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2013 STRATEGIC DIRECTIONS IN THE U.S. WATER INDUSTRY

A Black & Veatch Report





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THE NEW CAMELTOWN WASTEWATER TREATMENT WORKS UPGRADE PROJECT FOR SCOTTISH WATER IN THE UK REDUCES WASTEWATER DISCHARGE DURING STORMS AND LOWERS THE RISK OF FLOODING.

Welcome to the 2013 *Strategic Directions in the U.S. Water Industry Report*. For the second consecutive year, Black & Veatch has worked to capture the industry's viewpoint concerning ongoing issues through our industry-wide survey. In addition to graphical interpretation of survey results, our full report provides expert analysis, recommendations and actionable intelligence for overcoming the growing challenges of limited finances, rising costs and the need to ensure the long-term viability of the provision of water and wastewater services.

Primary findings from this year's report validate, at a macro level, what the industry has been saying for years. Aging infrastructure is threatening the financial viability of water and wastewater utilities, and traditional operating models are no longer sustainable. At the micro level, we see a commitment to improvement. However, the industry is just now developing real maturity in regard to formal asset management programs. As a result, ongoing efforts to fix aging infrastructure and gain efficiencies may not be addressing the root causes of some of the challenges impacting utilities.

The good news for U.S. water and wastewater utility leaders is that proven and tested methods for overcoming these challenges exist. In addition to survey findings and analysis, this report serves to highlight best practices and global project case studies that have benefited clients around the world and provided their customers with enhanced levels of service.

On behalf of Black & Veatch, we thank all who participated in our 2013 survey. We also acknowledge our own subject matter experts who contributed their time, talent and knowledge for this year's report. This report and all Black & Veatch thought leadership materials are available at www.bv.com or on our iPad application, which is available for free via the iTunes® app store. To continuously improve our reports and thought leadership materials, we welcome your questions and comments. Please send your feedback or requests for information to MediaInfo@bv.com.

Sincerely,

CINDY WALLIS-LAGE | PRESIDENT & CEO

Black & Veatch's water business

JOHN CHEVRETTE | PRESIDENT

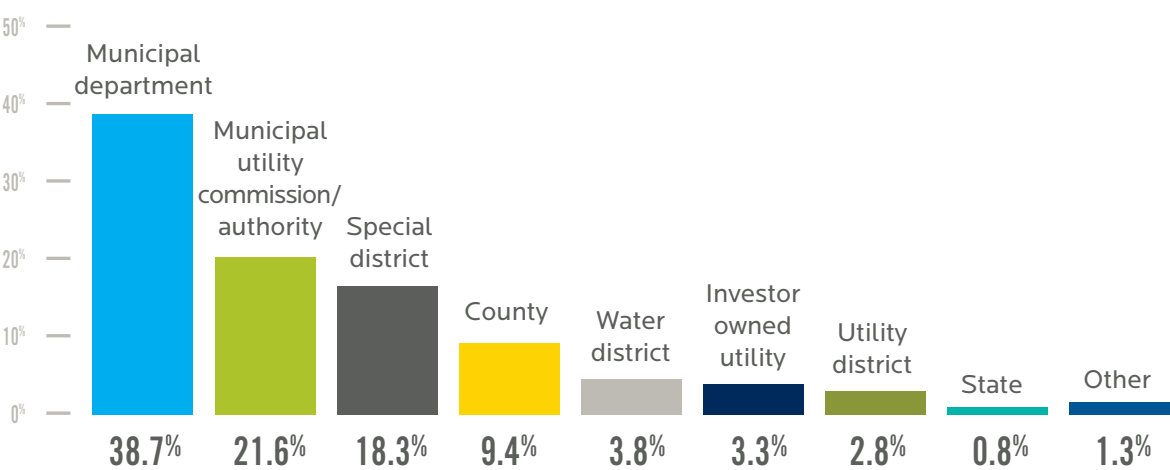
Black & Veatch's management consulting division

The second annual *Strategic Directions in the U.S. Water Industry Report* is a compilation of data and analysis from an industry-wide survey. Since its inception, the report has served to provide insights on challenges and opportunities facing the water and wastewater industry.

This year's water industry survey was conducted from March 18 through April 7, 2013. A total of 397 qualified water industry participants completed the online questionnaire – a 9 percent increase in participation from the 2012 survey.

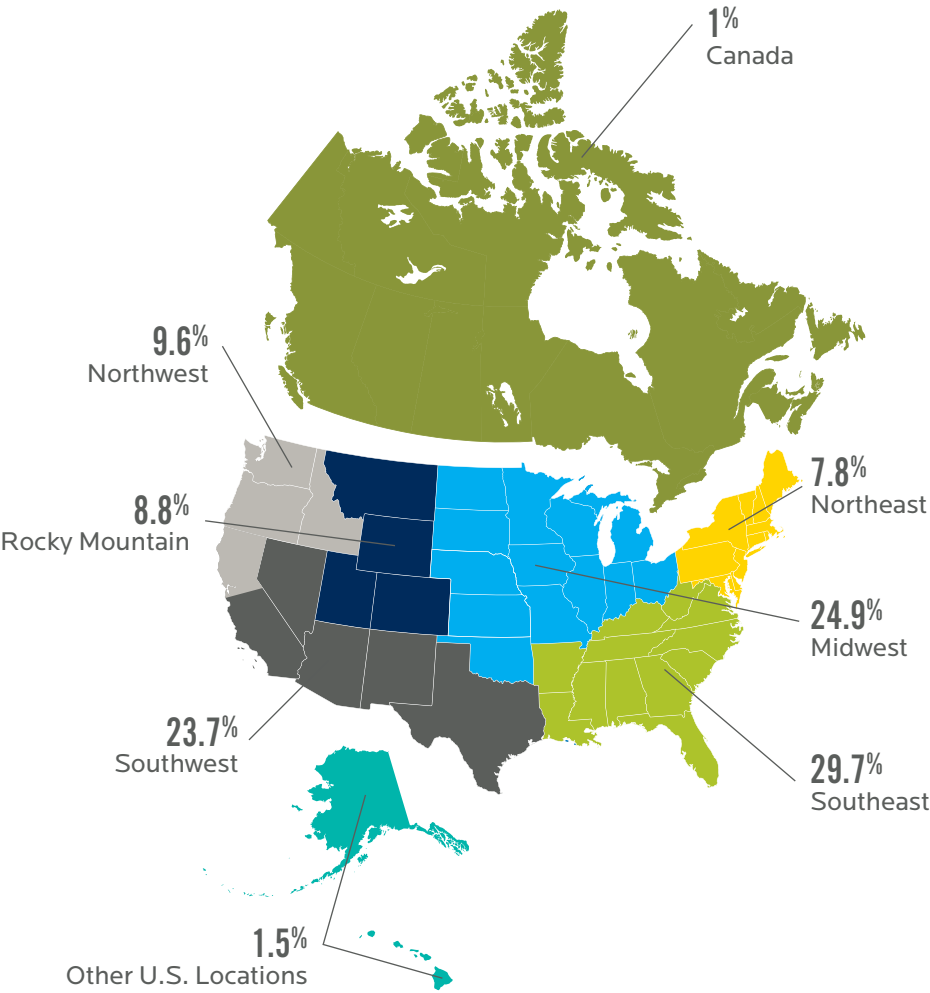
Statistical significance testing was conducted on final survey results. Represented data have a 95 percent confidence level. Figures 1, 2 and 3 provide additional detail regarding the types of utilities represented by respondents, services their organizations provide and geographic regions served.

FIGURE 1
RESPONDENTS BY ORGANIZATION TYPE



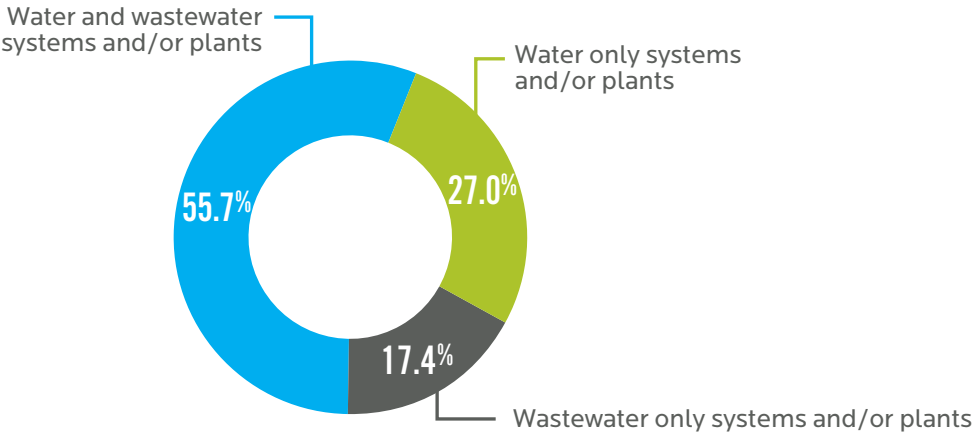
Source: Black & Veatch

FIGURE 2
INDUSTRY RESPONDENTS BY SERVICE REGION



Source: Black & Veatch

FIGURE 3
INDUSTRY RESPONDENTS BY TYPES OF SYSTEMS AND/OR PLANTS



Source: Black & Veatch

THE BLACK & VEATCH ANALYSIS TEAM

EXECUTIVE SUMMARY

John Chevrette is President of Black & Veatch's management consulting division and works closely with clients to address key challenges affecting today's electric, water and gas utilities. Chevrette has more than 20 years of industry consulting experience and has worked with domestic and international clients in the electric utility, energy technology, gas pipeline, telecommunications and water industries.

AGING BURIED INFRASTRUCTURE

David Egger is a Senior Vice President and Executive Managing Director of the Technical Solutions group within Black & Veatch's water business. Egger is also the Director of Heavy Civil for the Americas and Asia Pacific regions, leading teams of highly experienced professionals in the fields of hydropower, buried infrastructure and conveyance, tunneling/trenchless, dams and other areas.

Joseph Mantua is a Project Manager in Black & Veatch's water business. His nearly 30 years of industry experience includes 22 years as a utility manager at one of the largest water/wastewater utilities in the United States. Mantua is actively involved in the American Water Works Association and has served as Vice President and President, in addition to performing numerous committee assignments.

Ahmad Habibian, Ph.D., is a Technical Specialist in Black & Veatch's water business. Dr. Habibian specializes in infrastructure management, pipeline rehabilitation and trenchless technology. His more than 25 years of industry experience has been gained through engineering practice, education and research at the local, national and international level.

INTEGRATED RESOURCE PLANNING

Les Lampe, Ph.D., is a Vice President in Black & Veatch's water business and is the Water Resources Global Practice and Technology Leader. Dr. Lampe is responsible for the technical aspects of numerous water supply plans and designs of storm water and flood control facilities. During the past year, Dr. Lampe was one of six international experts serving on a panel to revise storm drainage and flood control practices in Singapore.

THE NEXUS OF WATER AND ENERGY

Patricia Scanlan is the Director of Residual Treatment Technologies in Black & Veatch's water business. Scanlan's work focuses on technologies that can be implemented at wastewater treatment plants. Scanlan is the chair of the Water Environment Federation's Residuals and Biosolids Carbon Resources subcommittee.

Fred Ellermeier is a Vice President and the Chief Operating Officer for Black & Veatch's Smart Integrated Infrastructure service line that is focused on maximizing client value creation from increasingly intelligent and integrated infrastructure assets. With more than 20 years of experience, Ellermeier is an expert in energy management, energy optimization and sustainable design practices.

ASSET MANAGEMENT

Matt Bond is an Associate Vice President and the Director of Infrastructure Planning and Asset Management for the Americas and Asia Pacific regions of Black & Veatch's water business. In 2012, Bond finished serving as the President of the Water Environment Federation (WEF), an international organization of 36,000 water quality professionals.

James Strayer is an Associate Vice President and Department Manager for Infrastructure Planning

and Asset Management for the America's region of Black & Veatch's water business. Strayer has 20 years of experience in infrastructure planning, asset management and designing conveyance facilities for all types of water systems.

Will Williams is a Director in Black & Veatch's management consulting division where he leads the asset management practice. Williams 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

Jeff Stillman is a Practice Leader for asset management in Black & Veatch's water business. He has extensive experience in using asset information databases and geographic information systems (GIS) to aid development and analysis of various model software packages and prioritization databases to support master planning and development of capital improvements plans.

