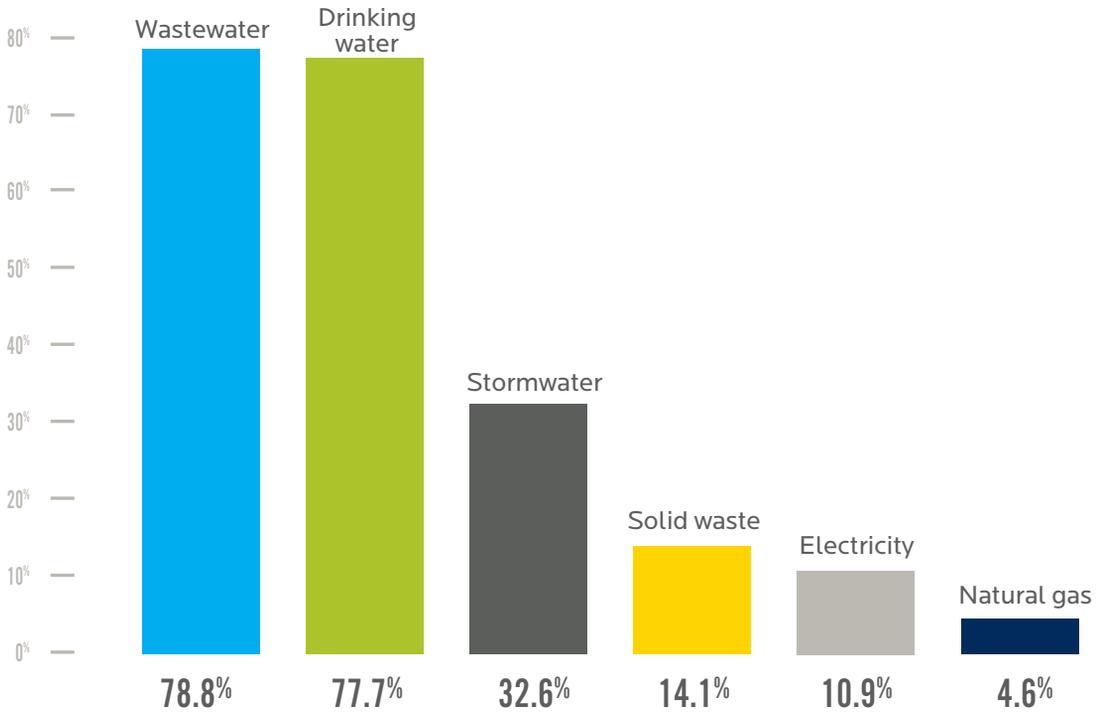
INDUSTRY RESPONDENTS BY TYPES OF SYSTEMS AND/OR PLANTS



Source: Black & Veatch

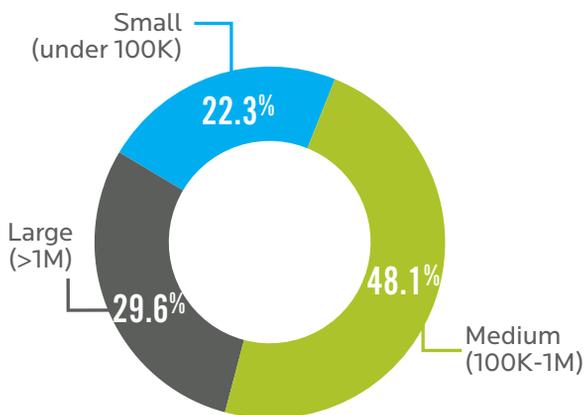
Because of the small sample size, report analysis does not include comparisons of data from industrial facilities.

RESPONDENTS BY SERVICES PROVIDED



Source: Black & Veatch

RESPONDENTS BY SIZE OF POPULATION SERVED

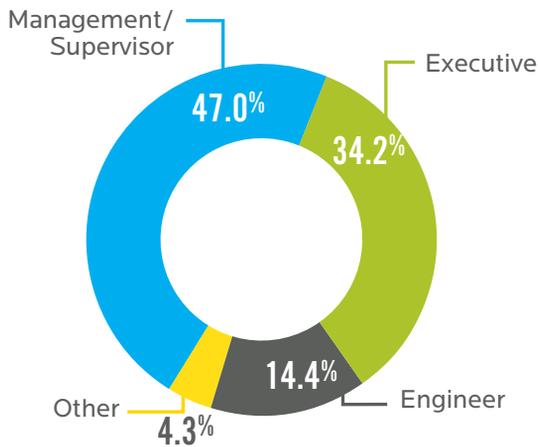


Source: Black & Veatch

Within applicable sections of this report, Black & Veatch analysis will examine the differences between water utility service providers who serve large, medium and small populations.

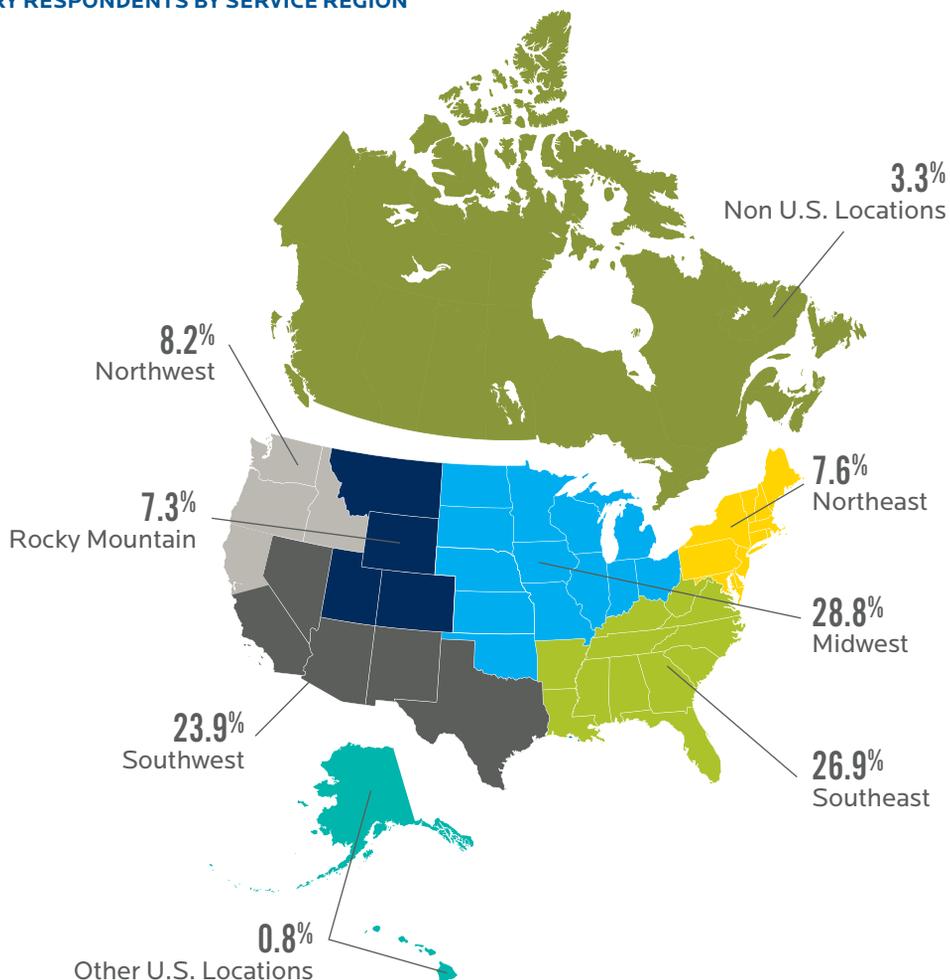
INTRODUCTION

RESPONDENTS BY JOB FUNCTION



Source: Black & Veatch

INDUSTRY RESPONDENTS BY SERVICE REGION



Source: Black & Veatch

NOTE: Because of the small sample size of respondents that represent organizations in Alaska, Hawaii and the U.S. Virgin Islands (collectively referred to as "Other U.S."), as well as Canada and Mexico (Non-U.S.), this report will only provide regional data comparisons from within the continental United States.



THE AMERICAN SOCIETY OF CIVIL ENGINEERS ESTIMATES THAT THERE ARE 240,000 WATER MAIN BREAKS PER YEAR IN THE UNITED STATES, DEMONSTRATING WHY AGING INFRASTRUCTURE IS THE PERENNIAL TOP INDUSTRY ISSUE.

COMMON ISSUES, DIFFERENT NEEDS

BY RALPH EBERTS

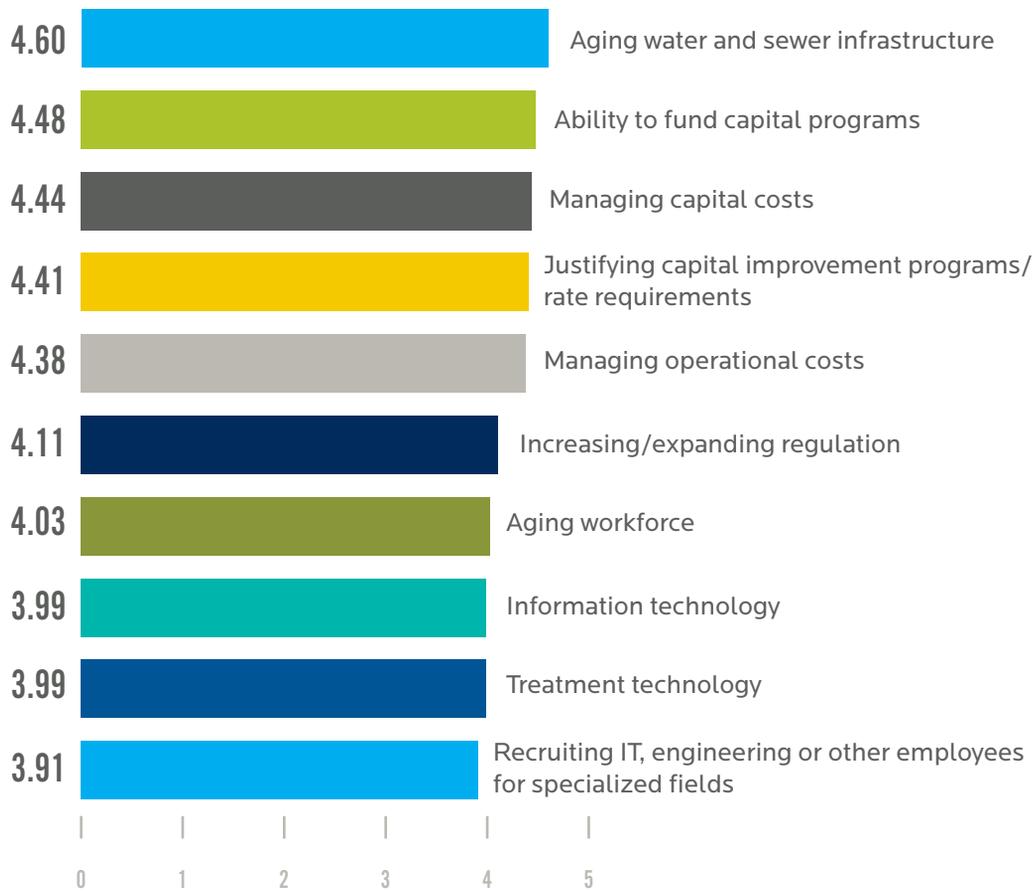
The United States is rich in geography, climates, natural resources and beauty. The communities that collectively make up individual states are as unique as the habitats in which each are located. Our communities each have unique economic drivers, population trends and opportunities resulting in different priorities and approaches to overcoming challenges. Despite our differences, many similarities remain, particularly as they relate to our water resources and infrastructure.

Aging infrastructure, managing operational costs, availability of funding and managing capital costs remain among the top five industry issues at a national level (Figures 1 and 2). Not surprisingly, these issues are also in the top five issues for each geographic region and population demographic. While the gap between current water infrastructure investment and total need is an area of common concern, the difference is why these issues are pressing needs for communities from California to the Carolinas.

Perennial water scarcity issues within the Rocky Mountain and Southwest regions bring intense focus on fixing leaks in aging infrastructure to conserve water resources. In regions such as the Northeast and Midwest, where water is typically plentiful, the drivers for rehabilitating aging infrastructure tend to be based on meeting regulatory requirements and/or improving operational efficiency and resiliency.

AGING INFRASTRUCTURE, MANAGING OPERATIONAL COSTS, AVAILABILITY OF FUNDING AND MANAGING CAPITAL COSTS REMAIN AMONG THE TOP FIVE INDUSTRY ISSUES AT A NATIONAL LEVEL.

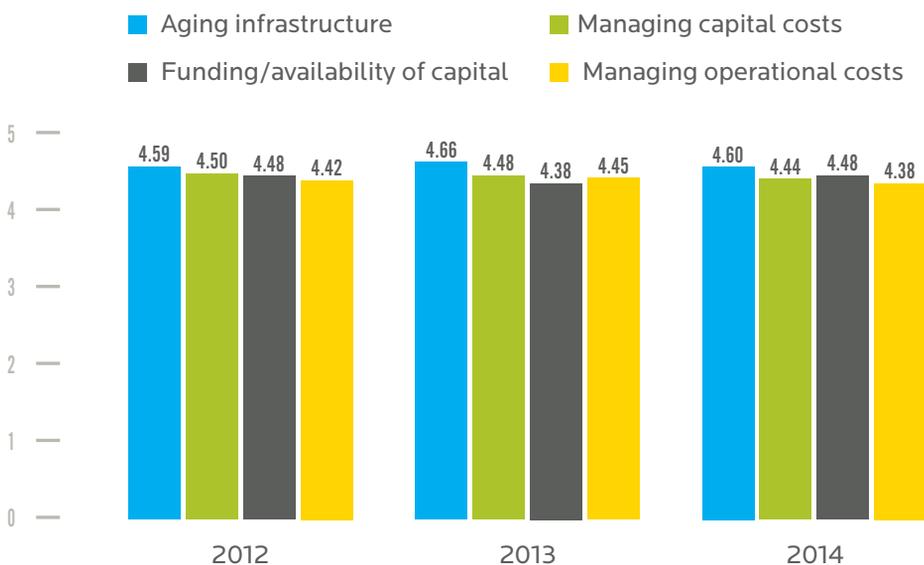
FIGURE 1
TOP 10 INDUSTRY ISSUES



Source: Black & Veatch

Participants were asked to rate the importance of a variety of issues using a scale of 1 to 5, where 1 indicates “Very Unimportant” and 5 indicates “Very Important.” This chart provides the 10 industry issues that received the highest rating based on the mean value for each item among all survey participants.

FIGURE 2
THREE-YEAR COMPARISON OF TOP INDUSTRY ISSUES

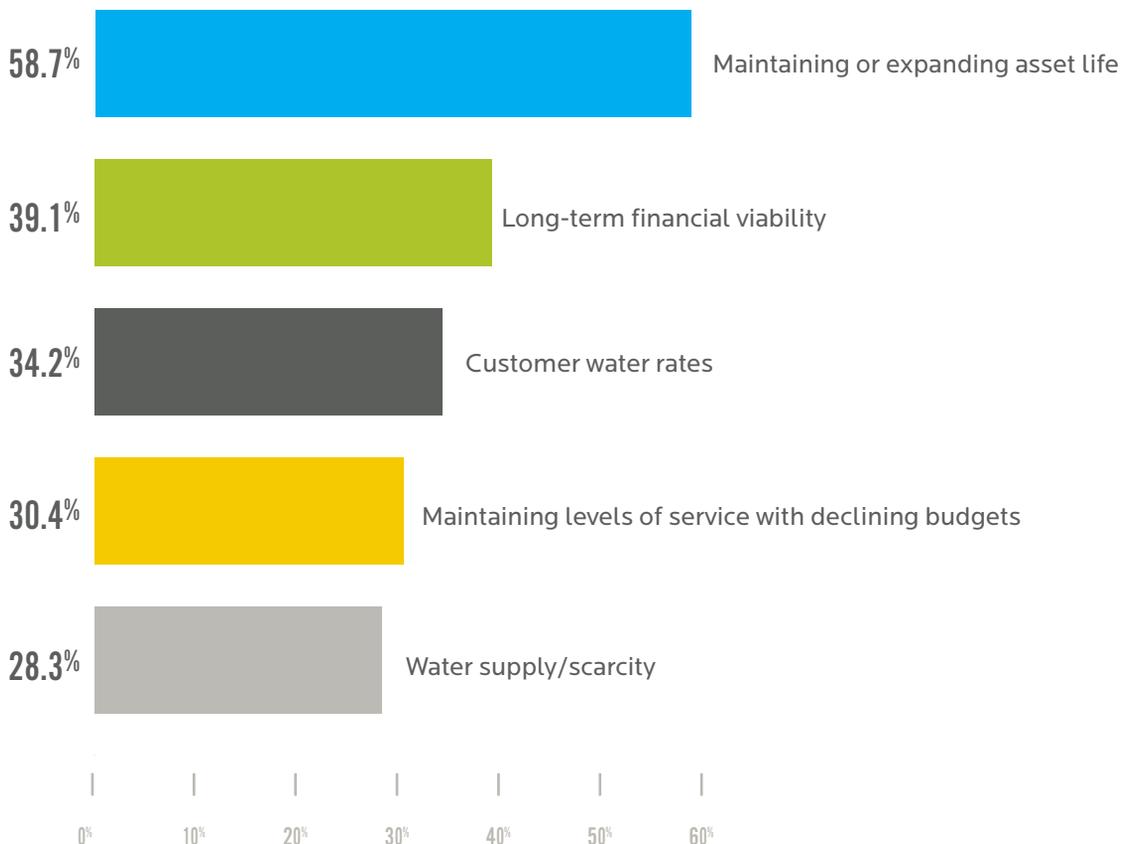


Source: Black & Veatch

This chart provides a comparison of the rankings of perennial top industry issues during the last three years. Aging infrastructure remains the top issue for the third consecutive year.

EXECUTIVE SUMMARY

FIGURE 3
MOST SIGNIFICANT SUSTAINABILITY ISSUES



Source: Black & Veatch

Respondents were asked to select the three most significant sustainability issues for their utility from a broad list of choices. This chart highlights the five issues selected most among all respondents.

Ageing infrastructure and the challenge of managing capital costs align with the industry's most significant sustainability issues (Figure 3), as illustrated by the top two issues: maintaining or expanding asset life and long-term financial viability.

Ageing infrastructure, regulatory mandates and/or water scarcity in combination with economic downturn and financing challenges have caused sustained financial stress for the industry. Not surprisingly, the issue of customer water rates is among the top sustainability concerns for nearly all geographic regions and population demographics. The ability to justify capital improvement program needs and necessary rate adjustments requires

public education on the value of water resources and the cost of providing water services. These issues are examined in the *Bridging Industry Gaps* section.

The *Gaps in Water Financing Now More Pronounced than Ever* analysis details specific challenges and opportunities for utilities regarding revenues from rates and different ways for managing capital programs and costs. Regardless of utility size or geographic location, the collective water industry in the United States must do a better job of engaging its stakeholders and educating them on the true cost and value of providing reliable and safe service.

The value of water has become apparent in California, Texas and other areas of the country, such as southern Florida, where water scarcity is part of the daily discussion. Survey results indicate the need for a sense of urgency to shore up alternative forms of water supply, such as reuse, to address water scarcity. The *Keys to Sustainable Water Supply: Reduce, Reuse, Recover* analysis highlights the need for public outreach efforts on the same level as the need for diversified water supply portfolios.

Beyond challenges with public awareness and acceptance of necessary infrastructure solutions is the need for operational improvements, covered within the *Gaining Operational Efficiencies* section. Managing operational costs has maintained its position within the top five industry issues for three consecutive years. The application of technological solutions to automate processes and enhance efficiencies is an area of growth and opportunity within the industry. The *Creating an Intelligent Water Utility* analysis details the advantages of investments in advanced metering infrastructure and distribution technologies that can drive down operational expenses.

Based on traditional U.S. water utility management practices, there is no clear path for overcoming the totality of today's most pressing issues. If a water utility seeks to move forward with large-scale infrastructure renewal programs, customers may balk at proposed rate increases. However, utilities that do not renew their infrastructure will experience a greater number of water main breaks that disrupt traffic and community services. Water main breaks require emergency repair budgets to fix. Larger emergency repair budgets may come at the sacrifice of other budgeted maintenance items. The social and economic impact to the end users can also be significant.

Breaking the cycle of deferred maintenance; generating understanding and acceptance of necessary improvements and subsequent rate adjustments; and implementing meaningful operational cost reductions can all be achieved through the use of best practice asset management frameworks. The first step in meeting current and future needs, however, is for utility and community leaders to know the tools are available.

Previous Black & Veatch industry surveys demonstrated the desire for improving asset management across the industry. However, as noted in the *Top Water Infrastructure Issues Solved through Asset Management* analysis, awareness of standardized frameworks and methodologies for such programs is severely lacking. To educate the industry on the opportunities available in the area of improved asset management, this report contains descriptions, benefits and limitations of four different frameworks.

Best practice asset management truly is the foundation toward creating a sustainable water utility. New to this year's report is the inclusion of a *Regional Viewpoints* section. This section provides an overview of the most pressing issues within specific regions and ideas for solving each as viewed by the Black & Veatch professionals who call these regions home. Each region references the value of best practice asset management as an essential tool for meeting current and future challenges.

REGARDLESS OF UTILITY SIZE OR GEOGRAPHIC LOCATION, THE COLLECTIVE WATER INDUSTRY IN THE UNITED STATES MUST DO A BETTER JOB OF ENGAGING ITS STAKEHOLDERS AND EDUCATING THEM ON THE TRUE COST AND VALUE OF PROVIDING RELIABLE AND SAFE SERVICE.

GAPS IN WATER FINANCING NOW MORE PRONOUNCED THAN EVER

BY WILLIAM ZIEBURTZ AND MICHAEL ORTH

Picture, if you will, a typical service-oriented business in the United States. This business has high fixed costs, slow growth and flat or declining revenues. Maintaining the service this business provides requires tremendous capital investments to sustain its operations. Under such circumstances, this business would experience difficulties in attracting capital and talent, and over the longer term, be at substantial risk of closure. Closure, however, is not an option for community water utilities, the majority of which face similar challenges and circumstances.

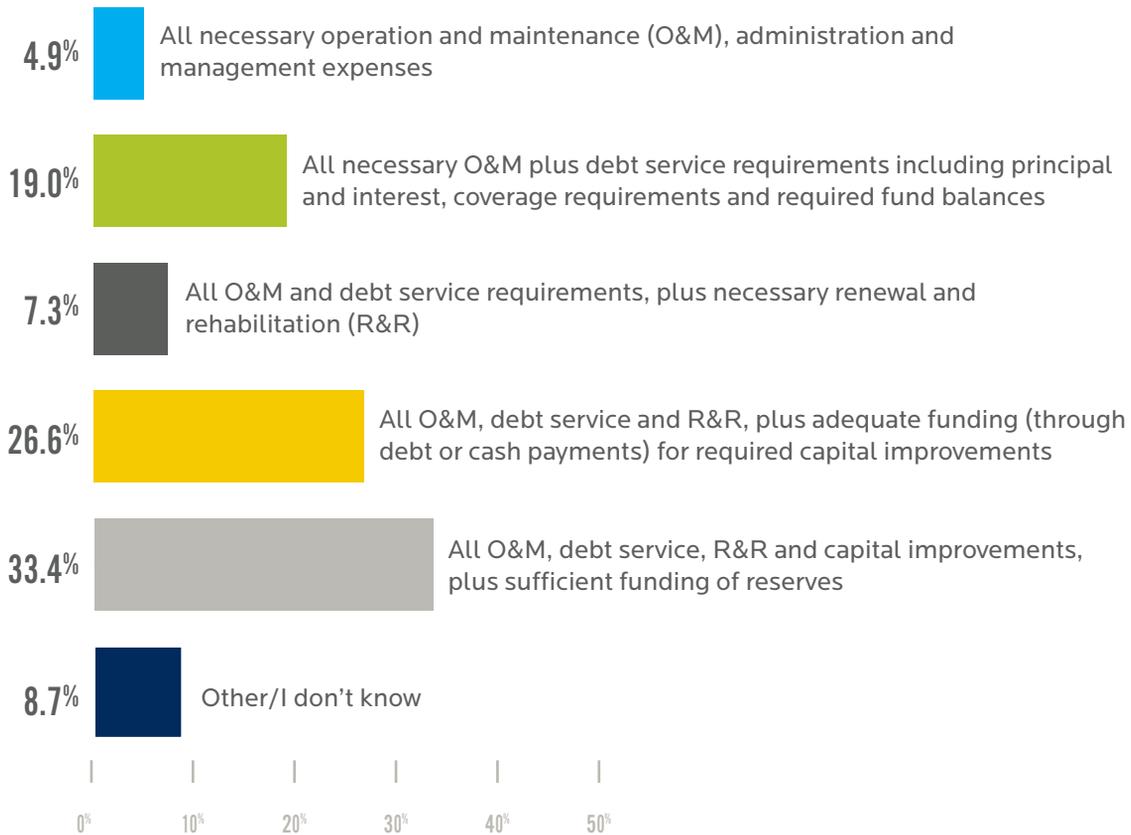
The fundamental issue of constraints to customer water and sewer rates increases is the driving force behind continued deferred maintenance, insufficient capital spends and run-to-fail management practices in effect at many utilities. Difficulties in raising rates is a contributing factor, too. Survey results indicate that only one-third of utilities in the United States have in place a revenue or rate structure that covers all of the components necessary for a financially sound business operation (Figure 4).

During the last five years, utility revenues have been further affected by consumer conservation measures, slow growth in the housing market, drought conservation measures and loss of industrial or commercial demand (Figure 5). While conservation measures are a positive development for the environment and can even help reduce utility operational costs, the financial viability of the organization can be challenged as a result of lower revenues from reductions in demand.

The gap between need and current resources within utility finances is pronounced. More than 60 percent of all respondents indicated their organization requires an annual rate increase of 5 percent or more each year in order to cover all fixed costs, operational and maintenance needs, funding for capital improvement and contributions to reserve funds (Figure 6).

Astonishingly, more than 20 percent of respondents suggest that rate increases of 10 percent or more are needed every year for the next 10 years in order to cover costs. This would amount to a doubling of current rates in roughly seven years, and in many cases may reflect decades of rate increase deferrals and/or large-scale environmental compliance programs. This large respondent base should offer some solace to water leaders as it indicates that they are not alone in requesting sustained rate increases.

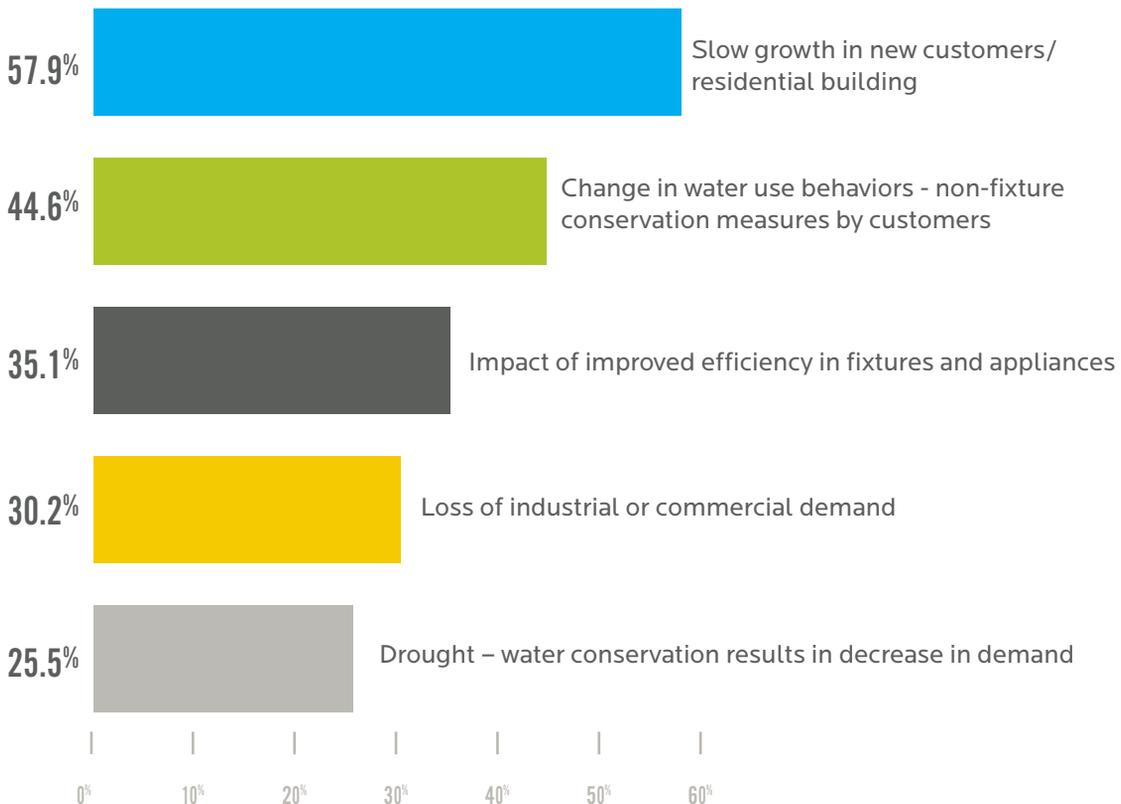
FIGURE 4
COVERAGE LEVELS FROM CURRENT UTILITY REVENUES



Source: Black & Veatch

Respondents were asked to select the option that best describes the coverage level achieved under their current revenue/rate structure.

FIGURE 5
TOP ITEMS THAT HAVE NEGATIVELY IMPACTED REVENUES DURING THE PAST FIVE YEARS



Source: Black & Veatch

Respondents were asked to select from a list of options all of the items that have negatively impacted their utility's revenue stream during the last five years. This chart highlights the top five issues among all survey respondents.

BRIDGING INDUSTRY GAPS

CAPITAL FINANCING AND IMPLEMENTATION

The need to stabilize and increase revenue to sustainable levels is only half of the water utility finance equation.

The industry may be reaching a tipping point for critical infrastructure rehabilitation, replacement and expansion.

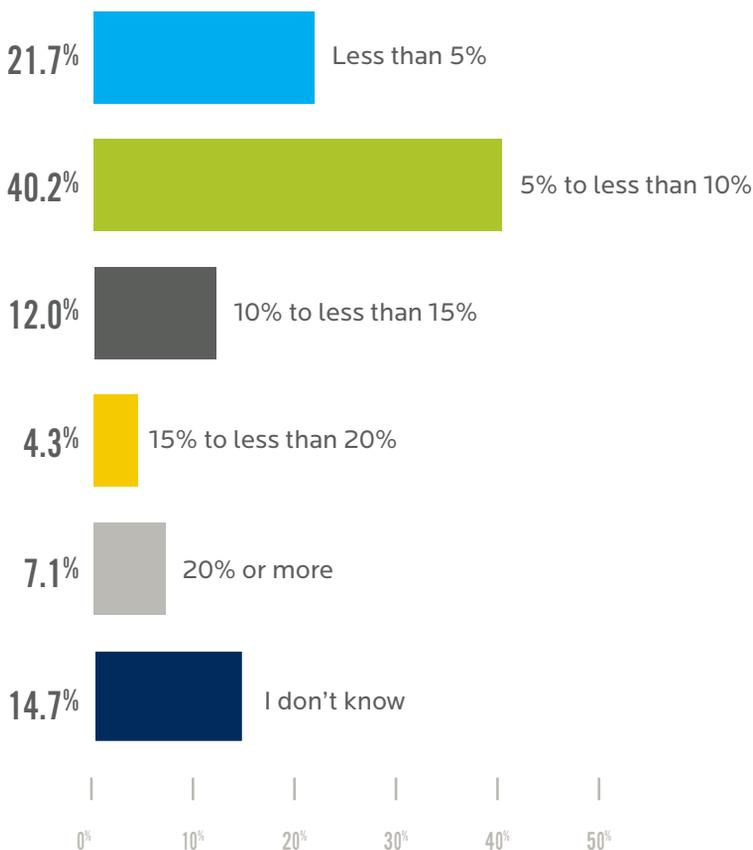
Regardless of investment drivers, such as water conservation, reuse and potentially desalination in water scarce regions, or massive programs to meet federal and state regulations that protect source water, innovation in how these investments are financed is necessary.

Utilities are increasingly considering the use of public-private partnerships (PPPs) as an alternative means for addressing capital improvement needs. Nearly one-third of survey respondents stated their organization is

considering some form of PPP in this year's survey as compared to 19 percent from a year ago. Among PPP choices under consideration, Design-Build-Finance and performance contracting were the top areas of interest (Figure 7).

Notably, the primary reason by a considerable margin for not considering PPPs according to survey participants is a lack of demonstrated benefit (Figure 8). This information places responsibility on industry participants, such as financial institutions and service providers, to do a better job with verifying benefits to potential clients and their customers, as well as raising awareness around previous success stories where a specific alternative delivery method has been implemented.

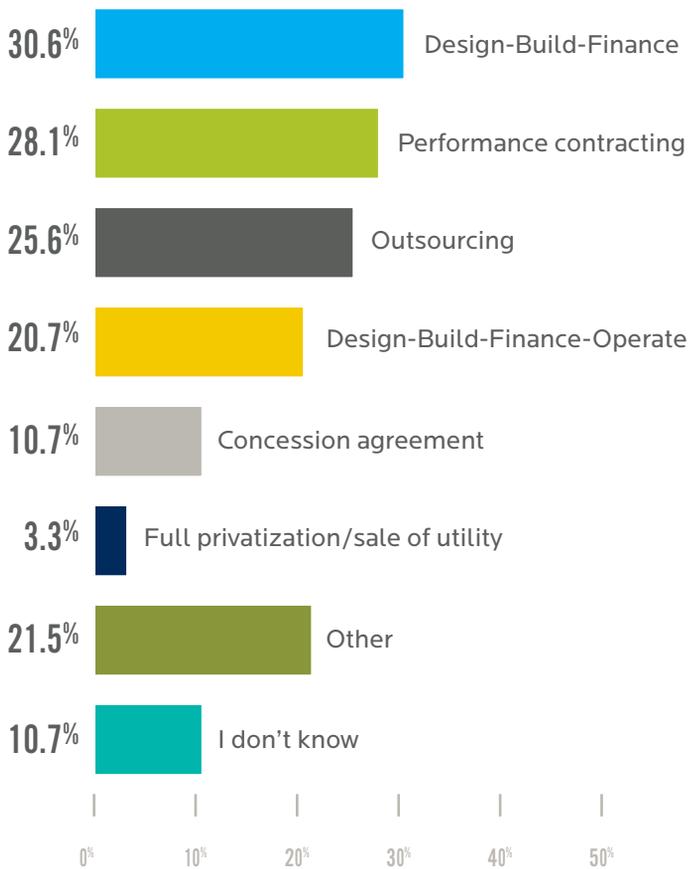
FIGURE 6
ANNUAL RATE INCREASE NEEDED TO COVER COSTS FOR NEXT 10 YEARS



Source: Black & Veatch

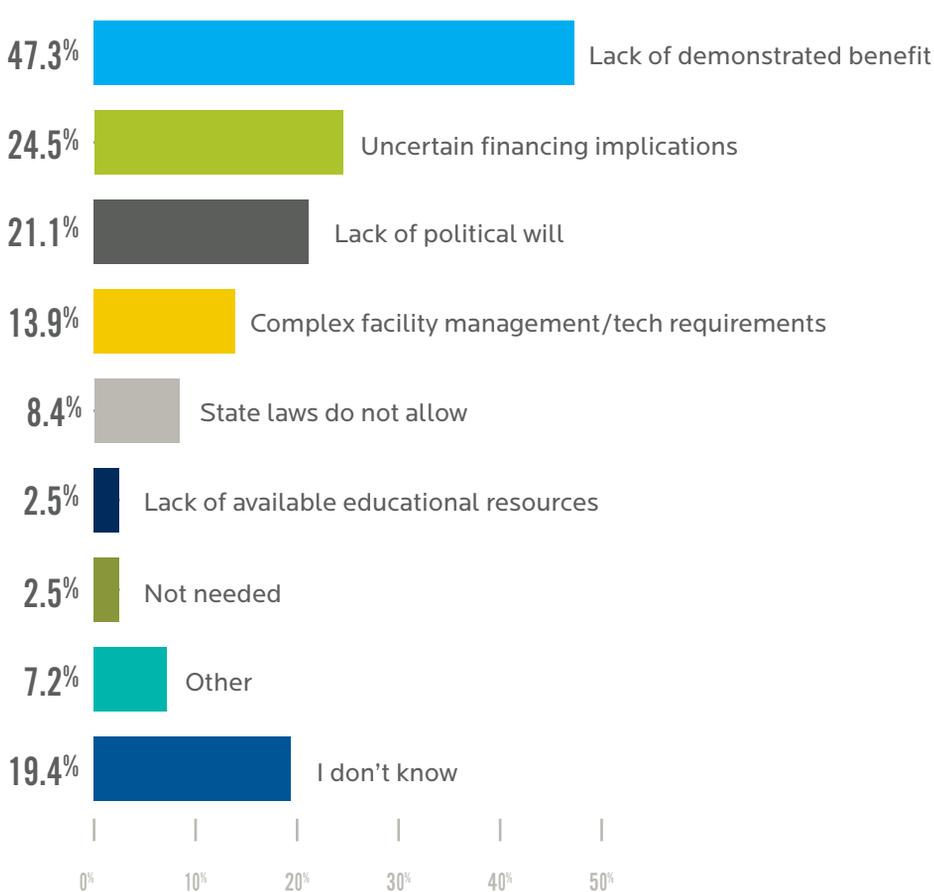
Respondents were asked what level of annual rate increases is needed during the next 10 years in order for revenues to fully cover all O&M, debt service, R&R, capital improvements and reserve funds.