Martin Jones is a Principal Consultant in Black & Veatch's management consulting division, 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.

TELECOM AND UTILITY AUTOMATION

David Roberts is an Associate Vice President in Black & Veatch's water business and the National Practice Leader for Instrumentation & Control services in the Americas region. He has more than 25 years of experience in the application of automation for energy monitoring, control and optimization of water and wastewater facilities.

William Biehl is an Instrumentation & Controls and Project Manager in Black & Veatch's telecommunications division. With more than 20 years of experience, Biehl oversees implementation of projects for electric, water and gas utilities across North America.

FINANCIAL OVERVIEW

John Kersten is a Vice President in Black & Veatch's management consulting division. His experience encompasses a full range of utility finance issues, including wholesale and retail ratemaking, revenue bond financial feasibility reports, capital financing analyses, economic feasibility studies and strategic and business planning, among other areas.

Bruce Allender is the Chief Operating Officer of the infraManagement Group (iMG), a wholly owned subsidiary of Black & Veatch. Allender works with infrastructure funds to develop concession contracts in North America for water and energy projects. Prior to his appointment with iMG, Allender was the Director of Business Development (North America) for Black & Veatch's water business.

William Ziebertz is the Director of Municipal Financial Consulting in Black & Veatch's management consulting division with more than 25 years of water industry experience. He currently serves as chair of the American Water Works Association's Rates and Charges Committee and is a contributing author to the recently released edition of M-1 Principles of Water Rates, Fees and Charges.

COMMENTARY

Cindy Wallis-Lage is President of Black & Veatch's water business, leading the company's efforts to address billions of dollars in water and wastewater infrastructure needs around the world. Wallis-Lage joined the company in 1986 and has provided project and leadership expertise to more than 100 municipal and industrial facilities throughout the United States, the UK and Asia Pacific.

EVOLVING UTILITY MANAGEMENT

BY **JOHN CHEVRETTE**

The 2013 *Strategic Directions in the U.S. Water Industry Report* expands upon our inaugural report to examine further the true costs of aging infrastructure, new ways to access critical capital for renewal efforts and options to enhance operations, among other key industry concerns. Analysis of this year's Top 10 Industry Issues list shows the top five items remain virtually unchanged, in terms of average score for each issue as well as overall ranking, when compared with 2012 results. The lone exception is that "Funding or availability of capital" has switched positions with "Managing operational costs" (Figure 4).

Perhaps the greatest surprise within the Top 10 Industry Issues list is the relatively low consideration for water loss, or non-revenue water. Aging infrastructure is the top concern followed closely by managing capital costs and operational costs. The *Buried Infrastructure* analysis details why a focus on reducing non-revenue water could help alleviate the accelerating deterioration of critical distribution and collection systems (thereby reducing capital costs) and enhance efficiencies within the organization (reducing operating costs).

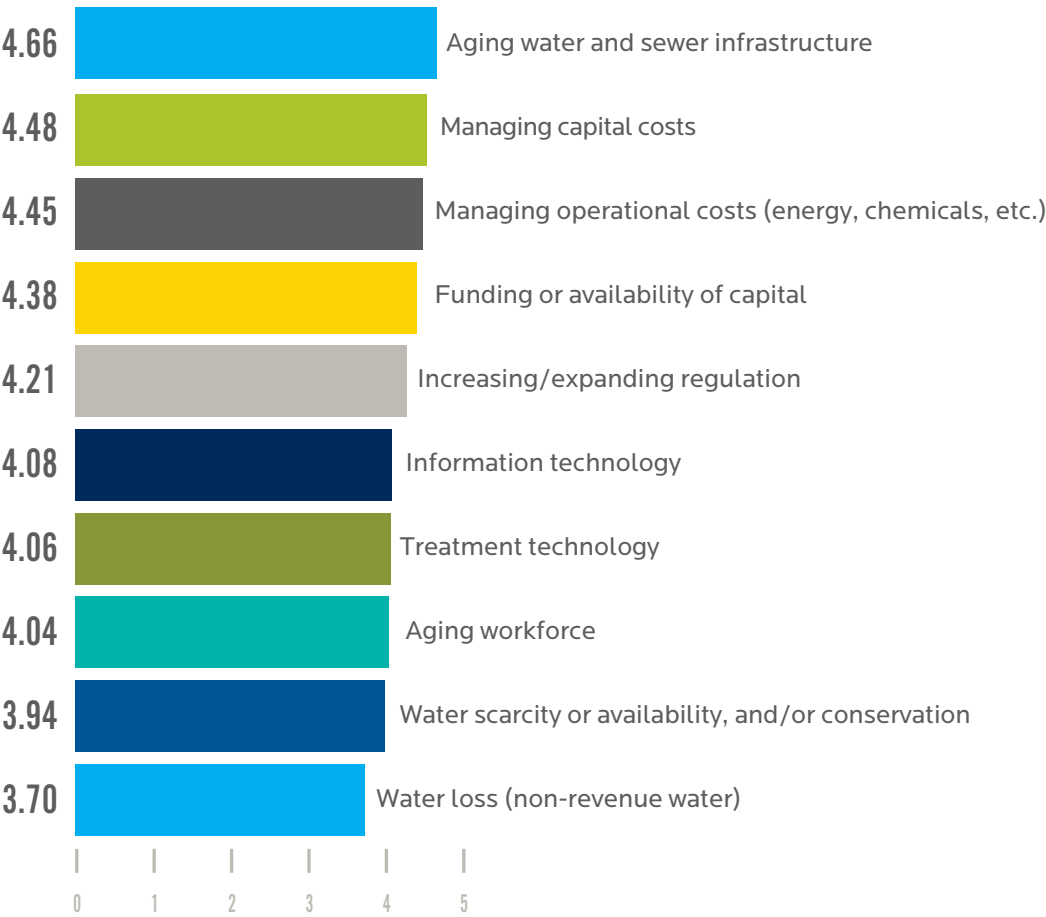
Regionally, the ranking of The Top 10 Industry Issues is fairly consistent across the board with the exception of "Water scarcity or availability, and/or conservation." Nationally, this was the ninth-ranked issue; however, respondents in the arid Southwest and Rocky Mountain regions ranked this issue fourth and second, respectively. With changing weather patterns and prolonged drought experienced across most of the country recently, the majority of utilities are incorporating drought contingency planning into their long-term water supply planning process, and nearly half are looking more at water reuse options. The *Integrated Resource Planning* analysis details additional information on ensuring a sustainable water supply.

The focus on reducing operating costs is also evident in responses to questions regarding energy programs that utilities have or are considering implementing. As noted within *The Nexus of Water and Energy* analysis, nearly 70 percent of utilities have or are in the process of implementing energy efficiency, optimization and/or management programs.

The focus on energy efficiency, aging infrastructure and managing costs has bred increased interest across the industry for the adoption of formal asset management

programs. This is a positive trend that, if fully embraced, can be the turning point for water and wastewater utilities in achieving a stronger financial position and more efficient operations. It will be interesting to see if these programs push the needle for infrastructure investment from largely reactionary (regulatory compliance and safety and reliability) (Figure 5) to a more risk-based, proactive approach in the future, a clear sign that these programs have become fully engrained in the organization and decision-making process.

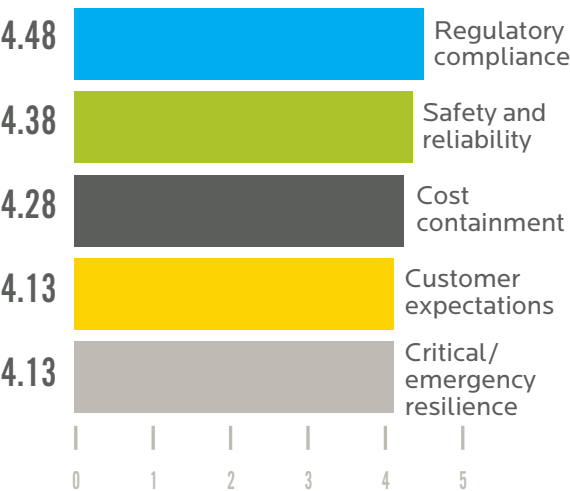
FIGURE 4
TOP 10 INDUSTRY ISSUES



Source: Black & Veatch
Participants were asked to rate the importance of each issue using a scale of 1 to 5, where 1 indicates “Very Unimportant” and 5 indicates “Very Important.”

EXECUTIVE SUMMARY

FIGURE 5
TOP 5 INFRASTRUCTURE INVESTMENT DRIVERS



Source: Black & Veatch
Participants were asked to rate the level of impact specific issues have in driving ongoing infrastructure investment using a scale of 1 to 5, where 1 indicates “Very weak” and 5 indicates “Very strong.” For the second year in a row “Regulatory compliance” is the top investment driver.

While survey results show the industry is committed to this massive undertaking, the data also suggest most of the industry is very much at the starting point and only now beginning to understand the full scope and potential benefits of such programs. The *Asset Management* analysis provides additional information for utilities interested in implementing a formal program.

Beyond the top five issues, information technology made a large jump in this year’s rankings (from ninth last year to sixth this year). Emerging technologies, such as cloud computing, virtualization and hosted applications are providing access to additional tools, resources and services to the water and wastewater industry that improve operations and potentially reduce costs. Security concerns, however, may have a dampening effect on the adoption of some telecommunications and automation technologies.

Through client work and industry activity, Black & Veatch is increasingly seeing water and wastewater utilities taking steps toward improving the security of their network infrastructure and, in many cases, following some of the

approaches taken by other industries (i.e., electric) that have had well-established standards and regulations for some time. As a whole, the water industry tends to adopt technologies only after systems and processes have been well-proven. Regardless, any and all large information technology programs should be included as part of a comprehensive master plan to ensure alignment with strategic goals. Additional information can be found in the *Telecommunications and Utility Automation* analysis.

Survey data is encouraging in that it shows an industry willing to change the manner in which it operates and develops plans in order to reduce waste and enhance service delivery to its customers. Unfortunately, these changes do not erase current capital needs, and respondents remain hesitant to look beyond traditional financing methods. As noted in the *Financial Overview* analysis, many municipalities today can no longer afford to defer necessary water and wastewater infrastructure renewal and rehabilitation.

Continuing the practice of deferred maintenance provides customers with a relatively smaller rate reprieve today as compared to the exponential costs that will come from having to replace deteriorating assets. Headlines pointing to municipal bankruptcies, diminished credit ratings and defaults demonstrate the need for today’s leaders to act now and consider all financing options, including private sector financing, from a position of strength. Continued inaction places utilities and municipalities at risk of having terms dictated to them in the future due to deteriorating asset and utility financial conditions.

The good news is that U.S. utility leaders do not have to develop new alternatives. Proven methods for alternative financing, capital delivery, asset management and enhancing operations exist. Case studies of successful programs that have benefited utilities and that provide enhanced levels of service to customers in the United States, UK, Hong Kong and Singapore, are noted throughout this report.

The needs of today’s water and wastewater utilities are great, but not insurmountable. Black & Veatch’s breadth of service capabilities and extensive project experience

provide utility leaders with a single point of contact for all their planning, management and capital implementation needs. For more information on how Black & Veatch can help your organization, please visit www.bv.com.



ADDRESSING THE ROOT PROBLEM OF TOP CONCERNS

BY **DAVID EGGER, JOSEPH MANTUA AND AHMAD HABIBIAN**

When it comes to aging infrastructure, this year's survey results indicate that there is significant opportunity to reduce operational and capital costs. Through proactive approaches that address service interruptions due to water main breaks and leakage/non-revenue water, utilities can prioritize replacement and rehabilitation needs.