FIGURE 7
PUBLIC-PRIVATE PARTNERSHIPS UNDER CONSIDERATION



Source: Black & Veatch
 Respondents that stated their utility is considering a PPP were asked to identify what types of PPPs their organization is considering.

FIGURE 8
REASONS UTILITIES ARE NOT CONSIDERING PUBLIC-PRIVATE PARTNERSHIPS



Source: Black & Veatch
 Respondents who stated their utility is not considering a PPP were asked to select all the reasons why their utility is not considering a PPP.

BRIDGING INDUSTRY GAPS

COMMUNICATING COSTS

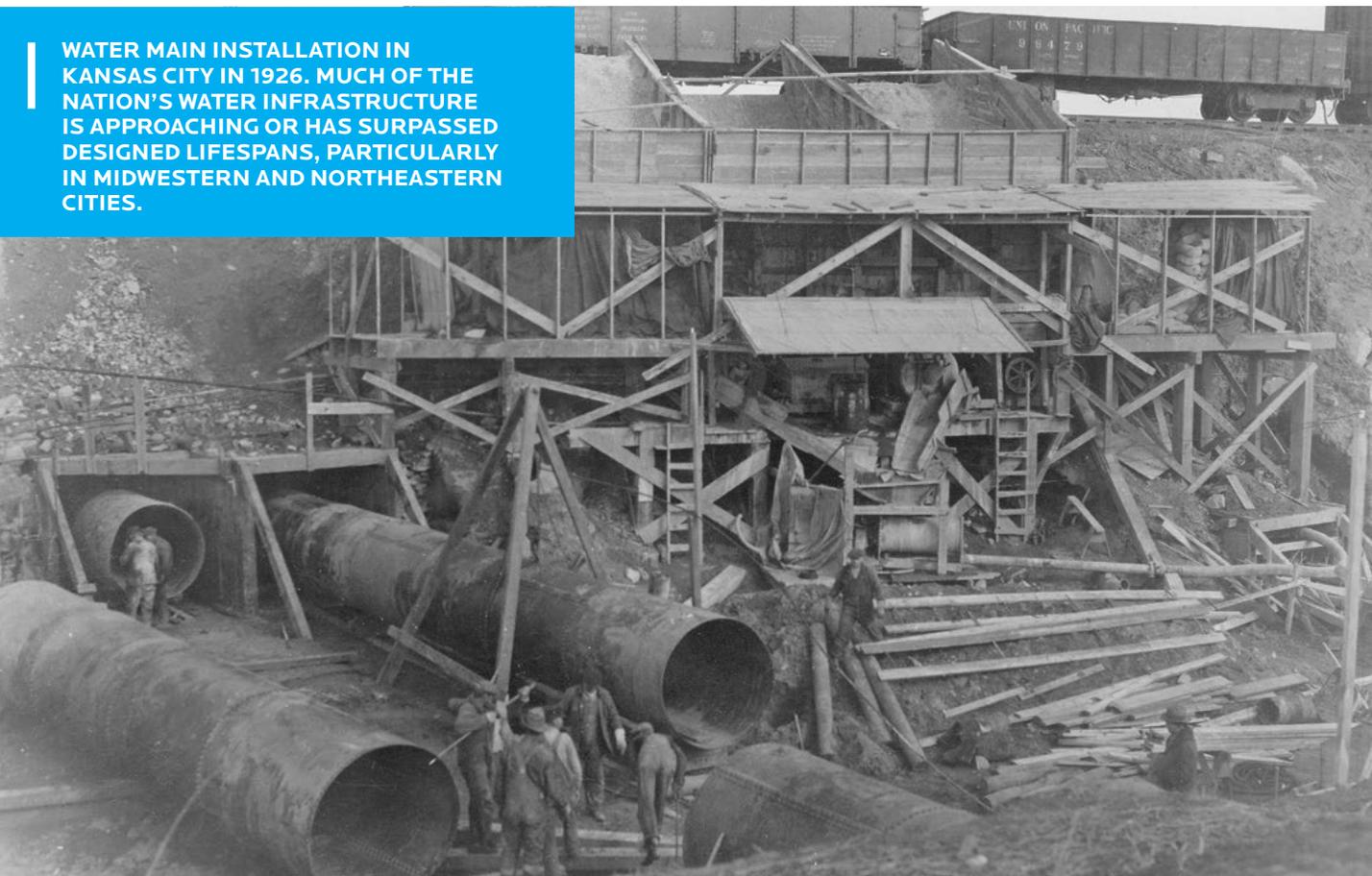
Justifying capital investments and rate increases was an option listed for the first time in this year's water industry survey and it bumped the perennial issue, "expanding/increasing regulation," from the top five industry issues list. The ability to communicate and justify water utility investments and expenditures is necessary to win public trust and acceptance of revenue policies, alternative delivery methods, and the use of PPPs (where applicable) and water supply opportunities.

The best way for utilities to justify necessary expenditures is to provide information on what is needed, why investment is needed and the risks associated with not investing within suggested areas. Developing capital programs that are based on quantifiable risks are one of the primary benefits of asset management frameworks. After all, it is hard to argue with a \$500,000 expense to repair or conduct maintenance on an asset with the knowledge that having to replace the asset could cost three to five times as much (see the *Top Water Infrastructure Issues Solved through Asset Management* analysis for additional information).

Asset management programs are extremely valuable and useful in determining utility budgets, revenue requirements and capital improvement plans. Thorough asset management programs can help reduce the overall capital program spend and drive down operational costs through gained efficiencies. Some water agencies have even benefited from credit rating upgrades as a result of demonstrating best practice utility management.

Regardless of how or why utilities implement their long-term capital programs, communication and education of stakeholders will be necessary. Water utility customers must understand the true cost of providing reliable water services — what it costs today, what it will cost tomorrow and what it will cost in 20 years. Proper preparation following asset management best practices, stakeholder engagement and a thorough analysis of available options on rates, financing and capital delivery will help utility leaders overcome their most pressing challenges and be financially prepared for the future.

WATER MAIN INSTALLATION IN KANSAS CITY IN 1926. MUCH OF THE NATION'S WATER INFRASTRUCTURE IS APPROACHING OR HAS SURPASSED DESIGNED LIFESPANS, PARTICULARLY IN MIDWESTERN AND NORTHEASTERN CITIES.





Three Common Public-Private Partnership Myths

BY **BRUCE ALLENDER**

MYTH 1: RATES GO UP BECAUSE OF PRIVATE SECTOR INVOLVEMENT

Customer rates are impacted by the decision to move forward with large-scale capital programs. The source of funding does not change the reality of the need for additional revenues to finance infrastructure improvements. Increasing rates is the cost of maintaining, expanding and repairing critical infrastructure that provides reliable, safe and secure water services.

Public-private partnerships (PPPs) can benefit customers and municipalities as a result of efficiencies gained in operations and the capital improvement process. The city of Bayonne, New Jersey, provides an example of benefits achieved under a PPP in the form of a concession agreement. Less than one year into the 40-year agreement, Moody's Investors Service upgraded the city's credit outlook. The value for money analysis conducted projects a 6 percent savings, approximately \$35 million, for ratepayers and the city over the life of the contract. In addition, customers gain greater reliability and stability with regard to rates over the length of the contract.

MYTH 2: THE CITY/PUBLIC LOSE CONTROL OF WATER SYSTEMS THROUGH PRIVATE INVOLVEMENT

A city only loses control of its assets and water system if it sells them outright through privatization. Other forms of PPPs maintain public ownership of existing assets. In the Bayonne example provided, the city still owns its infrastructure and provides oversight of the agreement.

In some cases, new assets such as a new water treatment facility can be designed, built, financed, operated and owned by the private entity that sells the services

provided by the plant back to the public authority. Such an arrangement can be beneficial as it enables cities to acquire expanded capacity, or meet regulatory requirements, without taking on additional debt burdens. In addition, the private entity takes on all risks associated with building and operating the facility.

MYTH 3: CITIES CAN USE STATE AND FEDERAL FUNDS TO FINANCE CAPITAL PROGRAMS

State and federal funds may be available for some infrastructure projects, but research shows there is not enough to cover all needs. The American Society of Civil Engineers (ASCE) gave the collective drinking water infrastructure in the United States a D+ grade (equivalent to poor) and wastewater infrastructure a D in its latest *Report Card for America's Infrastructure* (www.infrastructurereportcard.org).

The ASCE estimates that nearly \$300 billion in investment is needed for wastewater and stormwater systems alone through 2033. Repairing and/or replacing aging drinking water mains and other buried infrastructure could approach \$1 trillion in needed investment. The need varies widely by state. Government officials, utility leaders and customers should review the ASCE information to learn more about the full capital investment needs within their state and compare it to the level of revolving funds, grants or other programs available.

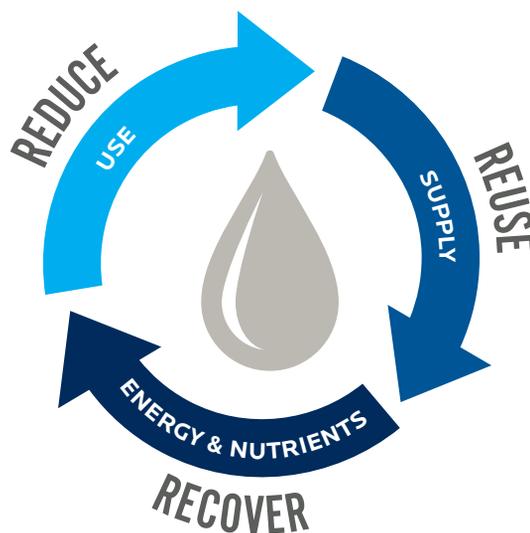
KEYS TO SUSTAINABLE WATER SUPPLY: REDUCE, REUSE, RECOVER

BY LES LAMPE

The focus of most space expeditions is not on finding mineral or industrial resources on far away planets; it is on searching for water to see if there are other locations that can sustain life beyond Earth. While the idea of an alternative planet is exciting, it also points to the need for sustaining this essential resource locally and as part of a global community.

Sustained drought across much of the western half of the United States has brought awareness to issues around water scarcity and water supply. At the same time, federal and state regulations regarding the levels of nutrients in water point to the need to protect large water bodies. Now, perhaps more than ever, utility leaders must lead efforts to educate their stakeholders on the value of water and the costs associated with reliable water services.

Awareness of specific environmental programs and needs has been successful in changing consumer behaviors. The mantra of basic environmental programs, Reduce, Reuse, Recycle, has helped communities establish recycling programs, urban gardening projects and other success stories. The water utility industry should customize the three Rs mantra to educate consumers on the needs of our water systems and watersheds: Reduce, Reuse, Recover.



REDUCE WATER DEMAND

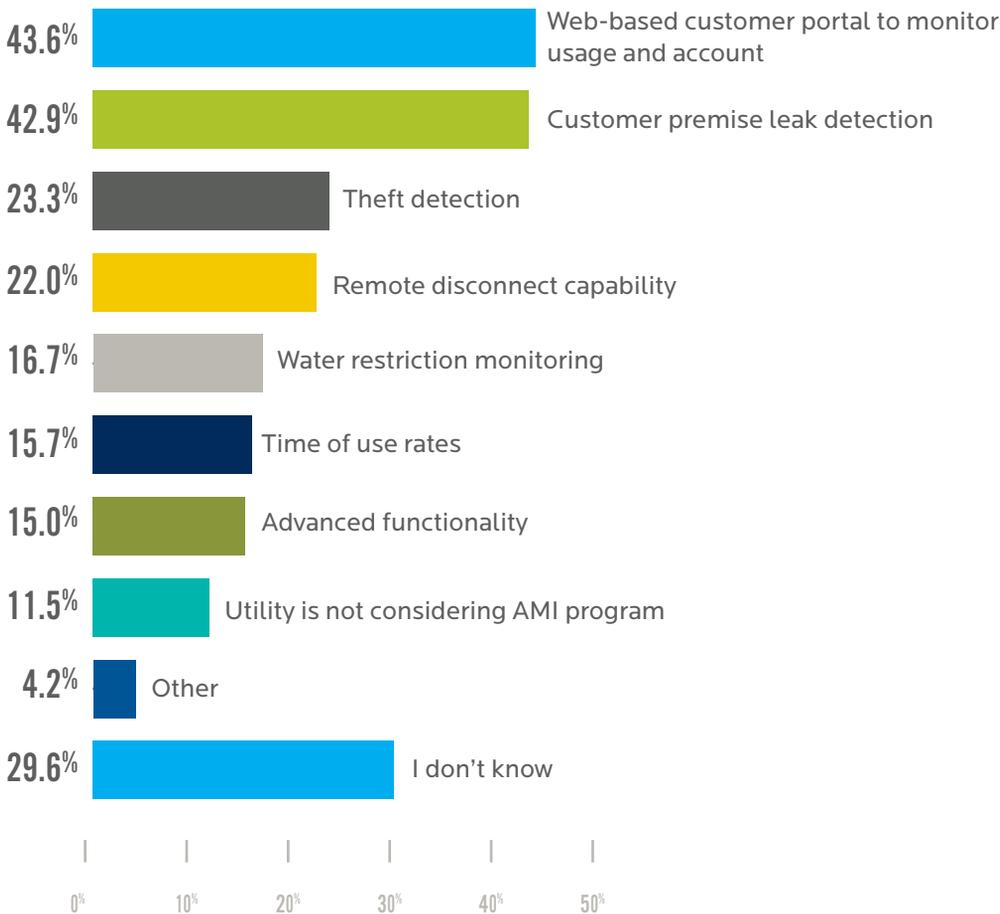
For utilities looking to reduce operational expenses, the least expensive drop of water is the one that is not used. Energy conservation among consumers took hold by providing an economic reward for doing so in the form of lower utility bills. However, utility budgets are already strained. Reduced revenues as a result of conservation efforts threaten utilities that have fixed costs associated with debt repayment.

Innovative rate structures are one way to encourage conservation. Currently less than 20 percent of utilities are considering progressive features within their advanced metering infrastructure (AMI) programs that can provide

water restriction monitoring and/or time of use rates (Figure 9). In addition to financial motivations for reducing water usage, online monitoring of water use via customer Web portals is another opportunity to encourage conservation. After all, customers cannot save water without knowing how much they use.

Leak detection is another area of opportunity to conserve water. Leaks within the distribution system can go undetected for long periods of time. Advanced distribution measures enable utilities to identify and repair leaks quickly in a manner that also benefits from lower overall operations and maintenance costs.

FIGURE 9
CONSIDERED FEATURES FOR AMI PROGRAMS



Source: Black & Veatch

Respondents were asked to select the features they plan to enable as part of their considered AMI programs.

BRIDGING INDUSTRY GAPS

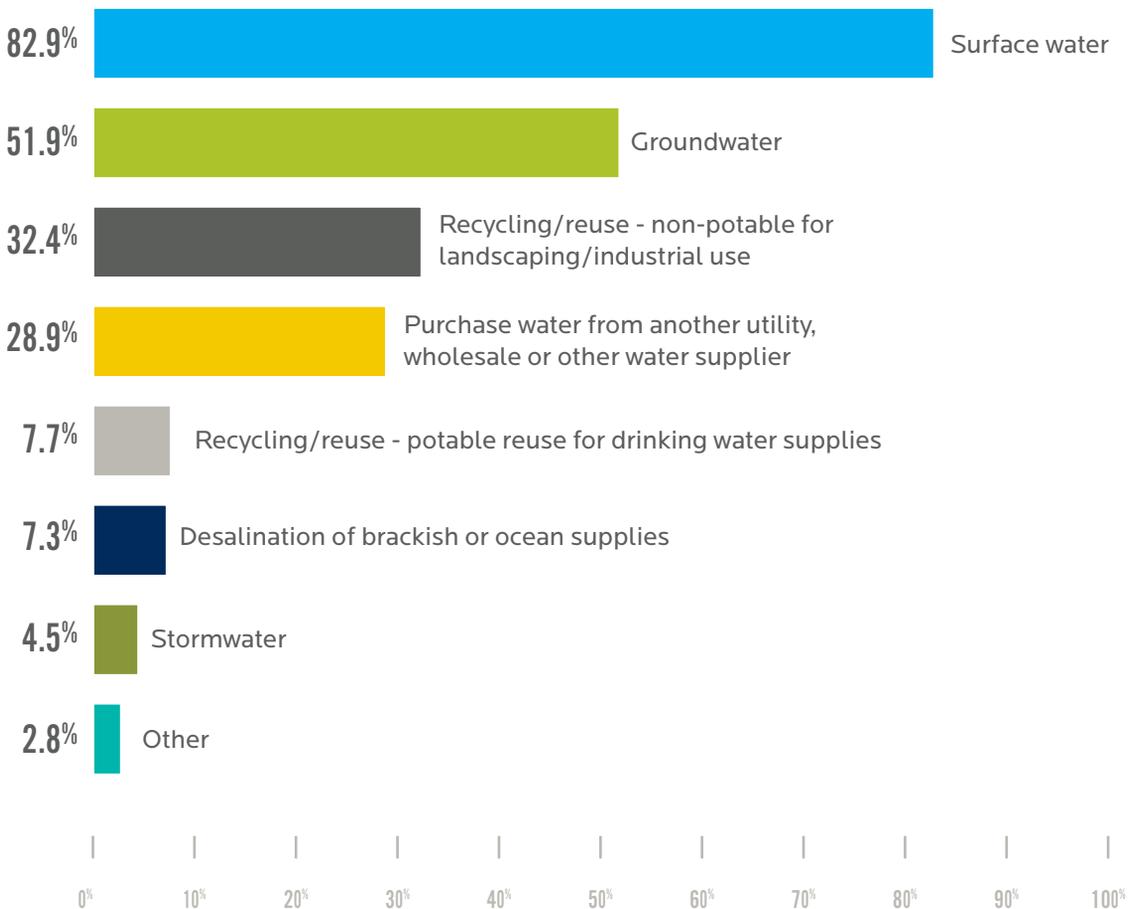
REUSE WATER

Reusing water is absolutely necessary in regions where population growth and customer demand strain available supply. Currently, approximately one-third of all utilities have some form of water reuse as part of their overall water portfolio (Figure 10). In regions such as the Southwest and Southeast, community and state leaders are considering comprehensive water reuse programs to wean industrial users off of freshwater supplies and to also recharge existing reservoirs and aquifers.

Another option for communities to consider is the capture of stormwater. Using stormwater to recharge groundwater is one way to supplement water resources. This option is likely only financially viable in areas where the hydrogeology is suitable for the practice.

The consideration of alternative water supplies highlights a disconnect among industry leaders on the importance of stakeholder engagement. When asked to identify the top three items they consider when comparing alternative water supply options, only 11 percent selected “Social considerations” (Figure 11).

FIGURE 10
CURRENT SOURCES OF WATER SUPPLY

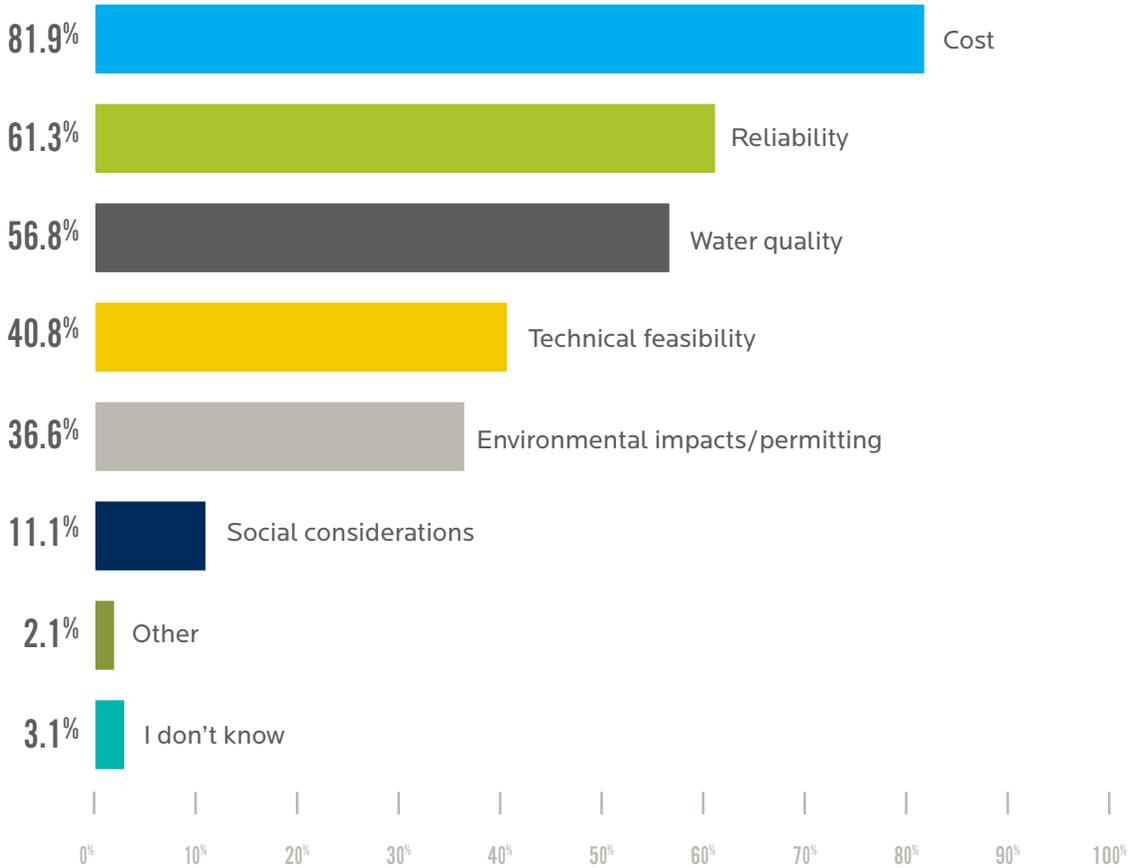


Source: Black & Veatch

Respondents were asked to identify all water supply sources available/used by their utility.

NOTE: Respondents who represent wastewater only utilities were omitted from these results.

FIGURE 11
TOP CONSIDERATIONS WHEN COMPARING WATER SUPPLY OPTIONS



Source: Black & Veatch

Respondents were asked to select the top three items their utility considers when comparing alternative water supply options.

NOTE: Respondents who represent wastewater only utilities were omitted from these results.

A significant difference exists on the effectiveness, particularly as it relates to public acceptance, of developing alternative water supplies for a portfolio over time versus during crisis. Highlighting this point are experiences from Singapore and Australia.

In Singapore, water self-sufficiency is viewed as a strategic requirement for national security and economic growth. Public education and awareness campaigns by the national water agency, Singapore’s PUB, have been sustained virtually since the country’s independence in the 1960s. Today, the country is the model for conservation, reuse and sustainable water management through a diverse portfolio that is slowly incorporating indirect potable water reuse through its trademarked NEWater supplies.

Extreme weather conditions plagued Australia for the last 10 to 15 years, pressing the country to develop new approaches to planning and securing water resources in addition to water restriction and comprehensive conservation programs. In Brisbane, serious drought led to the implementation of indirect potable reuse by the local government.

During the crisis, the public largely accepted policies implemented to safeguard future water supply. However, increased rainfall that followed the implementation of these measures eliminated the crisis, and the public no longer accepted the alternative water supply strategy. As a result the government changed its recycled water policy to only use indirect potable reuse during times of extreme water emergencies.

RECOVER RESOURCES

Black & Veatch is a strong advocate of the belief that there is no such thing as wastewater. Used water is full of valuable resources that should be recovered. Not recovering the water supply, nutrients and/or the energy potential of this resource is the “waste” element.

Protecting water bodies is the driving force behind regulations on nutrient removal and comprehensive programs to reduce or eliminate combined sewer overflows and/or sanitary sewer overflows. Nutrient removal can be an opportunity for utilities with wastewater assets to reduce energy costs and potentially gain new revenue streams.

Ongoing work with the Metropolitan Water Reclamation District of Greater Chicago (MWRD) for a new nutrient recovery system demonstrates the potential benefits of resource recovery. Black & Veatch and Ostara Nutrient Recovery Technologies were selected to design and build the new facility that will recover phosphorus from reclaimed water in a manner that allows the phosphorus to be sold as a fertilizer for agricultural purposes.

The program benefits MWRD and its ratepayers by meeting water effluent standards with regard to nutrient removal. It also provides a truly sustainable benefit to the global challenge of phosphorus supply. Mined phosphorus is a finite resource, and 90 percent of this resource is controlled by a single country, Morocco. Since no food, flora or fauna can grow without phosphorus, recovering rather than removing this essential nutrient is necessary.

Proven technologies and processes for treating reclaimed water can also be used to recover valuable energy resources. Methane gas produced from the biosolids digestion process can be harnessed to create on-site power. In addition, sewage sludge can be used as a viable biomass for on-site power generation. In the UK and Australia, several large facilities have benefited from the recovery of energy. Many are now energy self-sufficient and others have the capability of being net producers of renewable energy, providing additional revenue opportunities by selling power to the local electric grid.

Economies of size are a factor in any resource recovery program. Utility and community leaders that must upgrade, expand or build new facilities in order to meet regulatory requirements or new capacity needs are looking at options for partnering with other communities to meet a common need, reduce costs and provide tangible environmental benefits.

PLANNING IS THE CRITICAL STEP

Those who are prepared are better positioned to withstand, recover and prevail in the face of crisis or disaster. For this reason, integrated water management plans should be an essential component of utility strategic planning and asset management.

Naturally, comprehensive water supply planning has a greater focus for historically arid climates, such as the Southwest, Rocky Mountain and portions of the Northwest regions. More than half of the utilities within these regions have incorporated integrated water management into their long-range water supply planning process (Table 1). These regions also lead the nation in development of drought contingency plans with community outreach and use of alternative supplies.

Developing a long-term, integrated water resource plan involves all elements of the Reduce, Reuse, Recover ideology. First and foremost, customer engagement and education on the importance of conservation is necessary — even for traditionally “water rich” communities. Conserving water protects supply but also reduces costs. Innovative rate mechanisms combined with tools that enable customers to monitor and manage water usage enable conservation efforts.

Planning for and building in water reuse infrastructure over time is another way to conserve water, reduce industrial demands on freshwater supplies, and replenish reservoirs and aquifers.

TABLE 1
LONG-RANGE WATER SUPPLY PLANNING

Long-Range Water Supply Planning Process	All Respondents	By Service Region					
		Midwest	Southeast	Southwest	Northwest	Northeast	Rocky MT
Drought contingency planning for water conservation, community outreach and use of alternative supplies	64.8%	37.3%	67.4%	79.2%	84.6%	42.1%	68.2%
Water recycling/reuse	50.2%	25.4%	45.3%	81.8%	42.3%	36.8%	68.2%
Sustainability assessment for facilities planning	41.1%	40.3%	40.7%	39.0%	46.2%	47.4%	50.0%
Integrated water management or total water management	40.4%	19.4%	39.5%	53.2%	50.0%	26.3%	54.5%
Potential impacts of climate change	38.0%	22.4%	33.7%	37.7%	61.5%	42.1%	63.6%
Scenario planning	36.2%	20.9%	31.4%	37.7%	46.2%	15.8%	63.6%
Desalination of brackish or ocean supplies	15.0%	6.0%	19.8%	33.8%	11.5%	21.1%	9.1%
Other	4.2%	6.0%	1.2%	1.3%	7.7%	10.5%	4.5%
I don't know	10.5%	20.9%	8.1%	7.8%	7.7%	15.8%	9.1%

■ / ■ Statistically higher / lower than all respondents at the 95 percent confidence level.

Source: Black & Veatch

Respondents were asked if their utility has incorporated any of the listed items into their long-range water supply planning process.

Advanced planning and prioritizing capital expenditures over time will benefit communities susceptible to the increasing frequency of sustained droughts by spreading out costs over time. By contrast, water supply facilities constructed in response to a crisis are frequently characterized by excessive capital expenditures resulting from inadequate planning.

Finally, recovering valuable resources contained in used water benefits the environment, drives down operational costs and can generate new revenues for utilities. Nutrient recovery enhances the quality of freshwater resources, protects source waters and results in the production of

beneficial agricultural products. Energy recovery can significantly reduce overall energy costs by providing a renewable energy resource for the utility.

Safe and reliable water services are a cost-intensive process. However, by implementing best practice asset management and leveraging technology, utilities can effectively manage these costs, achieve conservation goals and be more resilient to future challenges, both anticipated and unpredictable.



Global Perspective: Industry and a Sustainable Water Supply

BY **DR. HOE WAI CHEONG**

Reducing global industry's thirst is critical for ensuring sustainable water supply and economic development. According to UN Water, global industry uses double the volume of water compared to domestic applications. Furthermore, industry's proportion of water use is rising in line with the maturity and extent of a nation's industrialization.

The challenge with reducing industrial demand for water is twofold: 1) Industrial processes are often closely guarded secrets and there is a reluctance to share best practices with competitors; and 2) Water is often viewed as a more controllable and lower cost raw material, making changes – particularly those that require capital investment – a lower business priority.

Aligning water utility conservation goals with the business goals of industrial partners is a critical step in this process. One example of engaging industry comes from Singapore, where encouraging sustainable practices by industry forms part of its integrated water supply management program.

USING REGULATIONS AND INCENTIVES

According to PUB, the national water agency of Singapore, the nation's total current water demand is approximately 400 million gallons per day. PUB expects total water demand to double by 2060, with household use accounting for only 30 percent of future demand (*SOURCE: <http://www.pub.gov.sg/water/>*).

As the population and economy continues to grow, Singapore needs to ensure that the demand for water does not rise at an unsustainable rate. While PUB continues to work to reduce household consumption,

a key focus area is to reduce water use in the industrial sectors. Singapore, through its work with the business community, has created a fair and optimal environment for water innovation that relies on incentives and regulations to meet water consumption goals.

Water is priced in Singapore to reflect its scarcity given the country's unique constrained circumstances including limited land to store rainwater. The costs involved in the entire national water system are taken into account and the price of water reflects the higher costs of water supplies from NEWater production and desalination as well as all operating costs of the extensive and advanced water infrastructure throughout the country.

The challenge is to keep water costs competitive to the industry while maintaining high service standards in water delivery and pushing for greater efficiency in water usage. This economic reality calls for a close understanding and acknowledgement from both PUB and the businesses that protecting and managing Singapore's water resources is a joint effort. Therefore, as well as tariff structures that encourage conservation, PUB works to design specific outreach programmes which aim to raise awareness and enhance the ability of water users to improve their water efficiencies.

For example, PUB, together with the Singapore Economic Development Board, is actively working with its large industrial water users to implement water management technologies and practices. Jurong Island, a self-contained industrial park in Singapore comprising many of the world's leading energy and chemical companies, accounts for more than 10 percent of Singapore's water demand.

PUB recently reviewed Jurong Island companies' water management and future water needs for processing and cooling. The goal of the study and consultation was to identify cost effective and sustainable solutions to optimize the use of local water resources as, even conservatively, demand from users on Jurong Island will increase.

The study highlighted a number of alternative methods to improve water management practices on the island including identifying more opportunities for water recycling or reuse and using seawater rather than treated water for cooling. Greater waste heat recovery was also identified as a viable option for users to explore as they examine their water management practices in more detail.

Singapore's use of both regulations and incentives encourages its industrial customers to adopt new ways of using and reusing water. Since 2010, PUB has been working with non-domestic customers to develop their Water Efficiency Management Plans. From 2015, it will be mandatory for all large non-domestic water users consuming 5,000 cubic metres per month or more of water to submit their Water Efficiency Management Plans to PUB by June on an annual basis. In addition to identifying potential water savings and developing an implementation timeline, large water users (with funding support) are also required to install private meters to measure and monitor water consumption in order to account for the breakdown of water use at the major water usage area in the premises. The purpose is to promote the establishment of water management systems across large water users, which is a key step for them to better understand and take ownership of their water usage.

In many ways, Singapore's water management strategies are similar to how governments worldwide have encouraged businesses to be more energy efficient. The argument to save energy is more readily understood by the average business leader. However, with the right information, right policies and the right incentives, there is no reason why similar arguments cannot be presented in the case for saving water.

Dr. Hoe Wai Cheong is an Executive Vice President at Black & Veatch and leads the company's EPC (engineering, procurement and construction) business for energy projects throughout the world. Dr. Cheong also is responsible for global strategy, business development and project acquisition and execution.

WATER'S ECONOMIC VALUE

While Singapore has long been noted for its comprehensive water strategy and management plans, perhaps its greatest success is with its work in creating broader public awareness on water's true economic value. Singapore rightly boasts that through its work it has turned its water scarcity challenges into economic advantages. In addition to creating a stable and secure environment for investment, Singapore's global hydrohub has a thriving cluster of more than 130 water companies and 26 research centres.

The economic impacts of water shortages can be severe and long lasting. In the United States, severe droughts in California, Texas and other areas of the country, are the reason why meat and dairy prices continue to rise.

China's plans to take advantage of a shale-gas revolution, similar to the unconventional gas success in the United States, is challenged because gas reserves are in the driest parts of the country. The drilling and fracturing of a typical horizontal shale gas well requires a huge amount of water and competes with other local water resource needs. Water constraints like these in China alongside the country's well-documented water pollution problems have led the World Bank to calculate the cost of China's water problems at 2.3 percent of its annual gross domestic product.

Singapore's water advantage dates back to the prominence of water policies from the inception of the country in the 1960s and from the vision of leaders like Lee Kuan Yew. This top-down political will has paved the way for comprehensive planning, investment and education that continues today. The Singapore approach demonstrates how establishing a clear vision and long-term water strategies, supported by the public and various levels of political and business stakeholders, enables a positive environment for investment, alternative financing and, in time, can turn a weakness for a region or country into an area of strength.



Global Perspective: Sustainable Water Planning Making Inroads in the Middle East

BY **CHRIS SCOTT**

Black & Veatch has been working on water and sanitation projects for communities across the Middle East since the 1920s. Currently, the company is focusing on the needs of the Gulf Co-operation Council (GCC) states,¹ a region with very specific water related challenges.

GCC states have high rates of water usage, driven in part by the lifestyles afforded by oil wealth. Average consumption of water per individual in the GCC is the highest in the world. In the United Arab Emirates (UAE), for example, average water consumption rates are 550 liters per person (145 U.S. gallons), more than double the global national average of 250 (66 U.S. gallons). In addition, it is estimated that an average of 40 barrels of water are needed for the production of one barrel of oil.

A further consideration is that demand is forecast to increase. The UAE's Ministry of Environment, for example, predicts the emirates' annual water demand will double to 8.8 billion cubic meters by 2030. These rates of consumption are all the more startling given the GCC is also among the world's most arid regions. According to the United Nations, all GCC countries, with the exception of Oman, fall into the category of acute water scarcity.

As a result, there is a growing recognition that current levels of usage are unsustainable. Around the world, Black & Veatch has seen that helping people recognize water's value is central to any successful demand management strategy. It is not that people have chosen to undervalue water; it is more that we need to be more effective at helping them understand its value.

To this end, GCC clients and other organizations in the region have launched a number of initiatives to promote water's value. In Qatar, the Tarsheed campaign is targeting public spaces such as schools and mosques. Last summer, Saudi Arabia's Minister of Water and Electricity Minister, His Excellency Abdullah Al-Hussayen, said his ministry had launched a nationwide campaign to reduce water consumption by 30 percent through free distribution of water-saving devices.

In the academic year 2013–2014, the Dubai Electricity and Water Authority (DEWA), in coordination with the emirate's Knowledge and Human Development Authority, launched a competition targeting 400 schools. The institution able to develop the best practices in water and energy conservation will receive a Dh10,000 (approximately US\$2,700) prize. DEWA is also among the utilities in the region to launch a mobile application that allows customers to track bills. Such applications can help reduce consumption by up to 15 percent according to Samir Al Bahaie, Google's regional policy manager for the Middle East and North Africa.

Water tariffs that reflect more closely the cost of providing water services are another way of helping people understand water's value. This is a highly sensitive area in the GCC, but it is to be applauded that a dialogue about water tariffs is beginning to be introduced into the debate about managing demand. Alongside education measures, for instance, the UAE's Federal Electricity and Water Authority (FEWA) Director General, His Excellency Mohammed Saleh observed at the end of 2013 that FEWA may have to, "reconsider the current tariff for water services."

¹ The GCC states are Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates

THE WATER ENERGY NEXUS

Recognizing that power and water are inextricably linked is crucial. Energy generation is water intensive, and water services are energy intensive; cutting consumer demand for one will reduce consumption of the other. This is important when considering that customers in the GCC have some of the world's highest per capita demands for energy as well as water.

To ensure the sustainable provision of both precious resources, the integrated planning and delivery of energy and water infrastructure provides the most efficient means to meet and manage demand. As a result, meeting governments' objectives will increasingly require companies like Black & Veatch that have expertise in delivering both water and energy projects, and successfully combining insights from both.

Understanding the technologies involved has a significant role to play. For example Saudi Arabia's average thermal efficiency in generation is around 30 to 35 percent. Converting the kingdom's single cycle plants to combined cycle is estimated to increase thermal efficiency to 40 to 45 percent. Combined cycle plants generate nearly 66 percent more energy per unit of water used compared to traditional gas fired plants. So, by understanding the technology and the nexus of water and energy, a virtuous circle begins to develop with more efficient generation coupled to a reduction in demand for water.