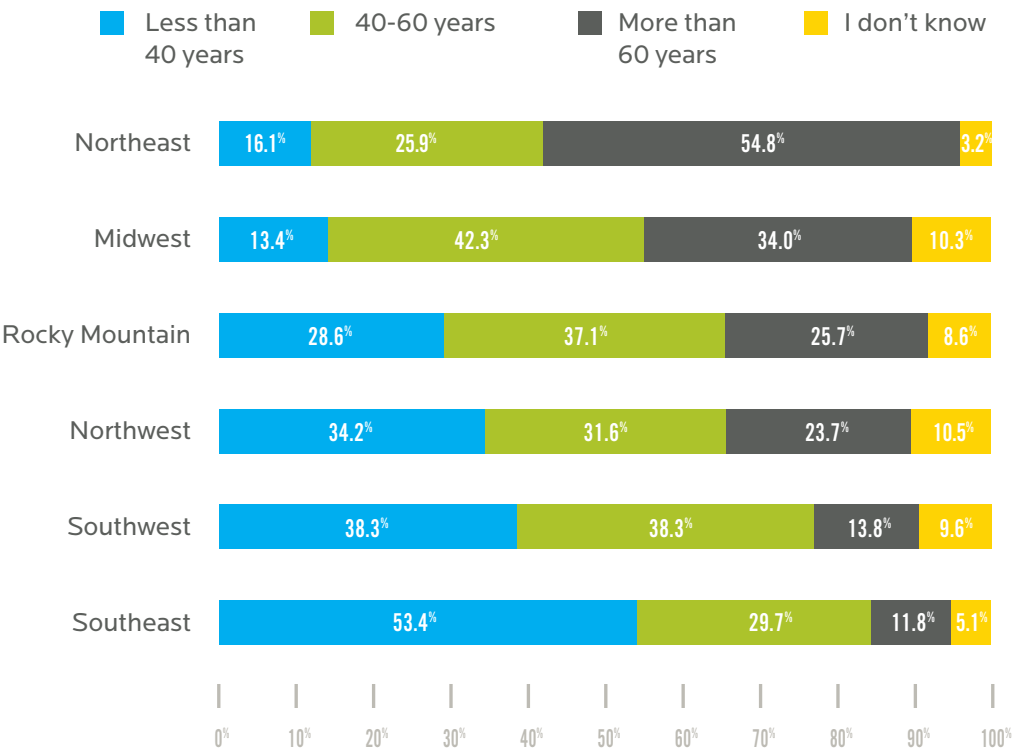
Utility leaders in all regions of the country unanimously selected aging infrastructure as the top concern. While the topic of aging infrastructure addresses all assets including pipelines, tunnels, dams, pumping, storage and treatment facilities, this analysis focuses specifically on buried assets. The rehabilitation and replacement of critical collection and distribution systems – for water, storm water and wastewater entities – represents the greatest need for capital improvements.

Although the focus of leading utilities is on informed spending, the overall lack of spending reported in aggregate does not indicate the reversal of a generational deficit that we have built for our children.

The severity of the problem can be tracked by region. The regions of the country with the oldest infrastructure, by far are the Northeast and Midwest (Figure 6). This aligns closely with Black & Veatch's current client work in the Northeast, where the company is currently engaged in several sanitary sewer programs that are largely driven by consent decrees with state regulators or the U.S. Environmental Protection Agency.

WITH MANAGING CAPITAL AND OPERATIONAL COSTS REPRESENTING TWO OF THE TOP FIVE INDUSTRY ISSUES, REDUCING NON-REVENUE WATER AND THE AMOUNT OF WATER MAIN BREAK INCIDENTS COULD HAVE A SUBSTANTIAL AND POSITIVE IMPACT ON A UTILITY'S BOTTOM LINE AND FUTURE RESOURCE NEEDS.

FIGURE 6
AVERAGE AGE OF DISTRIBUTION AND COLLECTION SYSTEMS BY SERVICE REGION



Source: Black & Veatch

Even though the industry recognizes that its infrastructure is aging, numerous competing demands for available funding mean that investment in rehabilitation and replacement is often slower than what is required. The current rate of replacement for aging collection and distribution systems nationwide is less than 1 percent for most utilities (Figure 7).

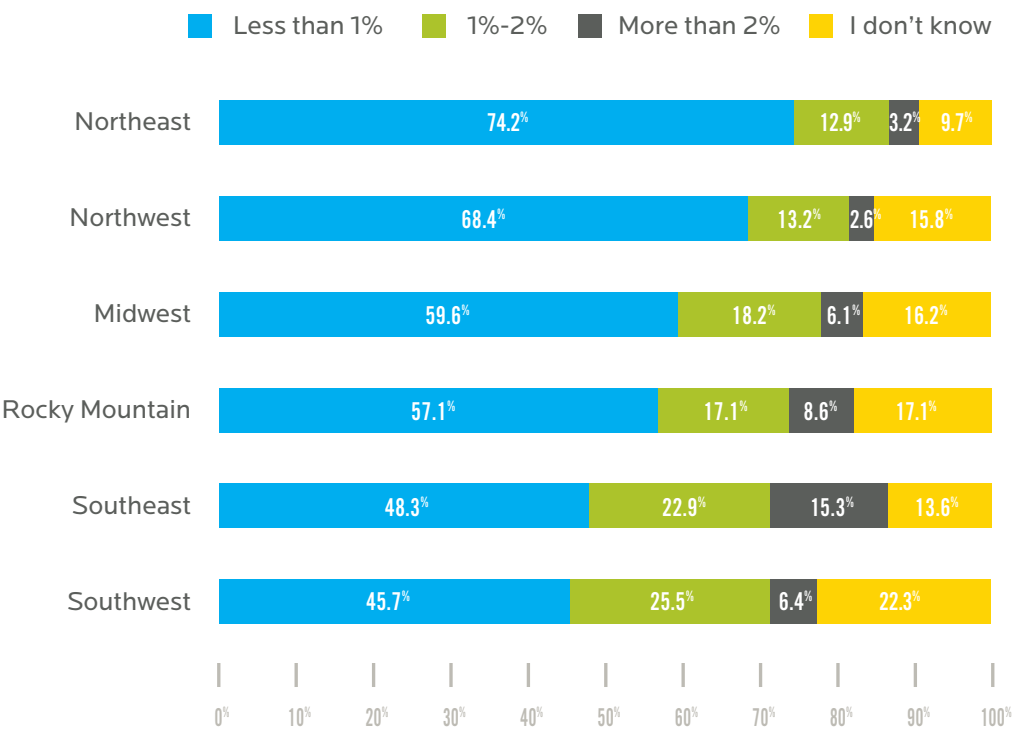
The *Financial Overview* analysis describes that because of flat or even declining budgets, utility managers are often tasked with doing more with less, and in some cases much less, funding. Just as the squeaky wheel will get the grease, capital programs for water and wastewater infrastructure that have regulatory drivers are usually the ones that are funded. So while it may be counterintuitive that utilities in the Northeast and Midwest – regions with the oldest infrastructure – have the slowest replacement rates, these are also the regions that have the highest

amount of activity to remediate sanitary or combined sewer overflows – programs with price tags that typically extend into the billions of dollars range for large systems.

However, conservation of precious water resources may be driving enhanced renewal rates in other parts of the country. For example, the Georgia Water Stewardship Act of 2010 required all utilities serving more than 10,000 people to complete an audit by January 1, 2012, and all systems serving more than 3,000 people by January 1, 2013, and then submit proposed changes to enhance conservation. Notably, the Southeast region has the highest percentage of respondents who indicated replacement rates for collection and distribution systems were greater than 1 percent.

BURIED INFRASTRUCTURE

FIGURE 7
CURRENT RATE OF REPLACEMENT FOR COLLECTION AND DISTRIBUTION SYSTEMS BY SERVICE REGION



Source: Black & Veatch

Renewal of water distribution systems will not only conserve water but also potentially reduce operational costs and increase revenue. Non-revenue water is a combination of system leaks, meter inaccuracies, theft, billing system inconsistencies and unbilled but authorized uses. Water loss includes all but the authorized uses. Non-revenue water just barely made the Top 10 Industry Issues list, indicating a comparatively low level of concern for this issue versus aging infrastructure and managing operating costs. However, non-revenue water, particularly where system leaks are concerned, could be the root challenge to meeting operational, capital and water conservation challenges.

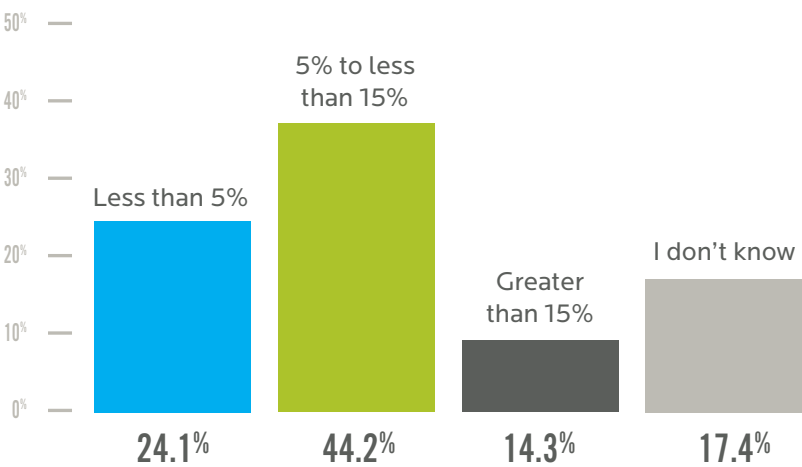
The International Water Association (IWA) and American Water Works Association (AWWA) have developed a standard methodology for reporting water loss that is now being used in North American water utilities and by regulatory agencies (including Georgia, Tennessee, California and the Delaware River Basin Commission). The IWA/AWWA standard uses a set of specific non-revenue

water performance indicators, such as leakage or “real” loss in gallons per connection per day. Black & Veatch is a thought leader in the monitoring and auditing of water loss data under this new methodology.

However, Black & Veatch also recognizes that the majority of utilities still evaluate water loss and non-revenue water by percentage. Therefore, Black & Veatch asked industry participants this year to identify their organization’s current levels of non-revenue water on a percentage basis to allow all respondents to report their data.

Responses to the question regarding current levels of non-revenue water indicate that there is still a fair amount of uncertainty regarding the validity of water loss numbers, including those from respondents to the Black & Veatch survey. This could explain why 17.4 percent of respondents stated they do not know current levels of non-revenue water, and nearly a quarter of respondents stated their organizations have less than 5 percent non-revenue water levels (Figure 8).

FIGURE 8
CURRENT LEVELS OF NON-REVENUE WATER



Source: Black & Veatch
More than two-thirds of respondents believe their organization's current leakage levels are less than 15 percent. NOTE: Responses from organizations that indicated they are "Wastewater Only" service providers were removed.

Reports from many industry associations and Black & Veatch's own client experience demonstrate that well-run and -managed utilities typically achieve leakage levels between 8 and 12 percent under normal water demand conditions. Nationally, non-revenue water levels average just over 20 percent. However, utilities with aging infrastructure, particularly in the Northeast and Midwest, could have levels exceeding 30 percent. Collectively, the larger percentage of "I don't know" responses noted within Figures 6, 7 and 8, demonstrate the lack of strong asset management programs in the U.S. water and wastewater industry.

With managing capital and operational costs representing two of the top five industry issues, reducing non-revenue water and the amount of water main break incidents could have a substantial and positive impact on a utility's bottom line and future resource needs. A utility incurs many costs when delivering safe and potable water to customers' taps. Costs include obtaining raw water and pumping it from the source to the treatment plant, the cost of treating the water and the cost of pumping the treated water throughout the distribution system.

Reducing leakage and the number of water main break incidents can substantially reduce operations costs

through reduced energy and chemical use and manpower. Unfortunately, without a regulatory driver, the issues of system leakage and frequent water main break incidents do not often register as a top concern, or, as the data demonstrates, a potential solution for the industry's top concerns.

Improving utilities' awareness of the importance of leak monitoring and control is paramount. Such programs not only reduce the level of non-revenue water but also improve system performance. It is well known that leaks are typically a precursor for catastrophic water main breaks. Chronic leaks can promote corrosion and degradation of water mains, reduce the life expectancy and increase the required replacement rate.

FIXING THE SYSTEM

This report details several options utilities can use to address aging infrastructure, manage costs and obtain financing. The best approach is to look at utility operations holistically and move forward with a formal asset management approach, as detailed in the *Operational Enhancements* analysis.

Asset management is important because even for utilities that are financially sound and renew their buried infrastructure at a reasonable rate, it will enable the utility to replace the right pipe at the right time with the right material (R³). Most utility respondents stated their organization has a less than 1 percent replacement rate of aging distribution and collection systems. This rate of renewal implies pipes will last 100 years or more, which is seldom the case. Utilities can save money by not replacing pipes that are in good condition and focusing capital on the most critical assets that have the greatest need.

Additionally, it may not be necessary to replace a significant amount of pipe, particularly for regions other than the Northeast and Midwest, provided a systematic condition assessment approach is used to identify the pipes needing to be replaced. Without such a systematic approach, and with the pivotal point in time approaching when the majority of the assets installed after World War II reach the end of their service life, utilities will have a daunting task to face. Sound asset management programs can help lessen this burden.