Leadership within the GCC is recognizing water and energy's interrelationship. In January 2014, the GCC's Electricity Cooperation Committee announced it was beginning to explore the possibility of implementing joint legal and legislative rules to strengthen rationalizing the consumption of water and electricity.

RECYCLING AND RECOVERING RESOURCES

A paradigm shift in how wastewater is viewed can contribute significantly to meeting the GCC's water challenges. It is time to treat wastewater treatment works as resource recovery plants. Utilities need partners with the technological understanding of, and experience in, wastewater recycling and unlocking wastewater streams' potential as sources of renewable energy and nutrients.

Interest in water reuse is growing. Abu Dhabi plans to reuse 100 percent of its treated wastewater for irrigation by 2018; up from the 7 percent of treated wastewater it uses currently. Water recycling technology means that virtually any population center that creates a significant wastewater stream has the potential, through water recycling, to create a renewable water source.

Across the world, large-scale transfers and integrated networks have been used to successfully help meet demands for water, so greater cooperation between GCC states is a development of increasing significance. "GCC water interconnection is a must now to overcome water security threats," Qatar's Minister of Energy and Industry, His Excellency Dr. Mohamed bin Saleh Al Sada, observed recently. The announcement by Bahrain's Minister of Electricity and Water that the GCC is commencing studies for a common regional water network shows how seriously this strategy is being taken.

MAINTAINING ASSETS AND KNOWLEDGE TRANSFER

Two other areas that have a significant impact upon the GCC's future ability to deliver sustainable water services are asset management and knowledge transfer. A total of US \$300 billion is expected to be invested in water projects in GCC between 2012-2022, according to a report by Global Risk Insights. Asset creation, however, is only half the story. To deliver the levels of customer service and environmental performance that end users and governments seek, the GCC states' infrastructure asset base needs to be managed effectively.

PAS 55 is recognized around the world as the benchmark for asset management quality. Use of the specification in the GCC is growing; Abu Dhabi Distribution Company (ADDC) announced last year the appointment of Black & Veatch to help it achieve PAS 55 certification.

In a recent advance in the discipline of asset management the International Organization for Standardization - commonly called the ISO - published ISO 5500X, the world's first international suite of standards for asset management. This international standard will further increase the implementation of effective asset

management regimes and help utilities in the GCC ensure that their investments deliver the performance desired in the long term.

In addition to developing infrastructure, the GCC needs to develop people. Reliance on expatriate expertise to deliver and manage utility infrastructure is unsustainable. Knowledge transfer is now essential to a project's success. For example, Black & Veatch's PAS 55 work with ADDC includes the development of training and structures for the adoption of industry best practices. Knowledge

transfer is an essential component of the overall program.

Overall, trends and developments within the GCC demonstrate the need for a holistic approach for managing water resources and water infrastructure. Public education and awareness is a foundational objective, while investment in water reuse and resource recovery programs provide for new supplies and enhanced operations. Finally, maintaining this infrastructure through the use of globally recognized best practices will help the GCC region ensure a sustainable water supply for generations.

Chris Scott is a Managing Director of Strategic Services for Black & Veatch. He has more than 30 years of experience in the water industry and is based in Redhill, UK.

THE WADI DAYQAH DAM
IN OMAN.



CREATING AN INTELLIGENT WATER UTILITY

BY KEVIN CORNISH, JEFF BUXTON AND JEFF NEEMANN

A water utility manager visited a power plant and was amazed at what he saw. A single person, the power plant manager, operates the entire facility. The water utility manager asks how this can be achieved for his water/wastewater treatment facilities. The answer is advanced automation, technology and analytics.

Managing operational costs is one of the top five industry issues nationally, and within nearly all geographic and population demographics (refer to *Executive Summary*). Labor and energy represent the largest operational expenses for water utilities. In addition to the cost of labor, aging workforce is an issue of rising prominence, ranking seventh among all respondents in the top industry issues list, and sixth among respondents that have both water and wastewater facilities.

To help support more sustainable operations, technology, coupled with the implementation of formal asset management frameworks, will enable utilities to capture the institutional knowledge of existing staff and reduce the need to replace retiring staff. In addition, well-planned asset management and technology programs will help utilities reduce energy consumption, improve maintenance programs and potentially improve cash flow and billing accuracy.

ENERGY RECOVERY AND EFFICIENCY

When it comes to reducing operational costs, improving energy efficiency has been the proverbial low-hanging fruit for water utilities. Nearly 80 percent of utilities have replaced some level of inefficient equipment; more than 70 percent are using SCADA data analytics; and nearly 60 percent have conducted energy audits (Figure 12). The chart also indicates that a large portion of water utilities are interested in pursuing more advanced energy programs, with 42 percent indicating interest in

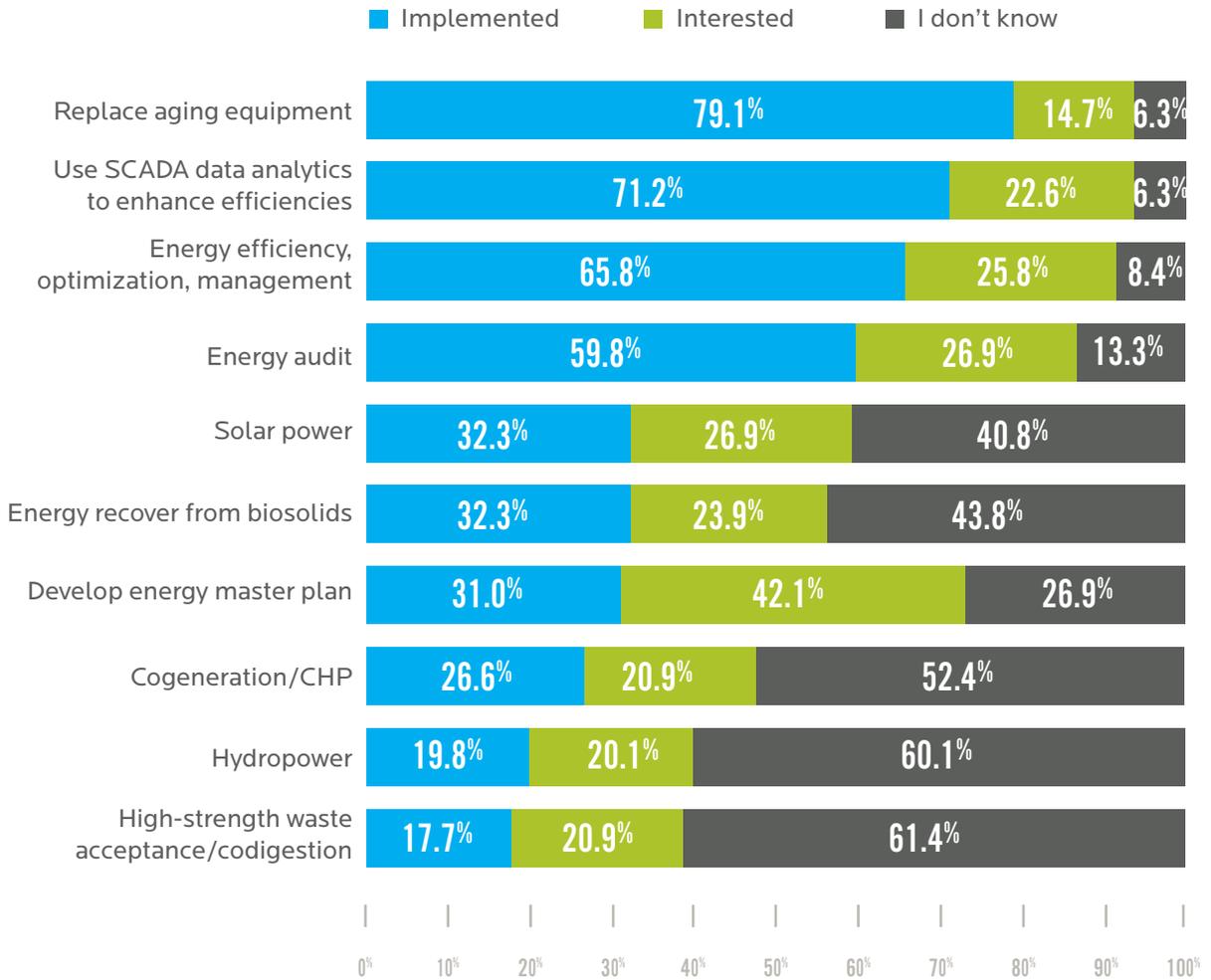
developing energy master plans. Energy master plans will help define the next level of energy conservation measures that go beyond what has already been implemented.

Survey findings show a definitive gap between large and small utilities, with utility size determined by the size of the population served, when it comes to the use of more advanced energy efficiency and/or recovery programs. Table 2 shows that more than half of medium and large utilities are considering or have implemented software and/or data analytics programs to proactively manage energy costs as compared to 30 percent of small utilities. Similar gaps exist for renewable energy programs and other energy recovery options, although for some renewable programs, economies of scale do still apply.

WHEN IT COMES TO REDUCING OPERATIONAL COSTS, IMPROVING ENERGY EFFICIENCY HAS BEEN THE PROVERBIAL LOW-HANGING FRUIT FOR WATER UTILITIES.

FIGURE 12

TECHNOLOGIES OR ACTIONS TO BETTER MANAGE ENERGY USE



Source: Black & Veatch

Respondents were asked which of the listed technologies or actions their utility has implemented or is interested in pursuing in order to better manage energy usage.

GAINING OPERATIONAL EFFICIENCIES

TABLE 2
ENERGY EFFICIENCY/RECOVERY OPTIONS CONSIDERED OR IMPLEMENTED

Energy Efficiencies Considered or Implemented	All Respondents	By Population Served		
		Small (Under 100K)	Medium (100K–1M)	Large (More than 1M)
Reduce losses or other infrastructure efficiency improvements to reduce water processing and handling requirements	45.9%	50.0%	43.5%	46.8%
Using distribution modeling tools to better size and optimize pumps and pipes	44.3%	37.8%	44.1%	49.5%
Implement software and/or data analytics programs	43.8%	30.5%	45.2%	51.4%
Renewable energy programs (e.g., solar panels, wind)	39.1%	28.0%	35.0%	54.1%
Restructure wholesale electric supply contracts	30.7%	22.0%	29.4%	39.4%
Waste-to-energy programs	28.0%	17.1%	28.8%	34.9%
Recover energy through in-line hydro	21.7%	13.4%	15.8%	37.6%
My utility is not focused on energy efficiency measures or costs	6.5%	7.3%	8.5%	2.8%

■ / ■ Statistically higher / lower than all respondents at the 95 percent confidence level.

Source: Black & Veatch

Respondents were asked which of the listed items their utility is considering or has implemented in order to proactively manage energy costs.

ENERGY PERFORMANCE CONTRACTING

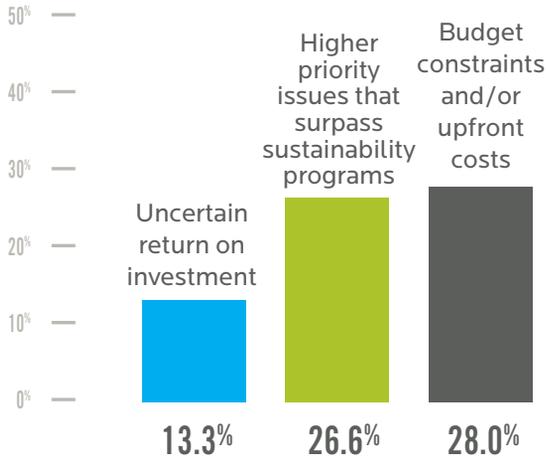
Many utilities remain challenged in developing and implementing enterprise-wide energy efficiency programs. Figure 13 highlights the top three challenges for pursuing sustainable solutions, such as energy efficiency. At the same time, less than 10 percent of all survey participants stated their utility plans to use energy performance contracting as a means for meeting energy efficiency goals (Figure 14).

Energy performance contracting is an alternative financing mechanism that can enable water utilities to move forward with energy efficiency programs while addressing the common challenges to pursuing sustainable solutions. This method often requires minimal upfront capital costs, addressing the challenge of budget constraints. Contracting terms often include guaranteed levels of

energy reduction, negating concerns over an uncertain return on investment. Finally, because performance contracting involves a third-party service provider, utility staff can continue to focus on other higher priority issues

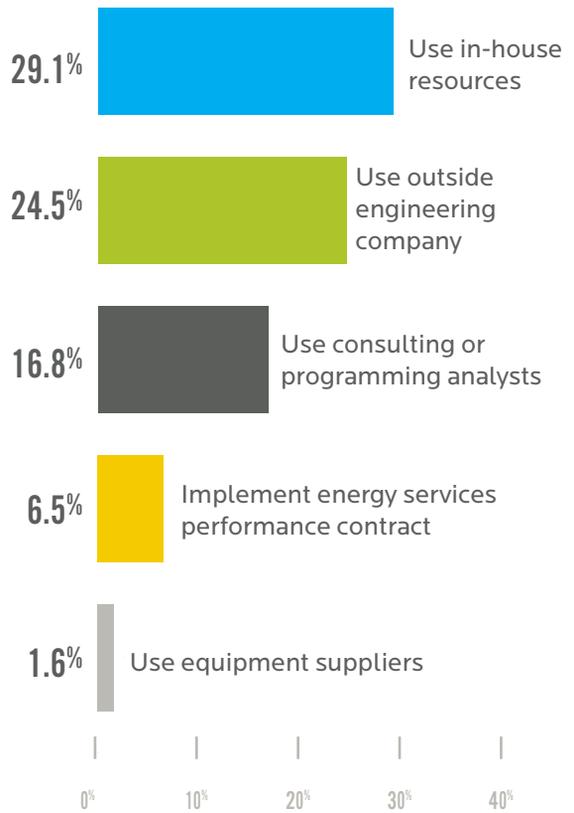
Energy performance contracts can be a win-win situation for utilities looking to achieve meaningful reductions in their energy bills that do not have available capital or staff resources to implement necessary changes. However, utilities that are financially sound with a strong business case for improvement will likely self-implement rather than share cost savings with a third party.

FIGURE 13
TOP CHALLENGES TO PURSUING SUSTAINABLE SOLUTIONS



Source: Black & Veatch
 Respondents were asked to select the top challenges to pursuing sustainable solutions for their utility. This chart highlights the three items selected most among all respondents.

FIGURE 14
PLANS FOR IMPLEMENTING ENERGY EFFICIENCY AND/OR RECOVERY PROGRAMS



Source: Black & Veatch
 Respondents were asked how their utility is planning to implement its energy efficiency and/or recovery programs.

THE WATER SMART GRID

Water utilities are strong believers in the immediate benefits of advanced metering systems. Nearly 75 percent of all respondents cited direct meter reading cost reductions as a primary driver for considering automatic meter reading (AMR) or advanced metering infrastructure (AMI) programs, commonly referred to as smart metering. Nearly half cited leak detection, which can reduce expenses associated with non-revenue water (Table 3).

AMR is a system that enables utility meter reading via mobile or drive-by technology. AMI, on the other hand, refers to more advanced technology where meter data is transmitted over a two-way, fixed network (for example, point to multipoint or mesh) to a central control center for processing. Utilities with AMI systems gain additional benefits from their infrastructure. As noted in Table 3, primary drivers for smart metering programs point toward growth in AMI use across the industry because of the additional benefits these systems can provide beyond meter reading cost reductions. Benefits of AMI systems include the ability to remotely control network devices, such as smart meters, help enhance customer service and support asset management and/or leak detection solutions.

WATER UTILITIES ARE STRONG BELIEVERS IN THE IMMEDIATE BENEFITS OF ADVANCED METERING SYSTEMS.

Black & Veatch projects that the technologies commonly referred to as the “Smart Water Grid” (e.g., smart meters, distribution sensors) will become an integral part of water utilities’ enterprise operations. Water utilities can achieve similar results as their electric utility peers who have realized increased system reliability, improved operating efficiency and enhanced customer service as a result of their AMI programs.

Just as the electric industry continues to capitalize from its initial AMI investments by moving forward with projects such as advanced distribution automation, water utilities can also continue moving toward greater levels of automation. Furthermore, water utilities can benefit from cloud-based services that have altered the economics of advanced automation programs.

The benefits that cloud-based services provide utilities were highlighted in Black & Veatch’s inaugural *Strategic Directions: Utility Automation & Integration* report released in January 2014:

Multi-tenant systems (cloud-based) have the scale and security needed to safeguard critical operational data and sensitive client information. Most importantly, they give even the smallest organizations cost-effective access to big system capabilities. Previously inaccessible computing power and data analytics and management tools can be deployed to increase efficiency and help facilitate data-driven management approaches.

Cloud-based services are closing the technology gap between small and large utilities. No longer will the latest technology be limited to large organizations capable of supporting dedicated IT budgets and staff. Nor will larger enterprises be locked into static computer systems as cloud technology facilitates continuous improvement approaches.

To achieve the desired future state of highly automated and efficient operations, such as a one-person water plant operation, utility leaders should incorporate technology master plans into their overall asset management plan. After all, evolving from a highly manual process organization to a fully automated utility will take time, change management and a thorough evaluation of current practices and future needs. In an era where utilities are constantly looking to “do more with less,” investing in automation technologies and greater intelligence will help water leaders meet their efficiency goals, become more resilient and provide greater levels of customer service.

Perhaps most importantly, advanced technology programs can be enablers of greater customer awareness regarding the value and cost of water services. More accurate billing, the option for on-site leak detection, automated alerts and other features all provide for more engaged customers and greater opportunity for utilities to accurately measure the success of conservation programs and other operational improvements.

BLACK & VEATCH PROJECTS THAT THE TECHNOLOGIES COMMONLY REFERRED TO AS THE “SMART WATER GRID” WILL BECOME AN INTEGRAL PART OF WATER UTILITIES’ ENTERPRISE OPERATIONS.

TABLE 3
PRIMARY DRIVERS FOR CONSIDERING AMR OR AMI

Primary Drivers for Considering AMR or AMI	All Respondents	By Population Served		
		Small (Under 100K)	Medium (100K–1M)	Large (More than 1M)
Direct meter reading cost reductions	73.5%	84.1%	75.5%	60.0%
Leak detection	48.4%	58.0%	46.2%	44.0%
Infrastructure/asset management	36.9%	27.5%	41.3%	37.3%
Water resource management	36.2%	39.1%	34.3%	37.3%
Cash flow improvement via more frequent billing, billing timeliness	34.5%	44.9%	28.7%	36.0%
Theft detection	23.7%	27.5%	22.4%	22.7%
Distribution automation	19.2%	15.9%	16.1%	28.0%
Advanced rate designs such as pre-payment or time-of-use rates	16.4%	18.8%	16.8%	13.3%
Improve response to EPA and other government mandates	5.6%	5.8%	5.6%	5.3%

■ / ■ Statistically higher / lower than all respondents at the 95 percent confidence level.

Source: Black & Veatch

Respondents were asked to identify their utility’s drivers for considering AMR or AMI programs



Global Perspective: Energy Recovery from Wastewater Gaining Traction in Europe, India and the Middle East

BY **JOHN TATTERSALL**

A desire to cut energy bills, reduce greenhouse gas emissions and enhance energy security is leading water utilities to explore their assets' potential to generate energy. Water services, after all, are energy intensive. Most energy is used treating wastewater and pumping clean and used water. A Black & Veatch study for UK Water Industry Research (UKWIR) shows that, on average, water services account for 1 to 3 percent of national energy consumption in Europe and 3 to 4 percent in the United States.

The cost of energy is increasingly driving investment decisions. For asset planners considering whole life or total expenditure (totex) models for investment decisions, energy costs represent a critical part of the decision-making process. Typically capital costs are less than 10 percent and energy costs are more than 80 percent of the whole-life cost of plant.

A current example of this approach is in Kolkata, India. Here, as elsewhere, the energy requirement for wastewater treatment has been exacerbated by inefficient, aging infrastructure increasing totex. The Asian Development Bank's recent US\$400 million loan to improve sanitation took account of the fact that some of the city's wastewater infrastructure is up to 90 years old and uses far more electricity than modern equipment. As a result, ensuring the use of energy efficient technology at the new treatment plants is one of the project's goals.

The chemical energy in domestic wastewater represents one of water utilities' best energy sources. Biogas produced as a byproduct of wastewater treatment can be used to fuel combined heat and power (CHP)

engines. These can help meet treatment works' energy requirements and provide heat for the facility.

Advanced sewage sludge digestion techniques that maximize biogas generation have been used extensively in the UK. Black & Veatch has been involved in several significant EPC (engineer, procure, construct) generation projects. The company recently commissioned the £105 million advanced sludge treatment facility at Davyhulme wastewater treatment works (WwTW), Manchester.

The process improves sludge's digestibility, increasing the biogas yield. The gas is used to generate up to 11.5 megawatts (MW) of electricity on-site using CHP engines. The WwTW is energy self-sufficient, and has the ability to export electricity to the grid. Black & Veatch has completed, or is executing, similar EPC projects at Anglian Water's Cotton Valley, Whitlingham, Colchester and Pyewipe WwTW.

In India, there is increasing interest from water utilities in biogas' potential. Ahmedabad Municipal Corporation recently approved a proposal to sell gas generated at Pirana WwTW. Previously the gas was flared off as a waste product. The new Kondli WwTW, built for the Delhi Jal Board, has the reported ability to generate 2 MW of power.

The potential of projects such as these has been noted by, among others, Gujarat State Chief Minister Narendra Modi. Speaking at the 2013 National Summit on Inclusive Urban Development he announced a pilot scheme at 50 cities within the state to recover energy, water and fertilizer from waste digestion infrastructure.

Even in the fossil fuel rich Gulf Cooperation Council (GCC) states of the Middle East, the potential of biogas is being investigated. Taqa, Abu Dhabi's National Energy Company, for example, is among those investigating the use of biogas from wastewater as a fuel for electricity generation.

Hydropower is another way in which water assets can be used to generate energy. With water and wastewater treatment infrastructure, the opportunity to install hydro turbines exists at any point in the hydraulic gradient where energy has to be dissipated. Examples of such opportunities include the head of a treatment process; within distribution systems for pressure management; and at the end of effluent discharge pipes.

In the UK, Black & Veatch has undertaken a number of EPC projects with a hydro generation component. These include schemes in Scotland and Wales, where the topography makes hydro generation especially favorable. Among the most notable hydro generation projects is Glencorse, a £130 million water treatment works for Scotland's capital Edinburgh. The installation of two hydro turbines utilizing pressure available from the raw water reservoirs makes the works energy self-sufficient and able to export power to Scotland's electricity grid.

Scottish Water has also begun a scheme to retrofit hydro turbines to a number of other Scottish Water treatment

and distribution assets. The schemes will contribute 9,500 megawatt-hours (MW-h) of electricity per annum to Scottish Water's renewables generation target of 25,000 MW-h per annum by March 2015.

Although hydro generation from water utility assets will be comparatively small-scale, in India it is potentially interesting against the backdrop of the government's support for this source of power. Plans to make it mandatory for power distribution utilities to purchase a fixed amount of hydropower have been mooted. Similar schemes already exist for other forms of renewable generation.

The land bank available to some water utilities has also allowed them to site small-scale solar photovoltaic (PV) and wind generation to augment their power needs, and sometimes export to other users. Black & Veatch has undertaken a study for the UK Environment Agency to assess the viability of renewable generation, including solar PV and wind, at some of their sites.

The nexus of water and energy means boundaries between the sectors are becoming blurred. This is especially the case with renewable generation. As a result, there are increasing opportunities for companies able to combine both water and energy expertise.

John Tattersall is the Global Director of Water Technology for Black & Veatch. He is based in the company's Redhill, UK office.

TOP WATER INFRASTRUCTURE ISSUES SOLVED THROUGH ASSET MANAGEMENT

BY JAMES STRAYER, WILL WILLIAMS, JEFFREY STILLMAN AND MARTIN JONES

The need for best practice asset management continues to grow within the water industry. The top five industry issues identified by our annual survey, such as aging infrastructure, managing capital and operational costs, and justifying investments and rate requirements, represent the core tenets and ultimate benefits of asset management.

Water utility leaders recognize that using asset management concepts can help address their most pressing challenges. On the surface, asset management provides a risk-based investment approach that is replicable, auditable and targets the best return on investment. A deeper dive into asset management frameworks provides even broader benefits. However, one of the more surprising results from Black & Veatch's industry survey is the general lack of awareness of available asset management frameworks. All of the four major frameworks used within the United States had an awareness level of less than 50 percent (Figure 15).

The value of asset management is the ability for utility leaders and managers to shift viewpoints from a facility to an objective. Asset management goes beyond identifying the age of an asset to quantifying the likelihood and consequence of that asset failing. Organizations that have committed to best practice asset management have identified their objectives and service goals and know the role people, processes and assets have in meeting those goals. The frameworks help define procedures and processes. They allow proactive management of the asset life cycle at the tactical level within the context of strategic considerations such as the utility's capital, operational and maintenance expenditure, appetite for risk and levels of service (refer to *History and Description of Infrastructure Asset Management Frameworks* for more information about each asset management framework).

PREFERENCES FOR ASSET MANAGEMENT

This year's water industry survey addressed influencing factors for selecting or considering an asset management framework. Preferences among respondents on the top attributes or factors for considering a specific framework were "Simple to understand" and "Covers all asset life cycle activities" (Figure 16). The conflicting nature of simplicity versus comprehensiveness underscores one of the most important challenges for implementing asset management programs. Merging complicated and comprehensive approaches, tools and processes into streamlined and easier to understand frameworks is not a simple undertaking.

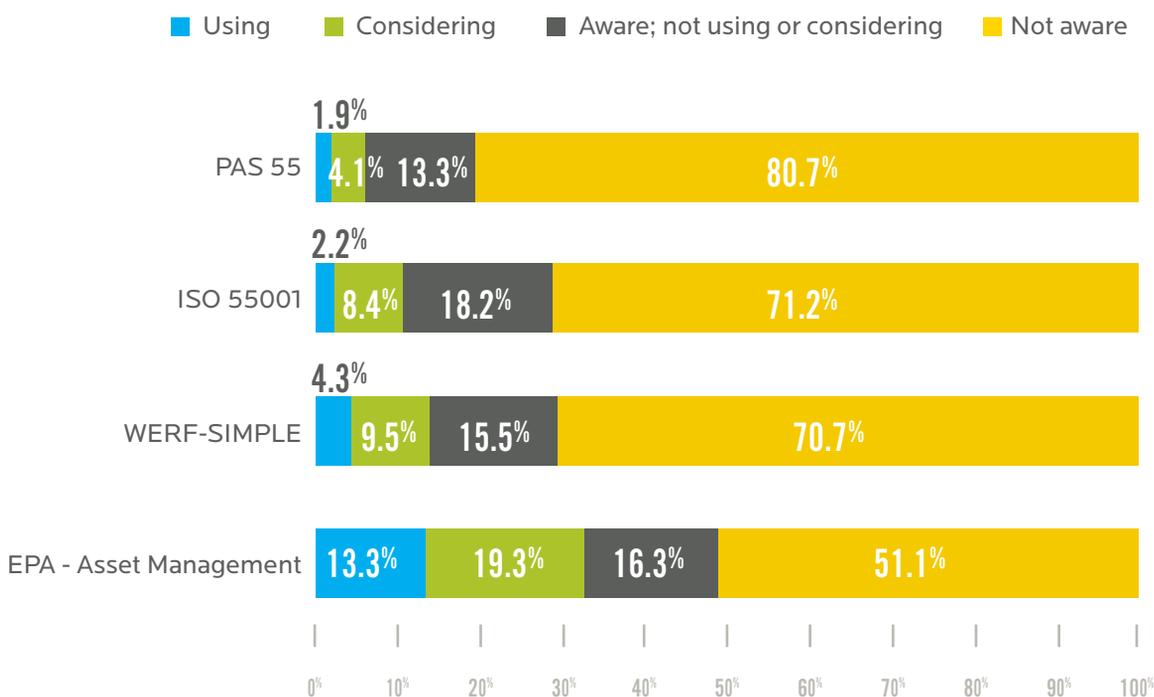
The relative ranking of the various responses provides a good barometric reading on the U.S. water industry's level of sophistication in asset management. Following simplicity and comprehensiveness, survey participants placed the strongest level of importance on practical application with proven results. This is a typical entry point into asset management, leveraging the experience of others in deploying an approach that has been proven to work.

The growing importance of the role of people within an asset management framework demonstrates growth in overall engagement and a growing realization that good practice needs to focus not just on assets but also on people and process to be truly successful. Utility leaders are moving beyond a facility-centric approach to more enterprise-level planning.

Regulatory drivers, certification and international best practice scored lowest. While these factors are not currently top considerations or drivers, the emergence of ISO 55001 may change this in the future. Learning from other, more mature, asset management programs (from the international water community and other utility

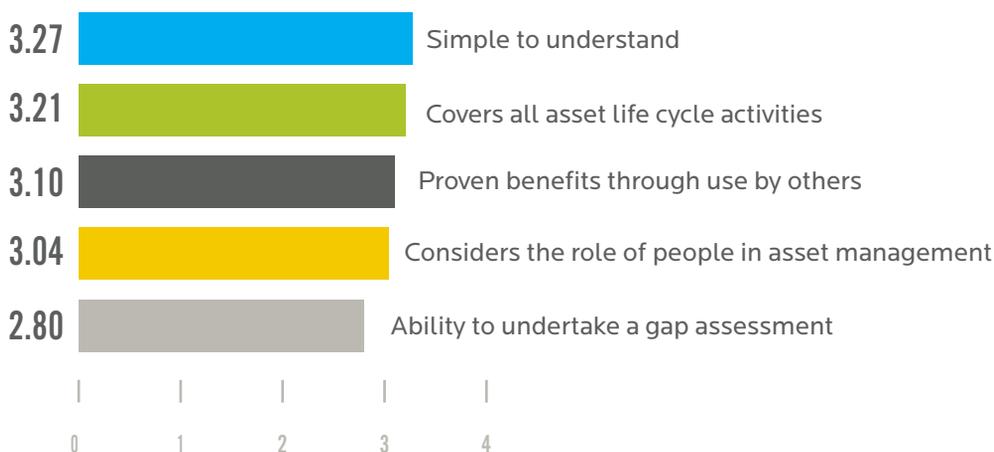
industries, such as gas and electric) suggests that utilities should track the development of standards and regulatory drivers. Adoption of best practice asset management could become part of the regulatory review process that affects capital cost recovery, bond ratings and approval for rate adjustments. *Continued on page 44.*

FIGURE 15
USE/AWARENESS OF ASSET MANAGEMENT FRAMEWORKS



Source: Black & Veatch
Respondents were asked if their utility is using or considering any of the listed asset management frameworks.

FIGURE 16
TOP CONSIDERATIONS FOR SELECTING AN ASSET MANAGEMENT FRAMEWORK



Source: Black & Veatch
Respondents were asked to rate the level of importance each of the listed items has in selecting their organization's asset management framework using a scale of 1 to 4, where 1 indicates "Not Important" and 4 indicates "Very Important."



History and Description of Infrastructure Asset Management Frameworks

BY **JAMES STRAYER AND WILL WILLIAMS**

The origins of asset management frameworks can be traced to the UK, Australia and New Zealand. In the UK, from the early 1980s, manuals like the *Sewerage Rehabilitation Manual*, *Water Mains Rehabilitation Manual* and the *Urban Pollution Management Manual* laid out the core concepts of condition and performance assessment and good practice, risk-based asset management.

The need for asset management within the UK was driven by regulatory oversight of privatized water companies where thorough demonstration of organizational effectiveness and justification for capital cost recovery is required. As a result of these requirements, the *Common Framework Approach to Capital Maintenance Planning* was published in 2002 in the UK for water companies to develop their asset replacement programs.

Similarly, in Australia and New Zealand the governments identified the need to address the management of infrastructure early on and promoted the development of asset management throughout the 1980s. This led to the development of the *International Infrastructure Management Manual* in 2000 which provided guidance and case studies of good practice asset management.

Publicly Available Specification (PAS) 55 was developed by the UK Institute of Asset Management in conjunction with the British Standards Institution in 2004. PAS 55 defines good practice asset management and specifies what elements need to be included in a successful asset management program. The framework is being used by a number of utilities in the UK and other parts of the world. However, adoption of PAS 55 among U.S. water utilities has been limited, an observation confirmed by survey

results that show less than 6 percent of U.S. utilities using or considering the framework.

Based on research that commenced in 2006, the Water Environment Research Foundation (WERF) developed its Sustainable Infrastructure Management Program Learning Environment (SIMPLE). SIMPLE is a Web-based knowledge management tool that provides a framework for strategic planning, guidance on best appropriate practices, decision analysis tools, case studies and a training program. SIMPLE includes a 10-step process for developing asset management plans.

The United States Environmental Protection Agency's (EPA) *Asset Management: A Best Practice Guide* published in 2008 has the greatest level of awareness among U.S. water utility leaders. It is targeted at small to mid-size utilities and provides guidance and a communicable structure for understanding asset management, focused around the following five core questions:

- What is the current state of my system's assets?
- What is my required "sustainable" level of service?
- Which assets are critical to sustained performance?
- What are my minimum life cycle costs?
- What is my best long-term funding strategy?

These various frameworks have migrated in varying degrees to the U.S. market. The level of use also varies by utility. Some organizations have adopted a well-structured approach, building from the ground up. Other U.S. utilities have selected a single area to improve, such as capital prioritization. Utilities that have taken the single area approach often find that adopting a comprehensive asset management framework is necessary in order to achieve

the more complex enterprise-wide improvements once areas of obvious need have been enhanced.

The need for an international standard for asset management was the driving force behind the development of ISO 55001 by the International Organization for Standardization (ISO). This standard was published in early 2014, so it is understandable that more than 70 percent of respondents are not yet aware of the framework. However, what is encouraging is that a small percentage of large utilities (serving populations greater than 1 million) have begun using the standard with nearly 14 percent considering its use.

There is high expectation for rapid acceptance of the ISO 55001 standard in the coming years among water utilities in the United States and globally, as well as other utility sectors such as natural gas and electric. A recent article in the Institute of Asset Management's *Assets* magazine suggests that more than 4,000 organizations worldwide are currently considering adoption of ISO 55001 as their asset management framework.

CAPITAL PLANNING AND PRIORITIZATION

Asset management programs focus on replacing the right infrastructure or assets in the right way and at the right time. This year's survey provides a baseline for the current basis of repair and replacement decisions among U.S. utilities (Table 4). As expected, staff knowledge of assets and the condition of each is used by more than 85 percent of all utilities in developing repair and replacement programs.

It is encouraging to see that more than half of respondents in each size demographic also use detailed condition assessments and risk assessments to provide analytical support to these important financial decisions. However, deterioration modeling is only used by a small number of all respondents (15.5 percent), which is likely a reflection of the lack of available data and understanding or awareness of this capability. Deterioration models are powerful tools for forecasting risks and impacts on service levels. Justifying capital expenditure and/or customer rates is a top issue nationally. Deterioration models will help utility leaders demonstrate the need for specific investments and quantify the potential consequences of inaction.

As greater levels of intelligence and data collection are implemented across the utility enterprise, such as advanced distribution programs and sensors, obtaining data on asset performance and condition over time will enable the development of deterioration models. This appears to be an area of growth and opportunity for the industry. Approximately 30 percent of respondents stated they are using or planning to improve or implement deterioration models, although this is much greater among large utilities.

In addition to asking the basis for utility repair and replacement decision-making, the Black & Veatch survey once again evaluated the usage plan for many common tools, software and techniques related to asset management (Figure 17). Respondents reported across the board increases in the use and planned development of these supporting elements. The top categories for improvement included condition assessment and operational items such as paperless work order systems and mobile applications. Managerial dashboards were rated the biggest planned improvement, similar to last year's results. The marked improvement and use of these elements paints a positive trend. Today's organizations are advancing all the tools in their portfolio to become the Smart Water Utilities of the future.