Major water main renewal programs require significant amounts of capital. The Water Supplies Department of Hong Kong, SAR, PR China, is in the midst of a 20-year, multibillion dollar water main replacement and rehabilitation program. Since the program's inception in 2000, significant progress has been made, providing tangible results. One key metric is the number of water main breaks, which have been reduced from approximately 2,500 at the beginning of the program, to a little more than 300 (see *Renewing Water Infrastructure in Hong Kong*).

WITH MANAGING CAPITAL AND OPERATIONAL COSTS REPRESENTING TWO OF THE TOP FIVE INDUSTRY ISSUES, REDUCING NON-REVENUE WATER AND THE AMOUNT OF WATER MAIN BREAK INCIDENTS COULD HAVE A SUBSTANTIAL AND POSITIVE IMPACT ON A UTILITY'S BOTTOM LINE AND FUTURE RESOURCE NEEDS.



Renewing Water Infrastructure in Hong Kong

BY ALAN MAN

Hong Kong blends the old with the new. Below the glittering, modern cityscape that embodies Hong Kong's persistence as one of the world's leading financial centers lies a network of some 8,000 kilometers (5,000 miles) of water mains, more than a quarter dating back more than 30 years.

Hong Kong's concern for its aging infrastructure, echoed by water utilities in this year's report, is also accentuated by its unique topography.

There are many hills in Hong Kong. Surface runoff and impoundments provide the locally sourced water while the large majority of the city's supplies are delivered via pipelines from Dongjiang in neighboring Guangdong Province. The Water Supplies Department (WSD) distributes water to 7 million people through its water mains network, mostly fed by gravity from service reservoirs at high points to suit the local hilly terrains.

The amount of pressure required to move water through this complex system contributes to water mains leakage. WSD has taken proactive steps to reduce leaks and attain network improvements, with various measures implemented to target a cut in water loss rates from 25 percent in 2001 to 15 percent by 2015. Active leakage control through advanced pressure management and district metering schemes is used alongside an ambitious

program to repair and replace almost 3,000 kilometers (1,864 miles) of its water mains. These initiatives form a major component of Hong Kong's Total Water Management strategy and are saving precious water resources.

The program has been underway since 2000. Its scale and the systematic approach involved provide invaluable lessons to utilities facing similar issues. Hong Kong is one of the most densely populated places in the world and, like most affluent cities, has a vocal public who demand the highest levels of service and minimal disturbance. Alongside the innovations in pressure management to reduce the stress on the existing network, there are a number of examples where new standards of trenchless technologies have been implemented to ease traffic and public disruption while working to renew buried assets.

Considerable and well-thought-out investments have been made in Hong Kong's aging infrastructure and WSD is clearly turning the tide. Comparing 2000/2001 with 2011/2012 figures, the number of pipe bursts recorded has fallen from 2,479 to 317, while leakage cases have fallen by almost half from 21,693 to 12,111. Other long-term benefits include reductions in operational and maintenance costs and in interruptions to society due to fewer bursts and leaks.

Alan Man is a Vice President and Managing Director in Black & Veatch's water business where he oversees operations in the North Asia Pacific Region. Among his numerous professional achievements, Man recently accepted an invitation to join the Hong Kong Trade Development Council's Infrastructure Development Advisory Committee. His two-year term began in April 2013.

INTEGRATED RESOURCE PLANNING

BY **LES LAMPE**

Water resource planning has quickly become synonymous with resource and environmental stewardship. This parallel is apparent in the responses to our survey as it relates to the industry's most significant sustainability concerns as referenced in the *The Nexus and Energy* analysis. Water utilities are making a series of choices based on climate-influenced water supplies, growing service populations and capital constraints.

Across the United States, recent droughts have threatened the reliability of supplies and brought the related issues, such as the impacts of climate change, to the fore. While reports of drought conditions in the Southwest are not surprising, the Southeast and Midwest also have experienced drought conditions. As water utilities develop long-range water supply plans, their priorities reflect the climate realities of more frequent and extreme droughts. Nearly 70 percent of survey respondents who identified themselves as having water supply services are implementing drought contingency planning that includes water conservation, community outreach and use of alternative supplies (Figure 9).

Taken region by region, the planning priorities become even more clearly a function of local variations. For example, in the Northwest, long-range water supply planning includes accounting for the potential impacts of climate change, as the region has historically been at the forefront of environmentally sensitive resource policies. Because of historical supply issues and recent years of extended drought conditions, the respondents from the Southwest focus planning on both drought contingency solutions and tactical programs such as water recycling/reuse and desalination of brackish or ocean supplies. The Southeast is also planning for drought conditions and is also looking at integrated water management to address present and future conditions. In the Rocky Mountain region, water recycling and reuse is being considered, which may be a result of reduced river flows and depleted groundwater reserves (see *Appendix* for regional data).

Whether supply challenges exist or are imminent, conservation planning must be part of a holistic approach to water resource management. This ensures that utilities remain focused on the efficient use of water. It is also a preventive measure that shores up supplies in the face of climate change. In Black & Veatch's experience, well-managed water use is cost-effective for the utility and consumer over the longterm but must be balanced with sound expansion of water supply portfolios to ensure reliability.

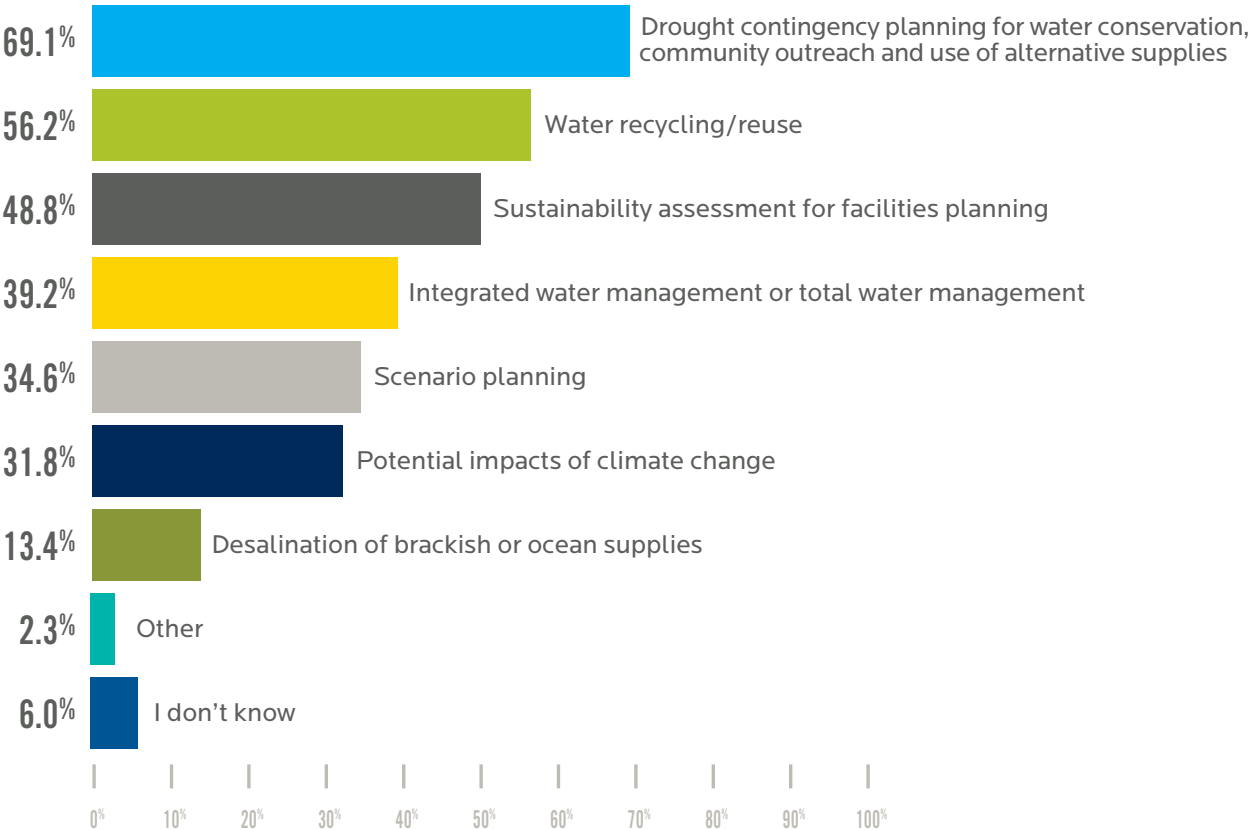
Demand decreases as an informed population makes wiser use of water. Water utilities surveyed recognize this benefit. More than half of participants who provide water services anticipate that their utility can realize between a 5 and 30 percent reduction in demand as a result of water conservation measures (Figure 10). As utilities are becoming increasingly aware of the benefits of sound planning, conservation measures are more accepted even if there is abundant supply. This is a result of an increased adoption of environmental stewardship principles by water users thereby minimizing the expenditures of energy, chemicals and capital resources.

The majority of survey respondents who provide water services cited surface and groundwater (88.0 and 58.3 percent, respectively) as their primary sources of water supply (Figure 11). This is true across all regions. Notably, utilities serving smaller populations (less than 50,000) rated distribution system water loss and water supply issues as a greater cause for concern than did those

that serve mid- to large-size populations (Figure 12). This is a result of smaller entities' typical reliance on limited supply from a single source. In contrast, larger metropolitan regions were mainly built along major surface water resources like rivers and lakes (i.e., New York, Chicago, Pittsburgh and Kansas City) and often incorporate multiple, naturally available supply sources in their portfolios.

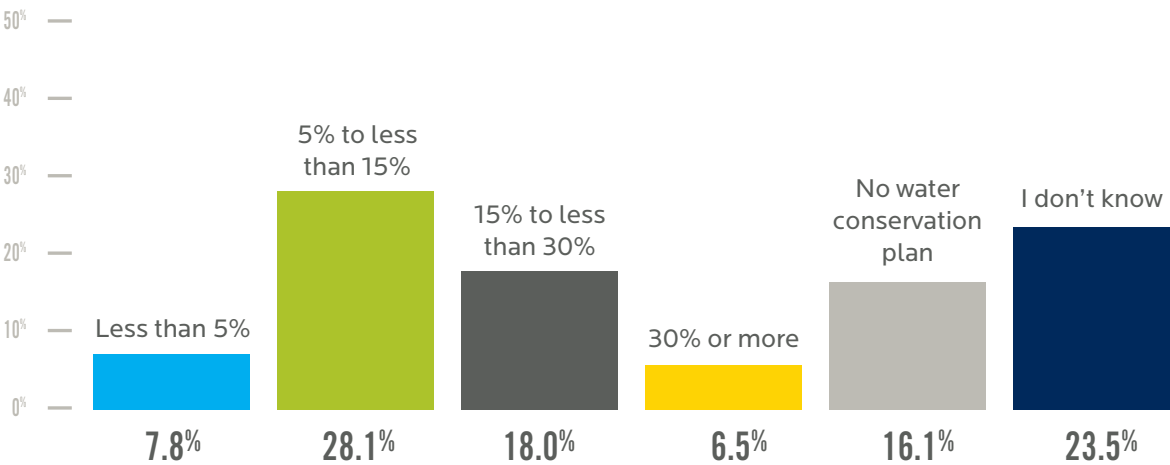
The major constraint in implementing new or increased water supplies is the availability of capital, as cited by 82.6 percent of the respondents who provide water services (Figure 13). Reliability, a theme across the entire survey, is the second greatest constraint and is particularly significant in light of recent drought conditions. This trend remains true regardless of utility size or geographic service region.

FIGURE 9
LONG-RANGE WATER SUPPLY PLANNING



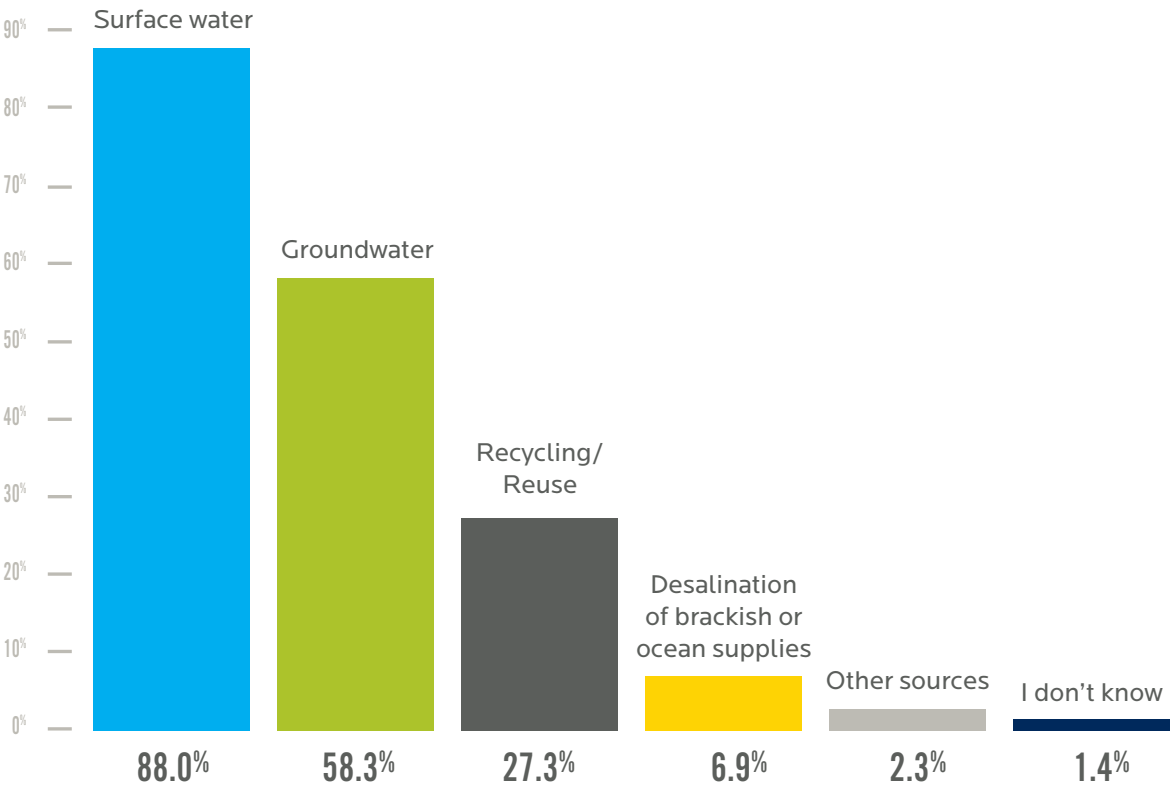
Source: Black & Veatch
Respondents were asked to select which of the listed items have been incorporated into their organization's long-range water supply planning process. NOTE: Responses from participants who identified themselves as representing "Wastewater Only" utilities are not included in analysis of this question.

FIGURE 10
WATER CONSERVATION PROGRAMS



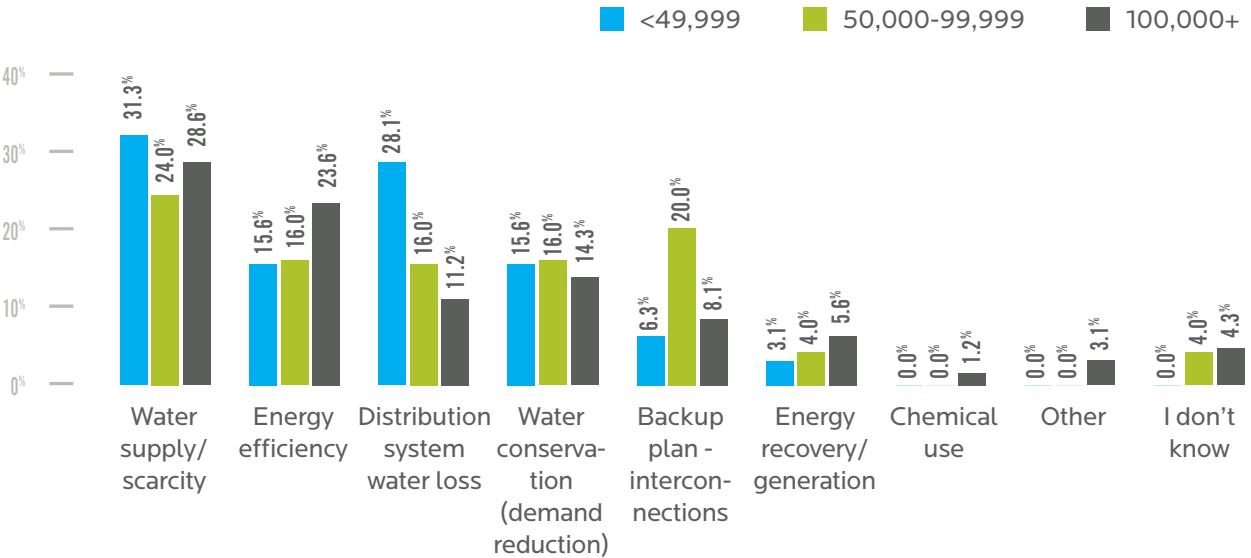
Source: Black & Veatch
Respondents were asked if their organization has a water conservation program and, if so, what is the anticipated maximum level of reductions in demand. NOTE: Responses from participants who identified themselves as representing “Wastewater Only” utilities are not included in analysis of this question.

FIGURE 11
WATER SUPPLY SOURCES



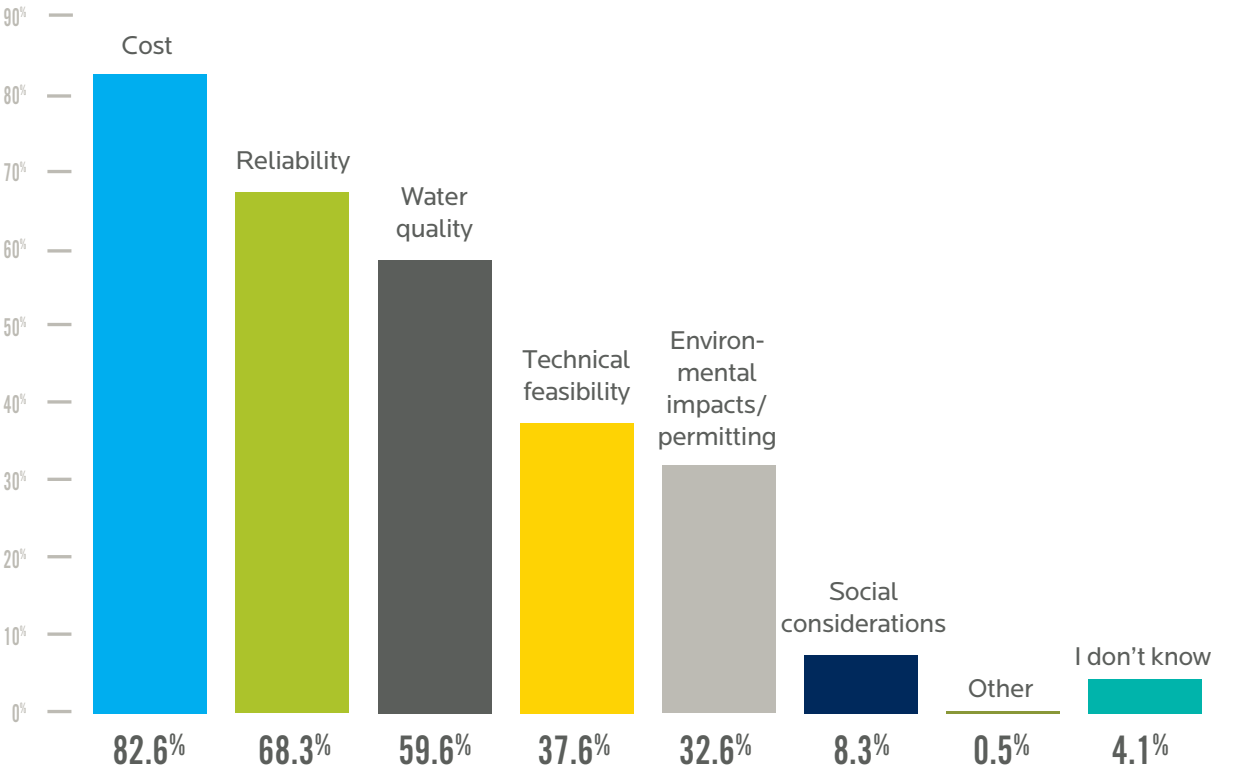
Source: Black & Veatch
Respondents were asked to identify all current sources of their water supply. More than 80 percent rely on surface water for some or all of their water supply needs. NOTE: Responses from participants who identified themselves as representing “Wastewater Only” utilities are not included in analysis of this question.

FIGURE 12
 MOST SIGNIFICANT SUSTAINABILITY ISSUES – BY POPULATION SERVED



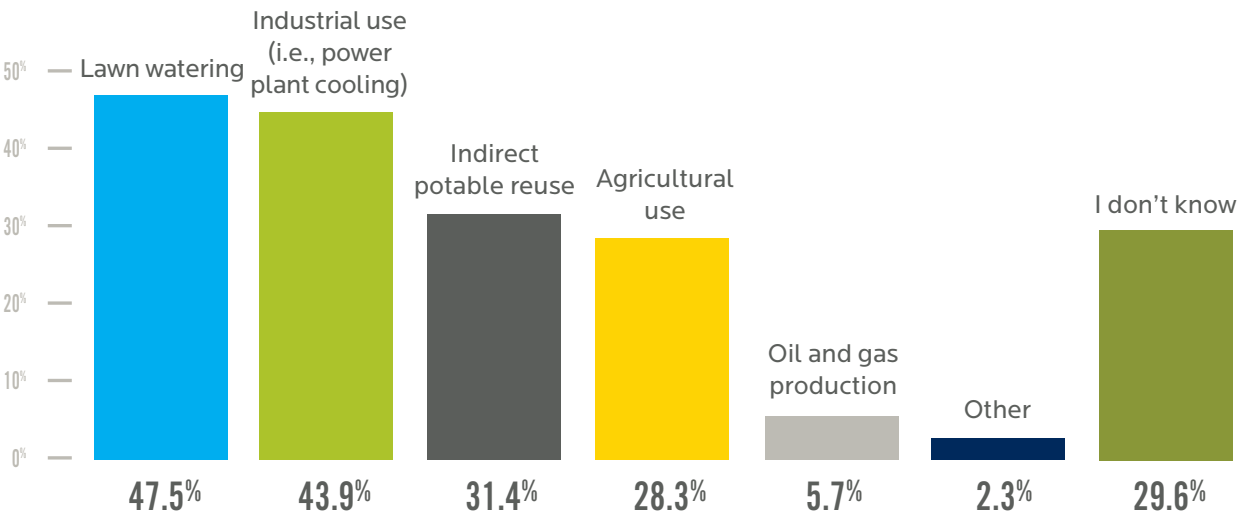
Source: Black & Veatch
 Respondents were asked to select the sustainability issue of greatest concern to their utility. A significantly larger number of respondents representing utilities that serve small populations chose “water supply/scarcity.” NOTE: Responses from participants who identified themselves as representing “Wastewater Only” utilities are not included in analysis of this question.

FIGURE 13
 CONSIDERATIONS FOR ALTERNATIVE WATER SUPPLIES



Source: Black & Veatch
 Respondents were asked to select the three most important elements for comparing alternative water supplies for their organization’s next long-range plan. More than half selected cost, reliability and water quality. NOTE: Responses from participants who identified themselves as representing “Wastewater Only” utilities are not included in analysis of this question.

FIGURE 14
OPPORTUNITIES TO USE RECLAIMED WATER OR WASTEWATER



Source: Black & Veatch
Respondents were asked to select the activities where reclaimed water/wastewater could be used. Lawn watering, industrial and indirect potable reuse were the top items nationally.

Because surface water and alluvial groundwater, which are particularly vulnerable to changes in climate and the environment, make up significant sources of supply, survey respondents are increasingly looking to reclaimed water/wastewater to expand their overall supply portfolio and increase water supply reliability. Black & Veatch asked industry representatives to select all areas where reclaimed water/wastewater could be used within their service area. The leading opportunities for reuse at a national level include lawn watering, industrial use (i.e., power plant cooling) and indirect potable reuse (Figure 14), although these did vary significantly by region (see the *Appendix* to view regional data). In coming years, Black & Veatch predicts that the shift toward resource planning with a focus on sustainability will continue. This new paradigm, evident in initiatives in Singapore and Australia, involves a multipronged approach toward water resource planning. These utilities are combining consumer-level water saving incentives, water imports, reuse and ocean desalting to meet water supply needs.