TABLE 4
TOOLS FOR DEVELOPING CAPITAL IMPROVEMENT PROGRAMS

Development of Rehabilitation Projects for CIP	All Respondents	By Population Served		
		Small (Under 100K)	Medium (100K-1M)	Large (More Than 1M)
Based on staff knowledge of the asset base and understanding of condition	85.6%	86.6%	85.9%	84.4%
Based on detailed condition assessment	62.8%	52.4%	61.0%	73.4%
Based on risk assessment	61.4%	41.5%	61.0%	77.1%
Based on book life/design life	27.2%	24.4%	28.8%	26.6%
Based on deterioration modeling	15.5%	13.4%	14.7%	18.3%
Other	4.1%	3.7%	4.0%	4.6%
I don't know	3.3%	3.7%	4.0%	1.8%

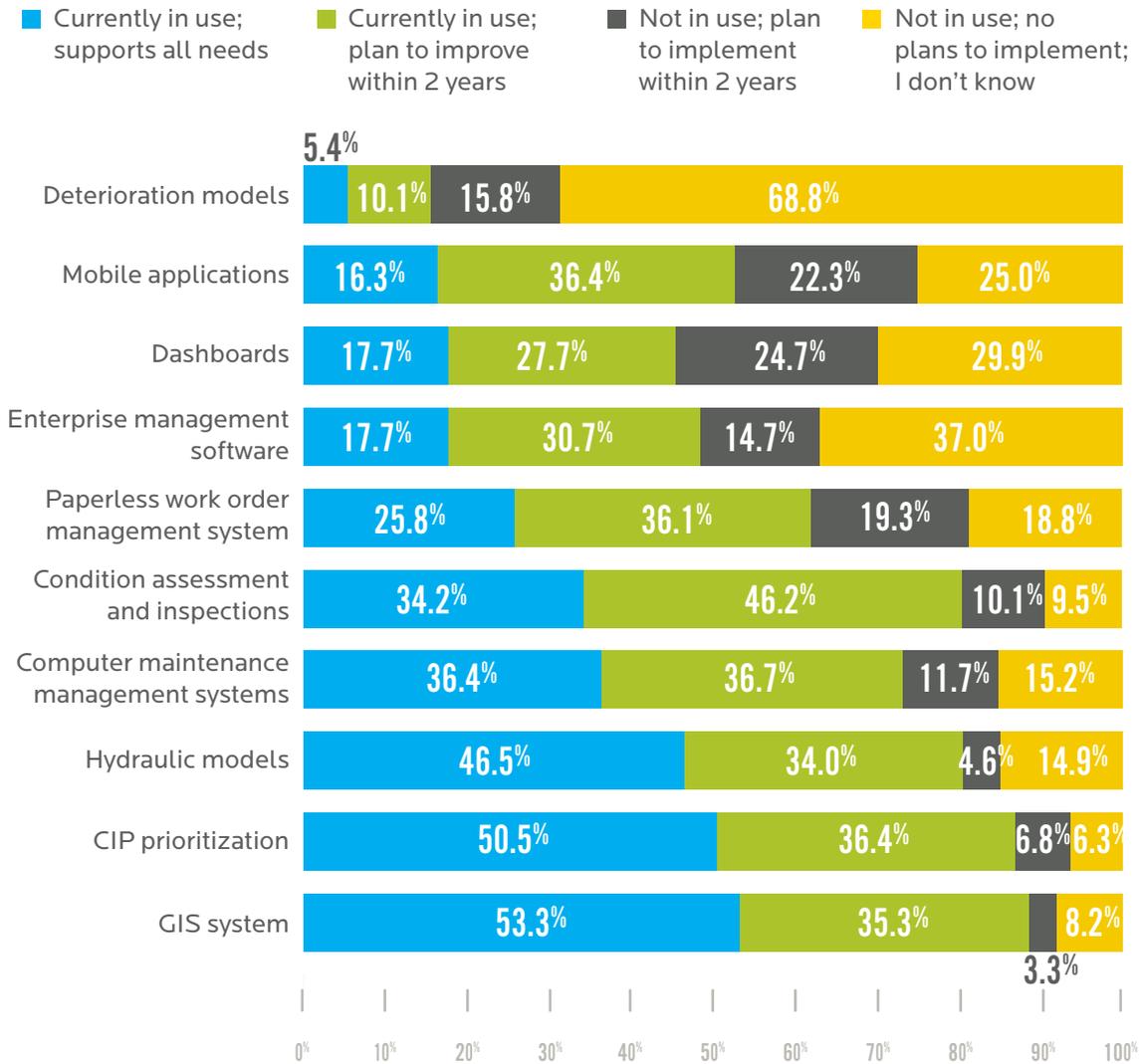
■ / ■ Statistically higher / lower than all respondents at the 95 percent confidence level.

Source: Black & Veatch

Respondents were asked to select all items from the listed options that their utility uses to develop replacement and rehabilitation plans for its capital improvement program (CIP).

FIGURE 17

CURRENT USAGE PLAN FOR TOOLS/SYSTEMS THAT SUPPORT ASSET MANAGEMENT



Source: Black & Veatch

Respondents were asked to select their utility's current usage plan for each of the listed tools/systems that support asset management with their utility.

PLANNING REQUIRED FOR FUTURE SUCCESS

Asset management is playing a profound role in building resilient, financially sound organizations. The vision and commitment to build next generation Smart Water Utilities has led to the continued maturity and adoption of asset management best practices throughout all sizes of organizations in the United States. Achieving this vision, however, requires a commitment to continuous organizational improvement as best practice asset management is not a checklist.

Utilities do not need to have all the tools and systems in place to begin the process of implementing a best practice framework. Rather, utility leaders can begin with the data they have and integrate new data sources over time. The new ISO 55001 standards for asset management, along with other frameworks currently in use, offer the opportunity for U.S. utilities to evolve into the broader benefits of asset management.

GAINING OPERATIONAL EFFICIENCIES

Conditions in the U.S. water industry mirror those experienced in other parts of the world where asset management has become “business as usual.” The need to repair and rehabilitate aging infrastructure, manage and communicate costs, integrate people into asset decisions, and consider how policies affect all aspects of organizations justifies the need for broader adoption of asset management practices.

As more utilities begin framework processes, it will be important to set expectations. True implementation is not an out of the box, flip of the switch solution. Comprehensive programs often take three to five years to fully plan and implement. Implementation often involves organization change that requires strong support from

the highest levels of the utility. But through this change, utilities will emerge better equipped for the challenges ahead. The results from this year’s survey support these conclusions and show a positive trend for asset management in the United States.



DIGESTERS AT THE DAVYHULME FACILITY IN MANCHESTER, ENGLAND, ENABLE UNITED UTILITIES TO RECOVER NUTRIENTS AND ENERGY. THE FACILITY IS ENERGY SELF-SUFFICIENT.



Perspective: Realizing Value with ISO 55001

BY **WILL WILLIAMS**

In January 2014, the International Organization for Standardization (ISO) published ISO 55001, the new international asset management standard. This new standard is the result of more than three years of development and collaboration among 30 participating countries, including the United States, led by ISO Project Committee 251 (ISO/PC251).

The ISO 55001 standard was developed to meet a need for an asset management standard that provides a common and uniform asset management language, is translatable globally and changes the perception that such standards are only applicable to large-scale utility and infrastructure companies and physical assets.

The standards are designed to provide a common language for communicating with financial stakeholders, such as bond agencies, investors, credit agencies and insurers. There are specific requirements for identifying financial reporting needs, considering financial implications of plans and including financial performance when reporting on performance.

While uniform standards and common language are beneficial, the fundamental objective of the international standards is to guide and influence the design of an organization's asset management activities. This is achieved by embedding a number of key concepts and principles within the asset management framework, such as the following:

- Focus on the value that assets provide to the organization and its stakeholders;
- Alignment of organizational objectives into technical and financial decisions;
- The importance of leadership and culture;
- Assurance that assets fulfill their required function.

While ISO 55001 is a new standard, it is based on Publicly Available Specification (PAS) 55 developed by the Institute of Asset Management (IAM) in the UK. PAS 55 methodologies have a proven track record for success within the water, electric and gas utility industries within the UK, Australia, United Arab Emirates (UAE) and, to some extent, the United States. Prior to the development of ISO 55001, PAS 55 served as the default international asset management standard since 2008.

Overall, ISO/PC251 produced three international standards related to asset management. The following provides a high-level description of each:

- **ISO 55000:** Provides an overview of asset management principles, concepts, terms and definitions, as well as a description of the benefits of asset management. Under ISO 55000, asset management is defined as the "coordinated activities of an organization to realize value from assets." The standard defines assets as "Something that has potential or actual value to an organization."
- **ISO 55001:** Provides the specific requirements for a management system for asset management, or a framework.
- **ISO 55002:** Provides guidance for the application of the requirements specified in ISO 55001

The new international standards move the discipline of asset management in a more strategic and financial direction and are likely to add value especially in terms of increasing the exposure and understanding of asset management to a wider audience. Utilities of all sizes can benefit from the adoption and implementation of the ISO 55001 framework, which can be purchased online at: www.webstore.ansi.org.

NORTHEAST PERSPECTIVE: CLIMATE AND FINANCIAL RESILIENCY TOP-OF-MIND

BY KYRIACOS PIERIDES

From Washington, D.C. to Maine, the winter of 2013 - 2014 delivered some of the coldest sustained temperatures in years. The headline-grabbing “Polar Vortex” followed in the wake of the historically hot summer of 2012, continuing a trend of extreme weather and storms that have battered the region. For many of the area’s 50+ million residents, the challenging winter served as a further reminder of the complex operating environment facing Northeast water utilities.

With some of the oldest and largest systems in the nation, time in and of itself is an enemy to ensuring the Northeast’s critical water services. As systems age and become more fragile, their weaknesses can be exposed by frigid temperatures through ruptured pipes and mains. As many homeowners know, a ruptured water pipe is a problem. A ruptured pipe buried underground or behind a wall, is a BIG problem. But, a broken pipe buried under the busiest streets of Washington D.C., Philadelphia, Boston or Manhattan represents an entirely different challenge.

Unfortunately, the financial realities facing many water utilities prevent the rapid deployment of capital to upgrade water systems. Among survey respondents, maintaining or expanding asset life was the number one sustainability issue identified by Northeast respondents (Figure 18).

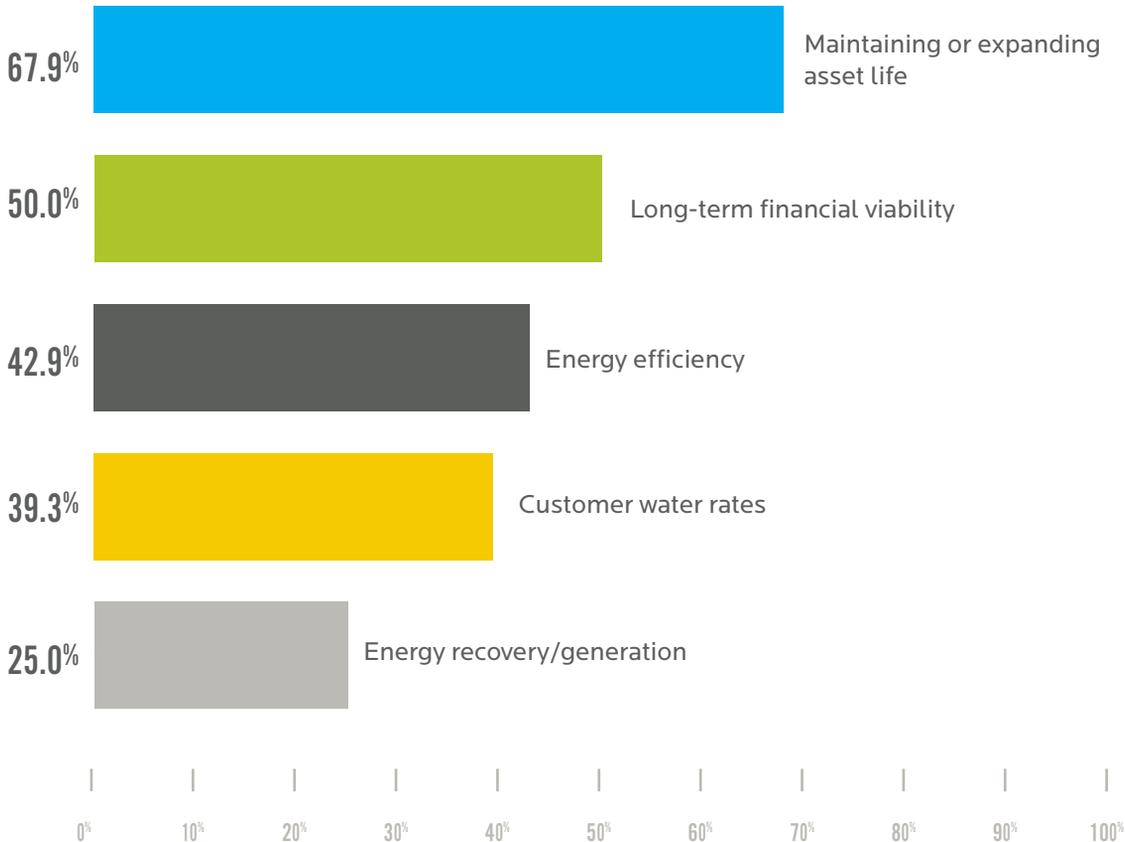
As memories of winter fade, regional water utilities find themselves preparing for the flip side of the climate coin. Increasingly warm summer temperatures are creating a different set of operating challenges, including the need to manage through strong weather events in high population zones.

The double impact of Hurricane Irene (2011) and, particularly, Hurricane Sandy (2012) accelerated regional action to address challenges caused by flooding. With more than 50 million residents living in the coastal megalopolis, flood protection and structural resiliency against flooding has become a central focus of capital spending. Solutions for key issues that were not anticipated decades ago are now under review as system vulnerabilities become more clear.

For example, Hurricane Sandy exposed the fundamental challenge of locating wastewater facilities in coastal flood zones. Many of the plants in the New York/New Jersey metropolitan area were impacted in some way by water surges that backed up outflow routes, overwhelmed pumps or exceeded plant treatment capabilities. Given the function and key role of gravity in discharging treated water, moving a wastewater treatment plant away from a water source is not feasible. Now, some operators are looking at how to balance the costs of new floodwalls and elevating critical equipment above floodplains to harden assets and improve resiliency.

FIGURE 18

MOST SIGNIFICANT SUSTAINABILITY ISSUES – NORTHEAST REGION



Source: Black & Veatch

Respondents were asked to select the three most significant sustainability issues for their utility from a broad list of items. This chart highlights the five issues selected most among all respondents serving the Northeast region.

COMPREHENSIVE RESILIENCY PLANNING

In the wake of major climate events, the pressure on elected officials and water utility executives to take preventive action is significant. In these moments it is critical to take a holistic approach to managing resiliency planning. For example, floodwalls and barriers can be a workable solution, but only as part of an integrated plan, as each measure has corresponding impacts on their surroundings.

Highlighting a comprehensive approach to resiliency planning is the groundbreaking New York City Special Initiative for Rebuilding and Resiliency. Released in June 2013, the report was created by a task force charged with developing a long-term focus on preparing for and

protecting against the impacts of climate change to increase the resilience of infrastructure and buildings citywide. Black & Veatch experts worked with the task force to help officials view the potential impacts of storms on water, wastewater, power, telecommunications and other forms of infrastructure.

Finding the balance between moving quickly while being deliberative is essential to developing a forward-looking resiliency plan. In an era where even the largest system operators are limited by budget constraints, risk-based assessments and planning help build resiliency through replacing, fixing, investing in the areas of greatest need and at greatest risk of failure.

SOUTHEAST PERSPECTIVE: PREPARE FOR DISRUPTIONS WITH MORE RESILIENT SYSTEMS

BY RAFAEL FRIAS

Water utilities in the Southeast face a dizzying array of challenges. Hurricanes, water scarcity, population growth and looming federal and/or state regulations concerning water effluent quality, are top-of-mind among industry leaders within the region. Failure to address these threats can directly impact a water utility's financial standing, customer relations, and ability to provide safe and reliable service.

Aesop's *The Grasshopper and the Ant* fable highlights the virtues of preparing for the future. Just as the ant and the grasshopper both knew winter was coming, water industry leaders in the Southeast know stricter water effluent regulations are forthcoming. We know every tropical depression that forms in the Caribbean between mid-May and November has the potential to become the next hurricane capable of wreaking havoc on communities and infrastructure. We also know our available freshwater supply is shrinking.

What is not known is *when* these disruptions will occur, so it is critical to begin preparing by building more resilient operations. Perhaps herein reveals the greater challenge: convincing a skeptical public and hesitant elected officials that rate increases are necessary to ensure the sustainability of water supplies and a utility's ability to quickly recover from natural and/or man-made disasters. For utilities that rely on city council approval for rate adjustments to finance needed improvements, leaders must do what they can to educate city leaders and their constituents on the true value and cost of delivering fresh drinking water, and the risks that come with not making necessary investments.

TWO PROBLEMS – ONE SOLUTION

The concentration of nutrients within water effluent is an important issue impacting utility capital spending and overall environmental quality. The U.S. Environmental Protection Agency (EPA) has mandated a numeric criterion be developed to reduce nutrient concentrations within the Gulf of Mexico. Currently, each state is responsible for developing these criteria, although the EPA will step in if a state or states fail to do so.

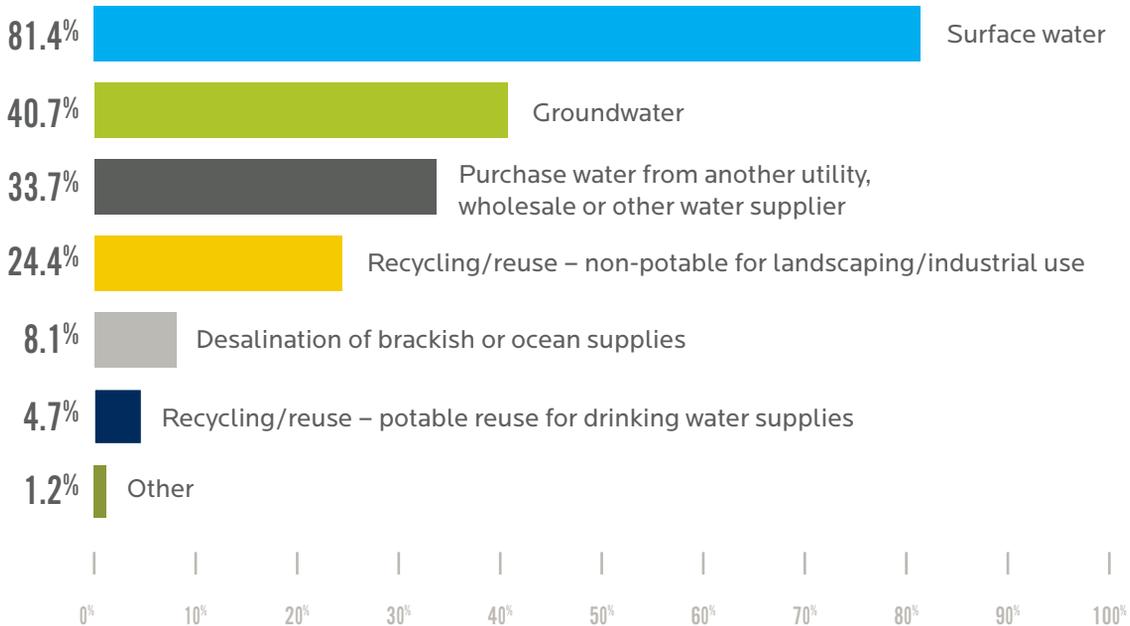
Nutrient criteria will affect all utilities in the region that treat wastewater and return it to water sources. Utilities can begin working in advance to address this issue by assessing current effluent concentration as well as various advanced treatment processes needed to reach anticipated concentration goals.

At the same time, the availability of water is becoming a much sharper area of focus as a result of drought, saltwater intrusion and overall availability. Highlighting this issue was the "water war" between Alabama, Georgia and Florida that raged within the federal court system for more than 20 years. The tri-state dispute started in 1990 when Alabama and Florida filed separate federal suits against the U.S. Army Corps of Engineers and Georgia challenging the Corps authority to reallocate water supply from Lake Lanier to the Atlanta region. In 2011, a federal appeals court confirmed the Corps authority to regulate Lake Lanier for Atlanta's water supply.