The notions of stewardship and the “wise and efficient use of water” are increasingly a part of the planning narrative across the board. In the Southwestern United States, for example, the seven states that border the Colorado River

are already exploring the combination of activities that give the region the best chance of addressing a water supply shortage precipitated by drought, population growth, legal constraints and environmental concerns. Black & Veatch is also seeing a move toward the adoption of improved metering technology so that users can know in real time what they are using instead of waiting until the end of the billing cycle.

In Black & Veatch's experience, the best approach to long-term water resource planning occurs through a tiered strategy. Consumer engagement and education about the importance of conservation and the individual's ability to manage their impact on supply should be its foundation. Second, an increased emphasis on looking at supply and demand management over the longterm will result in a more sustainability focused plan versus decisions driven by shorterterm considerations. Finally, a portfolio that includes a variety of water supply strategies will prepare utilities for unforeseen supply challenges.



Singapore Benefits from Long-term Holistic Water Planning

BY LIEW YIEN PHIN

In many ways, Singapore serves as a petri dish for the global water industry. The small city-state has tackled its limited natural resources head on and is today held up as a template for truly integrated and sustainable water supply planning.

It has been a long but methodical journey.

The long-term planning efforts are captured in what it calls the Four National Taps, a diversified and integrated portfolio of water sources. These “taps” are identified as local catchment water, imported water, NEWater (recycled water) and desalinated water.

Local Catchment Water: Singapore is one of the few countries in the world to harvest urban stormwater on a large scale. Rainwater is collected through a comprehensive network of drains, canals, rivers, stormwater collection ponds and reservoirs before it is treated for potable use.

Imported Water: Singapore has limited natural water resources and relatively little land to collect rainwater. In its early years, it relied on a small water catchment and importation of water from its neighbor, Malaysia. However, after experiencing drought soon after gaining independence in the 1960s, the government placed the goal of water sustainability at the heart of not only environmental planning but also economic planning.

NEWater: Singapore has long been a world leader in integrating indirect potable reuse into its supply portfolio, and focuses heavily on using each drop of water collected more than once. NEWater was introduced in 2003 and is produced by purifying treated, used water with advanced membrane and ultraviolet technologies. Singapore currently has four NEWater plants that can meet 30 percent of the nation’s water needs. Plans are in place to expand current capacity so that NEWater can meet up to 55 percent of future water demand by 2060.

Desalination: Singapore has one of Asia’s largest seawater reverse-osmosis plants, which produces 30 million gallons of water a day, or approximately 10 percent of Singapore’s water needs. A second facility is under development and will soon have the capacity to produce 70 million gallons of water a day. The 2060 target is to meet up to 25 percent of water demand from desalination.

Through its Four National Taps program, Singapore has short-circuited the natural water cycle process and created a diversified, reliable and robust water supply for its future.

Liew Yien Phin is the office leader for Black & Veatch’s water business in Singapore. The office has been working closely with PUB, Singapore’s national water agency, to deliver critical water infrastructure for the resource-scarce nation over the past 90 years. This includes award-winning facilities such as the Singapore-Tuas Seawater Desalination Plant, the largest seawater reverse-osmosis (SWRO) plant in Asia.

THE NEXUS OF WATER AND ENERGY

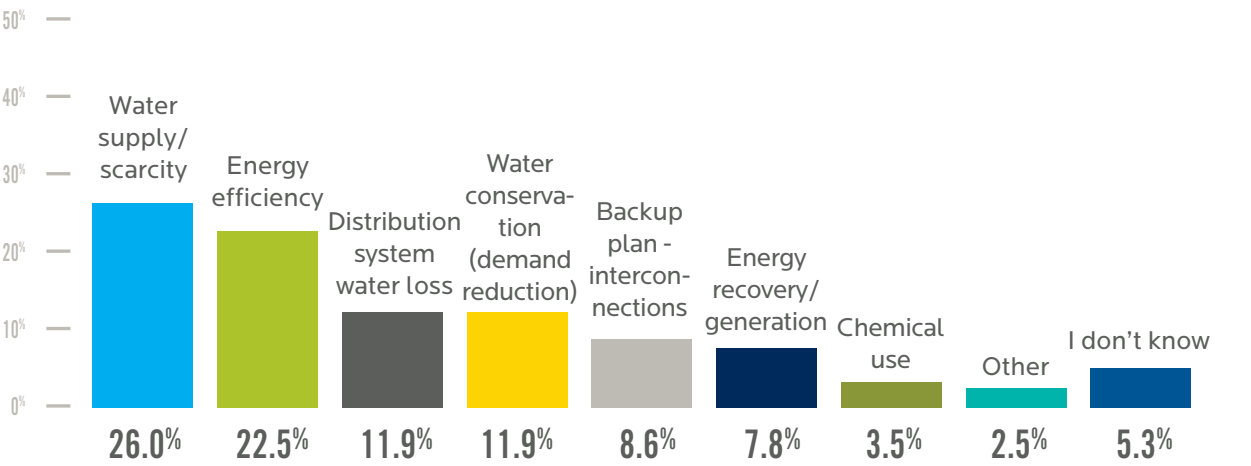
BY PATRICIA SCANLAN AND FRED ELLERMEIER

In Black & Veatch’s *Strategic Directions in the U.S. Electric Industry Report*, water supply has been the second-highest ranked environmental concern for seven consecutive years. Drought and high water temperatures, along with a high growth rate of unconventional oil and gas production in certain regions, are bringing renewed focus to the issue of water supply. For the water industry, water supply is also a top sustainability concern. However, in the Top 10 Industry Issues list (see the *Executive Summary*) water scarcity was ranked ninth on this list with non-revenue water listed as the 10th most important issue.

The varied rankings demonstrate the largely regionalized focus on the issue of water scarcity (participants in the Southwest and Rocky Mountain regions rated water scarcity as a “Top 5” issue). It also underscores the emphasis the industry has on several pressing needs, including managing operational costs, which was ranked third in the Top 10 Industry Issues list. Notably, energy efficiency was selected by 22.5 percent of respondents as their most significant sustainability issue (Figure 15).

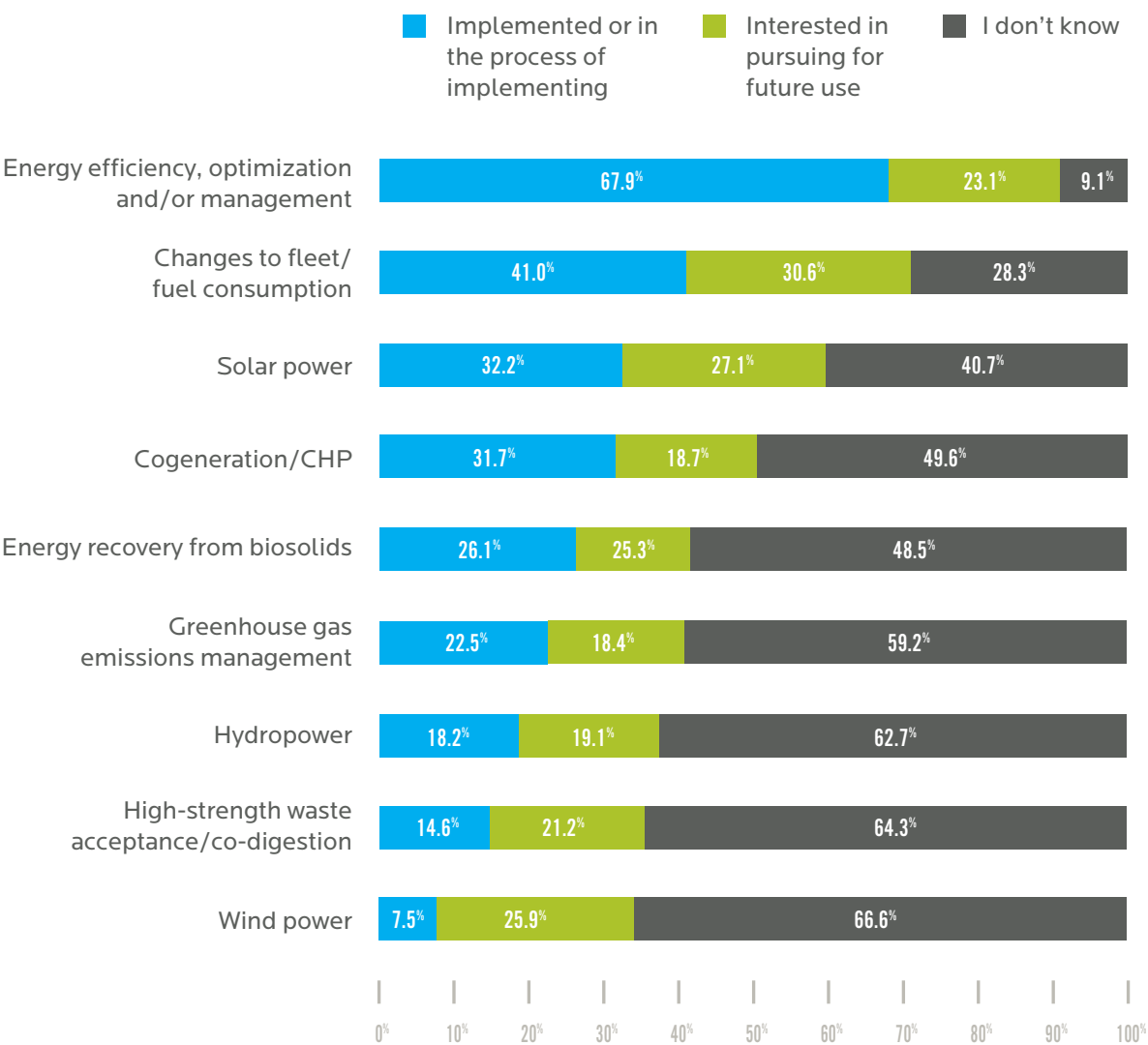
By and large, the industry is very focused on reducing energy use. Approximately 90 percent of respondents indicated their organizations are currently implementing or are interested in implementing energy efficiency programs (Figure 16). Reducing energy consumption provides triple bottom line benefits that include cost savings, greenhouse gas reductions and less dependency on fossil fuel energy use, among other results.

FIGURE 15
MOST SIGNIFICANT SUSTAINABILITY ISSUES



Source: Black & Veatch
Respondents were asked to select the most significant sustainability issue for their utility.

FIGURE 16
ENERGY EFFICIENCY, GENERATION OR RECOVERY PROGRAMS



Source: Black & Veatch
Respondents were asked to select if their organization has implemented or is interested in pursuing each of the listed energy efficiency, generation or recovery programs. More than two-thirds have or are in the process of implementing energy efficiency, optimization and/or management programs.

For organizations with wastewater treatment assets, energy recovery is becoming much more important and shows the transition of these entities from being considered waste disposal organizations to resource recovery organizations. Nearly a third of “Wastewater Only” organizations selected energy recovery/generation as the most important sustainability issue. More than half of respondents representing utilities that provide wastewater services indicated their organizations are either implementing or interested in pursuing

cogeneration or combined heat and power (CHP) systems and/or gaining energy recovery from biosolids programs.

Black & Veatch is also seeing increased interest in co-digestion programs among its clients. Co-digestion is beneficial because many utilities have excess digestion capacity. Utilities can gain value from this underutilized asset by increasing the amount of high-strength organic waste treated. This enables them to produce more recoverable energy in the form of biogas. It also enables

utilities to help solve other municipalitywide asset maintenance and waste disposal challenges, such as keeping fats, oils and grease out of the sewer system and waste organics out of landfills.

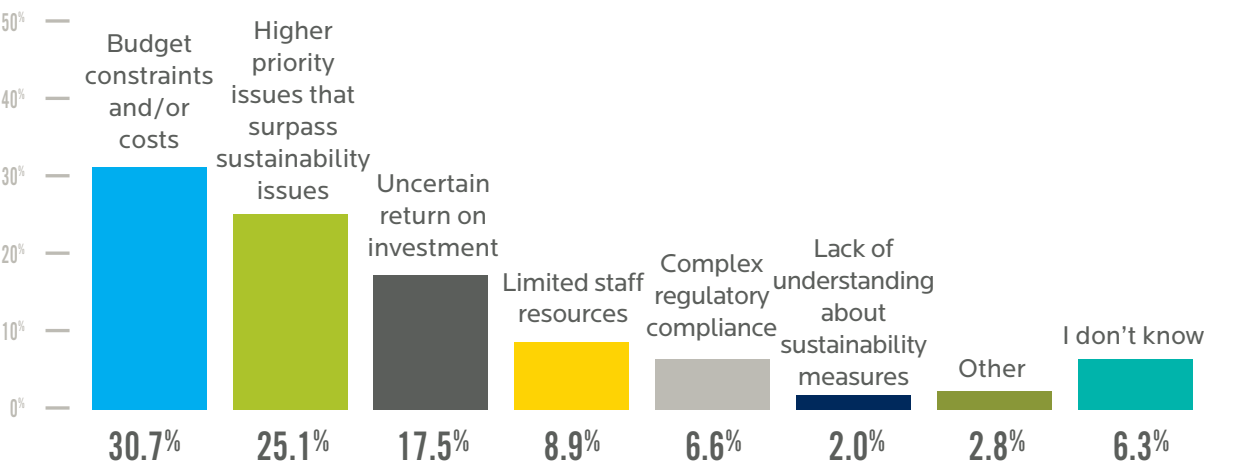
Energy efficiency and recovery does not just apply to wastewater treatment facilities. Significant energy savings can be achieved through energy programs that target pumping (see the WaterOne sidebar). Utilities can also recover the kinetic energy of water moving through their pipes and mains through micro-hydro projects (see Energy Recovery at UK Facilities project examples).

Unfortunately, since the beginning of the 2008 recession it has become increasingly difficult to move energy programs from the “interested” to “implementing” phase. Municipalities have less revenues and, for those with wastewater assets, increasing pressure to meet

more stringent regulatory requirements associated with combined sewer overflows and nutrient removal. It follows that respondents rated cost and higher competing priorities as the top obstacles to pursuing sustainable energy solutions (Figure 17).

It is noteworthy to see uncertain return on investment as the third greatest challenge for implementing sustainable energy solutions. Prior to the recession, these types of programs were rapidly gaining momentum among leading utility organizations that were focused on not just the financial bottom line but also environmental and societal benefits. This is understandable given the challenges municipalities have in achieving and maintaining strong bond ratings. However, as growth rebounds, Black & Veatch anticipates an increase in activity for sustainable energy solutions.

FIGURE 17
TOP OBSTACLES FOR SUSTAINABLE WATER AND ENERGY SOLUTIONS



Source: Black & Veatch
Respondents were asked to select their organization's greatest challenge to pursuing sustainable energy and water solutions.



WaterOne Achieves Energy Savings through Technology Enhancements

BY **JAMES WINGER**

WaterOne is a water utility that serves more than 400,000 customers in Johnson County, Kan. The utility draws raw water from the Kansas and Missouri rivers and distributes a peak supply of 200 million gallons a day of treated water through more than 2,600 miles of pipe. Energy costs for WaterOne, like most water and wastewater utilities, represent a significant portion of the utility's operations budget.

To reduce costs and gain operational efficiencies, WaterOne implemented Derceto Aquadapt software. The program integrates with existing management systems to help utilities make operating decisions that reduce energy consumption. Since implementation, WaterOne has been able to reduce peak summer demand by up to 4 megawatts and achieve cost savings of more than \$1 million per year (approximately 20 percent of the total annual energy bill).

James Winger is a Project Manager in Black & Veatch's water business. He is based in Kansas City, Mo.

Energy Recovery at UK Facilities

BY **JOHN TATTERSALL**

Scottish Water's Glencorse Water Treatment Works

Minimizing the environmental impact for the new and award-winning Glencorse Water Treatment Works project near Edinburgh, Scotland, was a top priority for Scottish Water. The facility's numerous "green" characteristics include partially buried treatment structures and reservoir with grass roofs, the use of gravity to convey water from the facility to customers and the use of a turbine within the incoming raw water main to generate 25 percent of the site's electricity.

United Utilities' Davyhulme Sludge Balanced Asset Programme

Black & Veatch was the primary contractor for the design and construction of United Utilities' new advanced biosolids treatment facility at the Davyhulme Wastewater Treatment Works (WwTW) in Manchester, England. The facility is designed to improve the quality of treated biosolids produced on-site and treat biosolids received from other WwTW sites. The new facility substantially increased the plant's capacity for treating biosolids.

The new Cambi thermal hydrolysis pretreatment process improves the digestibility of the biosolids before treatment in anaerobic digesters. Gas from the anaerobic digesters is used to generate electricity for on-site consumption or for export to the power grid. The increased quantity of renewable electricity generated by the project enables the entire works to be self-sufficient. In addition, waste heat from the generation process is used to provide steam for thermal hydrolysis.

John Tattersall is the Director of Technical Solutions for Black & Veatch's water business. He is based in the company's Redhill office (UK).

ASSET MANAGEMENT

BY **MATT BOND, JAMES STRAYER, WILL WILLIAMS, JEFF STILLMAN AND MARTIN JONES**

As noted in the *Buried Infrastructure* analysis, a significant portion of U.S. collection and distribution systems for water and wastewater utilities are aging. Various industry estimates show as much as a third of all water and wastewater infrastructure nationwide, accounting for approximately half a million miles of pipeline, has surpassed its useful design life. Cost estimates for rehabilitating or replacing this infrastructure extend into the trillions of dollars.

The good news for utility leaders nationwide is that these estimates are largely based on the “book life” of existing infrastructure assets, not the “current condition.” Deterioration rates can vary depending on a variety of influences, resulting in many assets lasting beyond documented design life while others require more frequent investment. Sound asset management improvement programs provide utility leaders with the information, tools and processes needed to identify and prioritize investments, maximize ratepayer return, analyze risk, extend asset life and optimize overall life cycle costs for both buried infrastructure and above ground assets.

Participant responses and overall industry activity indicate that the implementation of formal asset management programs is a fast-growing trend in the U.S. water and wastewater industry. More than 70 percent of respondents stated that in three years they expect their organizations to have good practice asset management programs in place or to be industry leaders in the development of asset management concepts and ideas (Figure 18).

Data collected from the 2013 industry survey indicate that the U.S. industry is very much in the early stages of understanding the concepts of asset management improvement programs and how these programs can benefit the entire utility enterprise. For a utility, the first step in implementing an asset management improvement program is to develop an understanding of all of the areas where these programs can improve utility operations.

Well-developed asset management programs have been shown to provide a high level of benefit for all of the areas listed in Figure 19 in U.S. and international utilities of various sizes. However, when asked to rate the level of benefit improvement programs will have on the listed activities and processes, utility respondents zeroed in on the benefits associated with prioritizing infrastructure replacement and developing effective capital improvement programs (CIPs). This is not surprising, given the current high degree of focus and scrutiny around funding these programs and the need to effectively target expenditure.

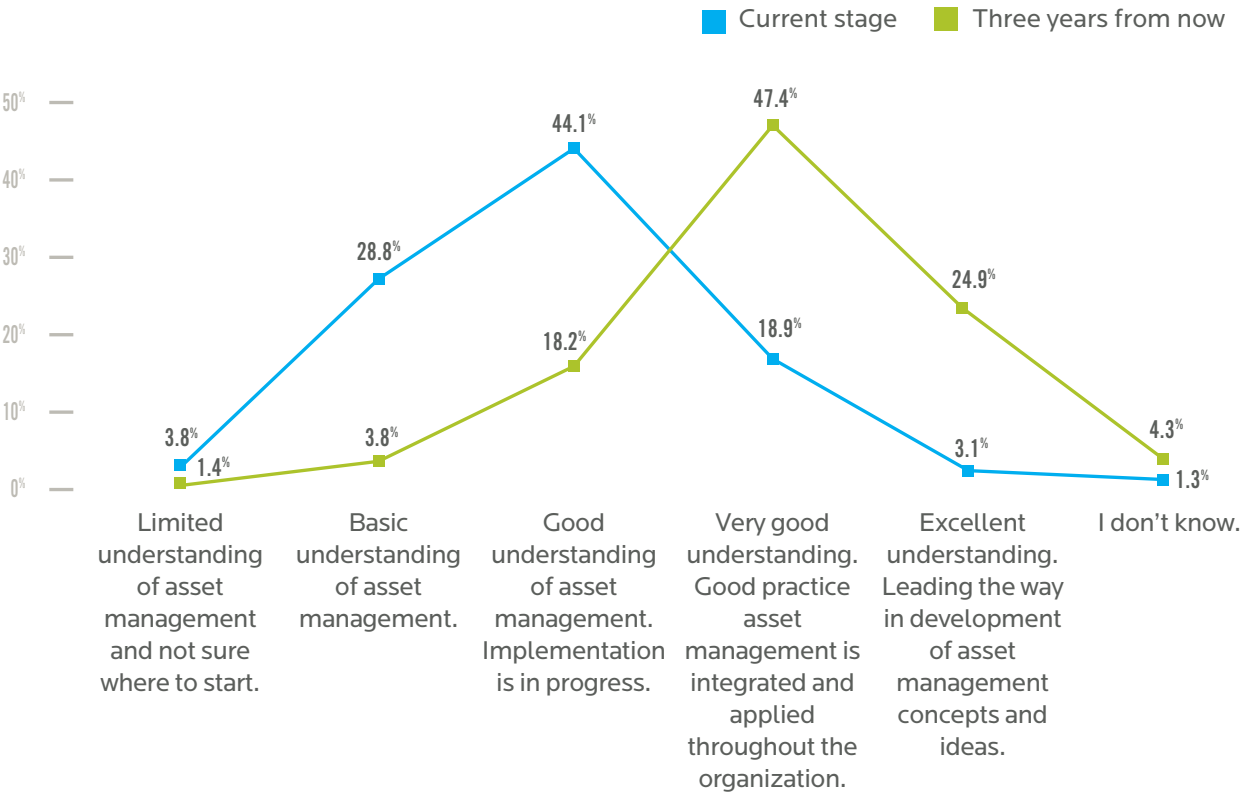
Less than half of respondents believe asset management programs will provide a high level of benefit for improving operational optimization, knowledge transfer and interdepartment communications and determining level of service goals. The sentiment that these later categories would benefit less from an asset management program was surprising. It may be attributable to the less mature level of asset management in the United States since these issues have risen in importance in countries with longer asset management programs, such as the UK and Australia.

In the 2012 survey, respondents identified developing the required processes and systems as the greatest challenge to improving asset management. This year, Black & Veatch asked survey participants about the tools and systems used to support asset management. Respondents indicated a high reliance on hydraulic models, geographic

information systems (GIS) and CIP prioritization, but these were also systems that needed improvement. In addition, more than 70 percent of respondents have condition assessment and inspection programs with an additional 20 percent planning to implement these programs. There is also a clear upcoming focus in improving capabilities in paperless work order systems and mobile applications, computer maintenance management systems (CMMS) and dashboards, indicating that respondents are looking to improve data collection and reporting (Figure 20).

Deterioration modeling is one example of taking data, in this case results from condition assessments and historical rates of performance, and turning it into usable information that supports proactive decisionmaking – a key component of effective asset management improvement programs. However, despite the fact that many respondents are collecting condition data on their assets, nearly half of respondents stated they are not currently using deterioration models and have no plans to implement them. This is potentially a missed opportunity because utilities could extract considerable value from condition data if it were analyzed to understand the deterioration rates of their assets, thereby enabling well-targeted rehabilitation and replacement planning.