Advanced water treatment programs to meet nutrient regulations can help the region address its water scarcity issues. Water reuse or water recycling is a proven solution and an area of opportunity. Currently, less than 5 percent

of utilities in the region use reclaimed water for drinking water supply (Figure 19). Utility leaders should consider the possibilities of harnessing this highly treated water resource for aquifer and/or groundwater recharge.

FIGURE 19
CURRENT SOURCES OF WATER – SOUTHEAST REGION



Source: Black & Veatch

Respondents were asked to identify all water supply sources available/used by their utility. This chart represents responses from survey participants serving the Southeast region.

PLAN THE WORK, WORK THE PLAN

Implementing best practice asset management frameworks is the first step for any utility, regardless of location, to begin the transformation from a reactive organization to a proactive one. Asset management programs provide utility leaders with the information and metrics needed to justify necessary rate adjustments (refer to *Top Water Infrastructure Issues Solved through Asset Management* analysis).

Through an asset management program, comprehensive plans can be developed that are based on the assets the utility currently has, current condition of assets and the capabilities of each. For the Southeast utilities, these plans must include integrated water resources management as well as preparations for enhanced

nutrient removal. Technology master plans should also be developed in order to adopt automated processes that can help further reduce operational and labor expenses and increase efficiencies.

From water supply issues to storms, drought and other climate effects, Southeast water utilities have long been affected by challenging operating conditions. Yet, a key benefit of what has become an extended period of hardship is hindsight. Utilities in the Southeast are perhaps best positioned to apply lessons learned not just at home, but from abroad as they embark on proactive planning campaigns. To prepare for the future, these lessons must be applied now.

MIDWEST PERSPECTIVE: HOLISTIC APPROACH BEST FOR CAPITAL PROGRAMS

BY **BRUCE ALLENDER**

“What’s the best way to eat an elephant? One bite at a time.” This age-old adage is often cited by business, organizational and industrial leaders when determining the best way to tackle overwhelming challenges. For Midwestern water utilities, however, a one bite at a time approach will not help them catch up to the tremendous capital program needs brought on by:

- Years, and sometimes decades, of deferred maintenance;
- Environmental compliance programs, specifically stormwater runoff and/or combined sewer overflow reduction programs; and
- A need to add resiliency to infrastructure and water supply in a region prone to severe drought and flooding (many Midwest cities have experienced both during the last 10 years).

Addressing the full scale of a water utility’s infrastructure needs will likely take decades. This is particularly true for communities whose infrastructure challenges include all of the previously listed items. The sheer scale and longevity of such programs underscores the need for best practice asset management. Black & Veatch’s work as part of the Asset Management Alliance supporting Welsh Water for the past 15 years demonstrates the payback of such programs over time.

Welsh Water is one of 10 regulated water and sewerage companies in England and Wales, serving more than 3 million people. Over the course of a 15-year, \$650 million capital improvement program, Welsh Water was able to reduce overall capital expenditures by 20 percent and its operating costs by 10 percent while still maintaining its level of service to its customers. Welsh Water was able to achieve this using the PAS 55 framework (refer to *History and Description of Infrastructure Asset Management Frameworks* for more information).

FINANCING THE CHALLENGE

Formal asset management frameworks are proven methods for reducing overall utility costs and enhancing services. However, the best asset management practices cannot erase the massive capital needs of our utility systems. Public officials are understandably concerned with creating a greater financial burden for their constituents. Some argue that water is free because it falls from the sky and is a basic human need. What these arguments fail to mention is that providing and maintaining the delivery of clean, safe and reliable water and wastewater services is a high-cost undertaking.

Community leaders and their constituents must understand that rates must rise in order to make the needed investments in their water and wastewater systems. How much and how fast rate increases happen depends squarely on the condition of the system and the willingness of the community and utility leadership to explore different management and financing mechanisms. Specifically, utility and city leaders should rethink how they finance large-scale deferred maintenance needs in a manner that minimizes rate impacts to customers.

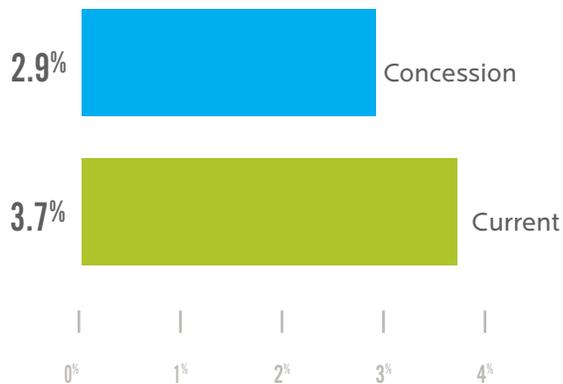
Private sector capital, through the form of a public-private partnership (PPP), can come in many forms, with many different arrangements. A common challenge for PPPs, however, is the overall “cost of money” from the private sector versus the cost of municipal bonds, the preferred

choice of municipal leaders. At first glance, the difference can be significant: typically 3 to 5 percent interest for municipal bonds versus a weighted average cost of capital between 7 and 9 percent from the private sector.

The difference in the cost of money often ends discussions of PPPs before a thorough analysis of potential benefits can take place. However, utility and community leaders should look beyond the cost of money and look at “value for money.” A life cycle cost analysis will enable utility leaders to consider the best approach for a capital program and assess the near- and long-term impacts to rates (Figure 20).

In addition to examining new financing methods, utilities should also try to match financing timelines to system needs and consider a generational payback period. Generational payback periods can provide rate relief to current customers and evenly distribute the financial burden of capital program spending among all who will ultimately benefit from the service.

FIGURE 20
COMPARISON OF FORECASTED AVERAGE ANNUAL RATE INCREASES FOR LARGE MUNICIPAL UTILITY



Source: Black & Veatch

This chart provides a comparison of the average annual rate increase customers of a large municipal water utility would have over the life of a concession agreement versus current operations and CIP financing methods. The analysis examined the total revenue requirement of the system in order to address regulatory requirements, deferred maintenance needs and costs associated with day-to-day operations and maintenance.

BUILDING IN RESILIENCY

The longer communities wait to address their aging infrastructure systems, the greater the issue and burden becomes. Unlike Midwestern residents, century-old pipes simply cannot become accustomed to the wide variety of extreme weather experienced within any given timeframe.

In 2013, the state of Kansas became the first state to have declared disaster zones as a result of flooding (in the east) and drought (in the west). In the last 10 years, the Missouri River has had two significant floods, in 2008 and 2011, and dramatically reduced water levels as a result of drought. Severe drought in 2012 threatened to close the Mississippi River to barge traffic. Addressing the aging infrastructure challenge at the same time utilities work to meet environmental regulations provides the opportunity to build in resiliency to the system to meet the new normal in weather and climate for the region.

Without question, balancing the conflicting demands of a community is a significant challenge for local elected official and utility leaders. The critical condition of many water and wastewater system assets coupled with financially constrained ratepayers is a huge hurdle to overcome. Yet, opportunities to challenge the status quo and explore proven best practices from around the world could be the solution to improve our water and wastewater infrastructure.

SOUTHWEST PERSPECTIVE: TECHNOLOGY'S ROLE IN OVERCOMING WATER SCARCITY

BY KEVIN CORNISH

Perennial water scarcity issues in the Southwest and South Central United States have fundamentally changed how water is viewed, managed and used. Increasingly, competing interests often erupt between agricultural, community and environmental water needs – all of which cannot be satisfied with limited water resources. Additionally, there are no new freshwater resources to tap, highlighting the urgency for enhanced conservation programs.

While the entire solution set for overcoming water scarcity challenges is multifaceted, utilities within the region are increasingly using available technologies to improve water management. Specifically, technology programs provide utilities with improved metering information, the ability to monitor water rationing, provide utility and customer-side leak detection, and support customer education and conservation programs.

The following provides a high-level overview of technology-enabled programs and how each can support greater levels of water conservation and management.

ADVANCED METERING INFRASTRUCTURE

Advanced metering infrastructure (AMI) is a solution that not only improves operational efficiency, reduces ongoing expenses and improves customer service, but also provides the utility and end-use consumers alike with significantly more information on which to make decisions. Beyond the current industry practice of only collecting monthly or bi-monthly water meter reads, there are currently a large number of water users in California's Sacramento Valley that do not even have water meters. Without the ability to measure consumption at a level of refinement and timeliness, it is difficult for water providers to know where conservation efforts should be focused and/or the success of each program.

Information contained from AMI meters can be aggregated to provide time-synchronized system flow information. Custody transfer meters and large C&I meters can be monitored continuously, eliminating potential for catastrophic failures or surprises. Meter flow for residential customers can be used to identify potential leak conditions on the customer side of the meter. This capability enables the utility to alert customers of a potential leak, thereby reducing wasted freshwater resources and unexpectedly high water bills.

Increased data from AMI meters also support development of advanced rate methodologies, such as time-of-use programs. Time-of-use rates help to inform customers and create incentives to shift water usage to more efficient periods. This can be especially useful for utilities that purchase power from entities that also charge premiums during high-demand periods.

CUSTOMER ENGAGEMENT

Customer engagement strategies are critical components of utility efforts to improve water understanding and conservation. Without customers actively changing how and when they use water, conservation efforts will not be as successful as they should. As with most utility commodities, customers rarely understand what a cubic foot of water looks like, or when news reports refer to an acre-foot.

Leveraging AMI data to provide consumers with daily — and even hourly — water consumption provides improved understanding of water use. Residential customers can see when sprinklers water in the early morning, how much water it really takes to fill up the hot tub and more. Studies have repeatedly shown that greater customer understanding and information on water use leads to reduced water use.

LEAK DETECTION

A critical component of an integrated water loss management approach is leak detection. All water systems have leaks; many exist for long periods of time but go unnoticed underground. The challenge for utilities is identifying, locating and focusing on the more impactful leaks with the limited capital infrastructure budget that exists.

Advanced acoustic leak detection systems that triangulate and locate leaks provide accurate and reliable leak information on which to act. Reducing water loss contributes not only to conservation but improves operating efficiency and may even delay significant utility water processing facility upgrades.

WATER REUSE OR RECYCLING

Technology enables water quality monitoring and real-time system flow information from SCADA and AMI systems. This information can be used by utilities to create programs and target infrastructure investment in the area of water reuse.

While water reuse is a well-used tactic by larger commercial and industrial customers, few cities have taken advantage of this resource to create a utility-managed recycled water program. The city of Santa Rosa, California, and Global Water properties in the Phoenix, Arizona area are excellent U.S. examples of developing a comprehensive, utility-managed recycled water system.

Currently, less than 20 percent of utilities in the Southwest region reuse water to supplement drinking water supplies (Figure 21). As demand grows, reuse must also grow within the region.

ENERGY EFFICIENCY

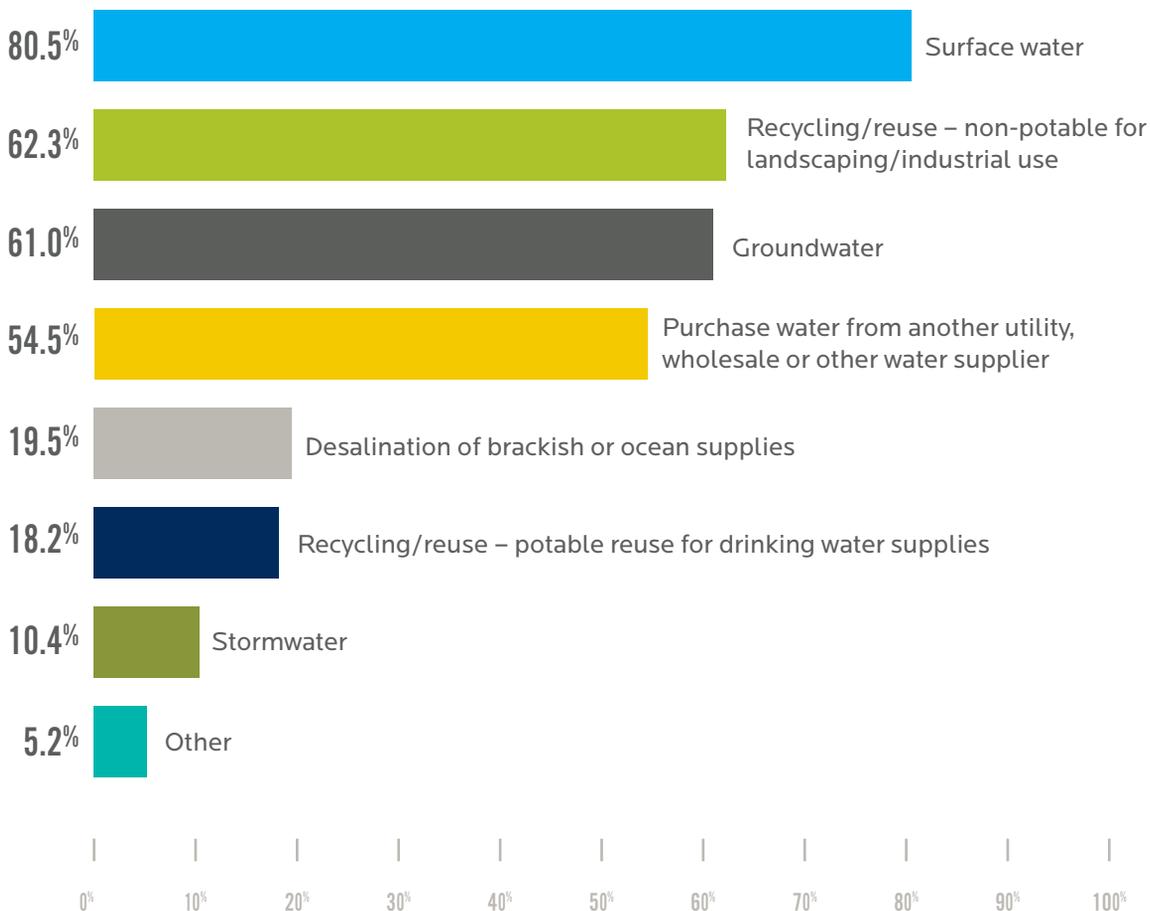
Electric energy use is a significant component of operating costs for all utilities for the production, treatment, pumping, storage and delivery of water. This is especially true for utilities in the West and South Central United States where water is sometimes pumped hundreds of miles from source to consumer.

There are two ways to lower utility energy costs: implementing off-peak pumping programs and reducing the need to use energy. Conservation and/or loss reduction programs reduce the amount of water that is treated and pumped through a system.

System monitoring capabilities enable utilities to determine the amount of current water storage, forecasted water use, and the impact of deferring pumping to off-peak periods. By deferring pumping, water utilities can take advantage of very favorable time-of-use rates and curtailment options from their local electric utilities. In addition, given that energy production is a water-intensive activity, saving energy also helps save water.

REGIONAL VIEWPOINTS

FIGURE 21
CURRENT SOURCES OF WATER – SOUTHWEST REGION



Source: Black & Veatch

Respondents were asked to identify all water supply sources available/used by their utility. This chart represents responses from utilities serving the Southwest region.

TECHNOLOGY AND DATA ANALYTICS CAN HELP UTILITIES AND CUSTOMERS BETTER MANAGE PRECIOUS WATER SUPPLIES.



STRATEGIC DIRECTION FOR U.S. WATER UTILITIES

BY CINDY WALLIS-LAGE

At the macro level, solutions to widespread water industry challenges seem simple: invest more in infrastructure, save more water, keep customers happy. But, as this report shows, when it comes to individual communities making difficult choices between raising customer rates and meeting operating budgets; or states deciding between fish, people and agriculture for scarce water resources, clear-cut solutions can be difficult to ascertain.

Identifying actionable plans that balance competing interests, such as water allocation, rate affordability and necessary investment requires an all-encompassing approach. For this reason, Black & Veatch continues to advocate the adoption of best practice asset management programs.

Frameworks, such as the new ISO:55000 series, provide proven standards and methods for utilities to develop their customized blueprint for achieving desired organizational goals. For utility leaders struggling to justify expenses and rate adjustments, risk-based planning provides essential data. This includes the information needed to educate decision-makers on why investment is needed and the potential risks associated with continued deferred maintenance programs.

Information-based decision-making is also becoming the norm for Smart Water Utilities as they move toward a Smart Integrated Infrastructure paradigm. System data should underpin everything because advances in information capture and analysis can provide major cost benefits in terms of how a utility or a specific asset is managed. While there are still barriers to entry for smaller organizations based on cost, it is imperative to note that advances in cloud-based services and telecommunications networks are quickly leveling the playing field between large and small utilities. Information systems once out of reach for a host of reasons can be integrated with few hurdles.

Greater access to information is a powerful tool for both the utility and its customers. Utilities can use information to identify, detect and repair problems before they

become potentially catastrophic asset failures. In regions suffering from sustained and severe drought conditions, information can help enforce water rationing and monitor usage, as well as quickly identify resource-wasting leaks. Customers who have access to information regarding their water usage are empowered to change water use behaviors, similar to demand side management developments and new consumer tools impacting the electric industry.

Even as utilities work to introduce advanced metering infrastructure (AMI) or other significant capital programs, the adoption, implementation and strict adherence to best practice asset management frameworks can help guide a utility through current and future challenges. In an era when utilities must leverage every opportunity for efficiency, justify every dollar spent and conserve as much water as possible, there really is no substitute for good asset management practices.

Asset management programs are also powerful management practices for optimizing capital spending. Prioritization of need enables utilities to make investment decisions based on actual asset condition and can help reduce overall capital spending requirements. Beyond efficiencies gained, however, lies the inherent need to invest in large-scale repair and replacement, environmental compliance and water resource programs.

How utilities choose to implement capital programs will affect current ratepayers and future generations, as well as the utility's ability to continue to meet community needs in the future. Implementing new financing mechanisms can be challenging within any community. Private financial firms and/or design-build, or EPC (engineering, procurement and construction) service providers must demonstrate value in any proposed alternative solutions, particularly value to the ratepayers. At the same time, utility and municipal leaders should thoroughly examine side-by-side comparisons of current financing mechanisms against proposed solutions.

If information derived from the use of asset management programs can help utilities improve performance and reduce costs, this same information can be leveraged to

change customer behavior. Water conservation requires widespread customer engagement and access to information in order to achieve optimal results.

Conservation is an important and valuable endeavor for all utilities, including those in seemingly "water rich" regions. The least expensive drop of water is the drop of water not used. When consumers use less water, utilities pump less through the system, process less water and generally spend less within the overall operations and maintenance of the system. At the same time, customer understanding of the true value of water and the costs associated with providing even that first drop is critical to gaining acceptance to rate-impacting capital improvement programs.

There are many opportunities to deploy innovative technology solutions to address industry water infrastructure needs. However, innovation for the sake of innovation is not ideal for utilities or their ratepayers. Utilities need solutions that make sense to their triple bottom line, accounting for a community's unique financial, social and environmental needs. However, utilities that make innovative technological and capital investment choices based on proven asset management principles have chosen the path of strategic and purposeful direction toward becoming a Smart Water Utility.

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