FIGURE 18
ASSET MANAGEMENT MATURITY LEVEL NOW AND IN THREE YEARS

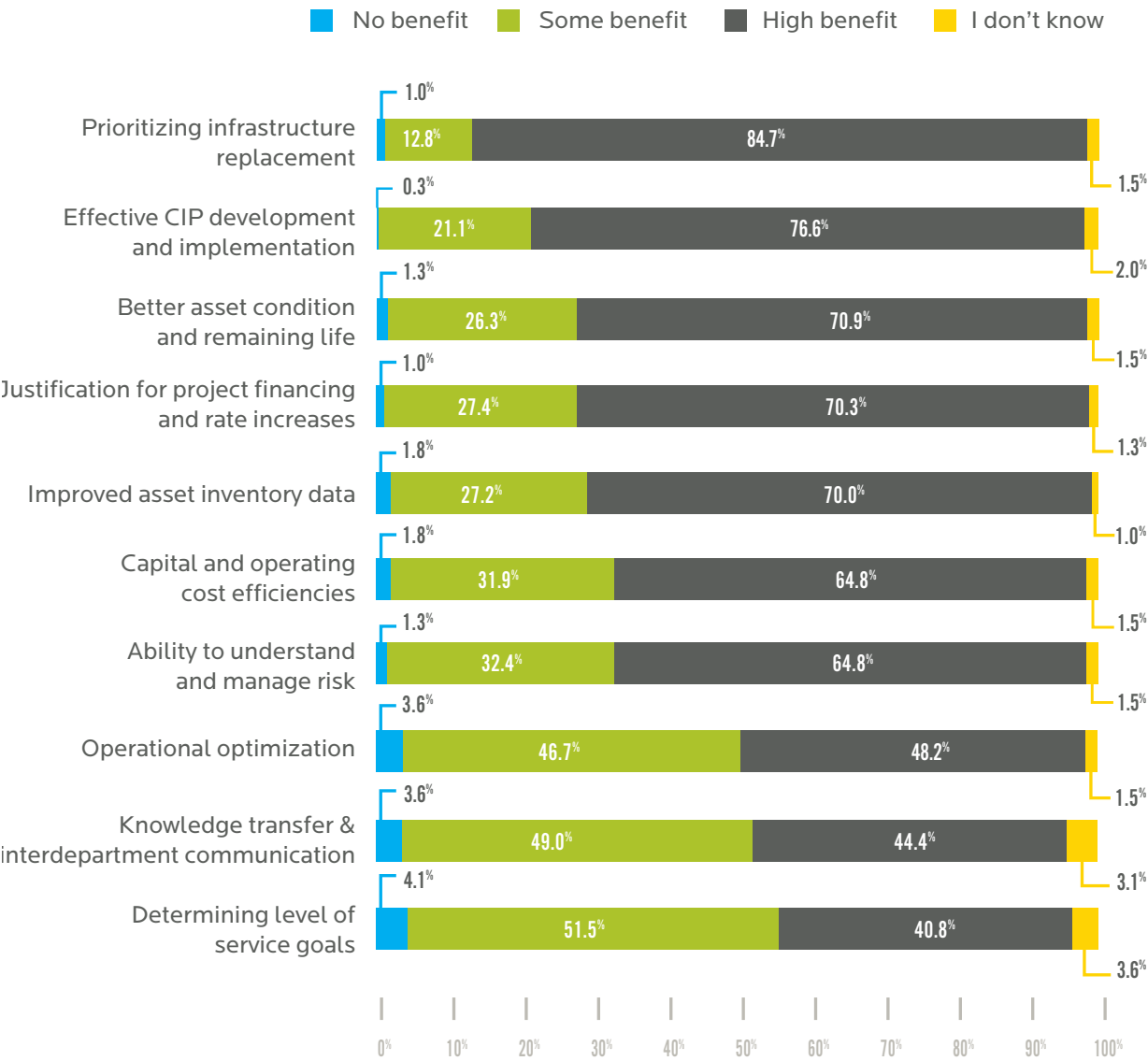


Source: Black & Veatch

Respondents were asked to select the response that best describes the level of asset management maturity within their organization today and what they expect it to be in three years.

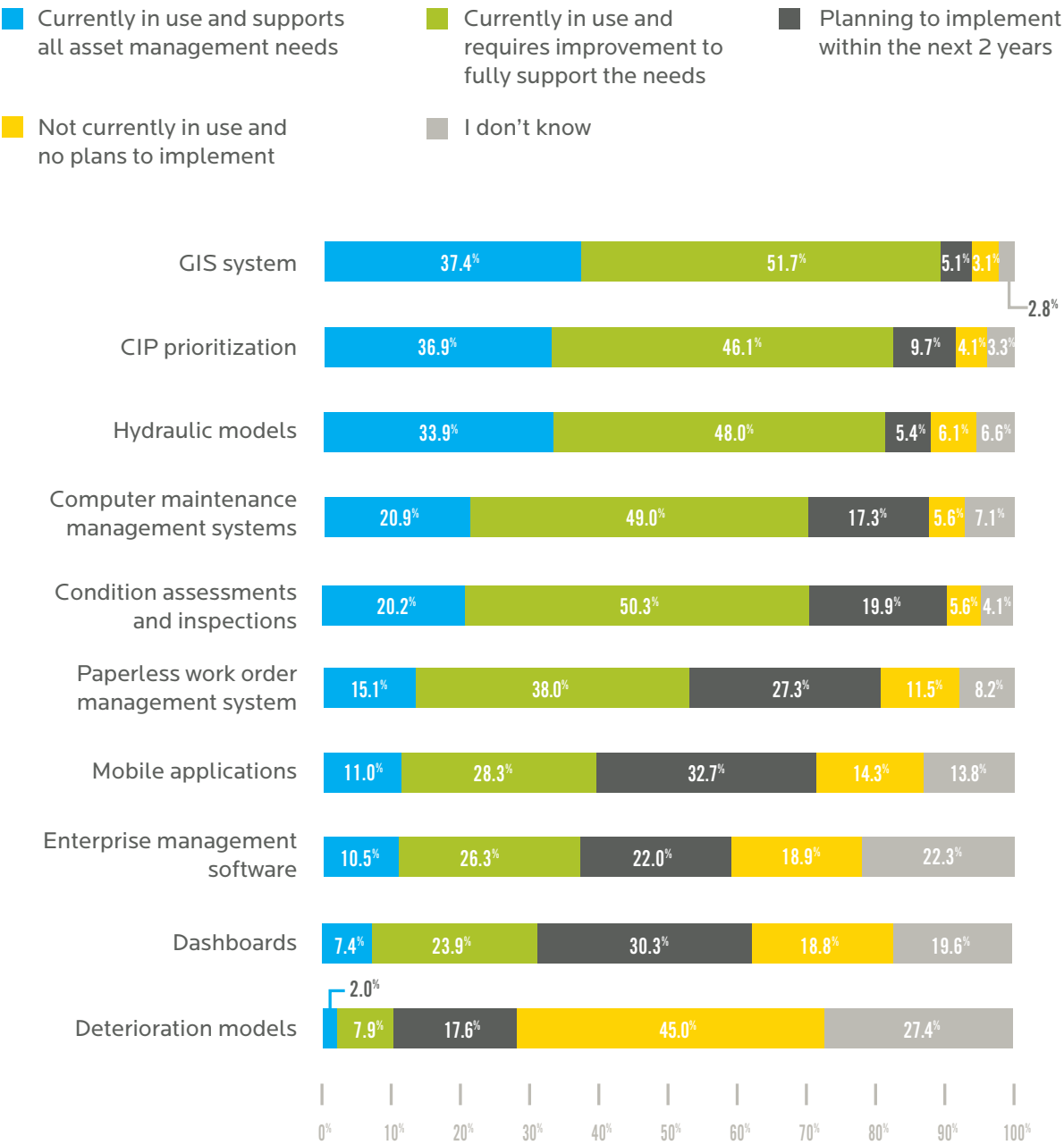
OPERATIONAL ENHANCEMENTS

FIGURE 19
BENEFITS OF ASSET MANAGEMENT IMPROVEMENT PROGRAMS



Source: Black & Veatch
Respondents were asked to rate the level of benefit an asset management improvement program will have on each of the listed activities.

FIGURE 20
TOOLS AND SYSTEMS USED TO SUPPORT ASSET MANAGEMENT



Source: Black & Veatch
 Respondents were asked to select the current usage and/or plans for any of the following tools and systems used to support asset management within their utility.

OPERATIONAL ENHANCEMENTS

Deterioration models are developed and continuously improved over time. The typical steps involve first developing a condition assessment and inspection program. Utilities assess the condition of the most critical areas of their organization first and then expand this analysis to other areas based on asset criticality. In addition to visual inspection, utility managers also review performance of these assets, such as burst rate or leakage levels. Leading utilities with this process in place will analyze the condition of approximately 10 percent of their systems each year, with 5 percent representing new, previously unanalyzed systems and the other 5 percent representing areas that were analyzed two to three years prior to determine how the overall condition of these assets has changed over time.

As noted in the *Executive Summary*, regulation is the primary driver for investment and change. This is also true for water industry leaders in other parts of the world. During the last 20 years, regulation of private water companies in the UK and state-owned water companies in Australia drove the need for improved asset management approaches. This included the development and implementation of comprehensive asset management frameworks (see *Development of International Asset Management Standards*).

The good news for U.S. water and wastewater utility industry leaders is that there is a real opportunity to benefit from these best practices pioneered abroad and essentially leap frog the development process. Adopting best practice asset management improvement programs now can provide tangible benefits to utilities and their customers.

One water utility located in the Southeast region is already integrating asset management approaches into its master planning process. Black & Veatch conducted a Publicly Available Specification (PAS) 55 assessment for the utility and developed recommendations based on strengths and weaknesses in utility operations as compared to best practices. The utility is now in the process of incorporating identified improvements into its sewer system operations and is considering similar improvements for

the management of the water distribution system and treatment plants.

However, great opportunities come with great challenges. Asset management improvement programs require at least three to five years to conceptualize and implement. Successful programs also require complete support from the highest levels of the organization to fully implement necessary changes. For the more than 70 percent of respondents who stated they expect their organizations to have very good or excellent programs in place in three years, the following provides a high-level overview of the steps needed to meet this goal.

To successfully implement an asset management framework, utilities must undergo a maturity assessment that identifies gaps in current practices as compared to industry best practices or identified benchmarks. The PAS 55 framework, for example, provides a 28-point requirements checklist of good practices in physical asset management. Typically, utilities undergoing a maturity assessment will enlist the help of a third-party organization to identify gaps in performance against established benchmarks.

Once gaps are identified, utilities and third-party advisors should develop a road map for improving all areas where gaps were identified. These maps require prioritizing specific initiatives based on desired outcomes – such as operational efficiencies, improvements to capital improvement planning, etc.

Finally, as improvements are made to close identified gaps, utilities should identify ways to track and measure various operational aspects. The best asset management programs are not checklists. They develop programs that enable utilities to manage their assets and operations efficiently, deliver high levels of service to their customers, and drive continuous improvement in people, processes and asset risk evaluation and reduction.



Development of International Asset Management Standards

BY **CHRIS ROXBURGH**

Publicly Available Specification (PAS) 55 was first published in the United Kingdom (UK) in 2004 in response to demand from industry for a specification for asset management and to define good practice. It is applicable to any organization, including water companies, where physical assets are a key or critical factor in achieving its business goals. Additionally, PAS 55 demonstrates to customers, stakeholders and regulators that organizations are managing their assets effectively, in line with good practice. The specification was revised in 2008 to reflect increasing international consensus about required good practices in the management of physical assets. PAS 55 was developed by the UK Institute of Asset Management in conjunction with the British Standards Institution.

Similar to the situation in the United States today, aging infrastructure remains an issue for UK water companies. To manage this challenge, a number of companies adopted a risk-based approach for prioritizing investment for asset (infrastructure) replacement and/or rehabilitation. This entails assessing the criticality of an asset base (the impact of failure) and undertaking condition assessments to determine the likelihood of failure. Combining the criticality and likelihood of failure enabled asset risk to be quantified and investment targeted to the highest-risk assets.

In 2002, the “Common Framework Approach to Capital Maintenance Planning” was developed on behalf of the industry by UK Water Industry Research to provide a formalized approach for optimizing expenditures across different asset types and developing cost-effective replacement and rehabilitation plans for aging infrastructure. Water companies in England and Wales used this framework to develop their five-year asset management plans during the previous two planning cycles (2004 and 2009) and will use it again in 2014.

Experience in the UK and elsewhere demonstrates the need for a robust framework to achieve the greatest benefit from various asset management tools, techniques, systems, processes and procedures. Today, PAS 55 is the only asset management specification that has been adopted worldwide. An international standard, ISO 55001, is currently being developed based on PAS 55 for issue in early (February) 2014.

Water companies in highly regulated countries such as the UK and Australia are implementing asset management frameworks and in some cases seeking external certification to PAS 55 for exhibiting and maintaining best practices. This is beneficial for these organizations when it comes to justifying necessary capital improvements and rate increases. While certification is not a priority for most U.S. water and wastewater utilities, there is an increasing interest to implement the PAS 55 approach due to its comprehensive methodology and proven benefits/results.

Chris Roxburgh is the Director of Asset Management in Black & Veatch's water business. He is based in the company's Redhill Office (UK). Black & Veatch is a corporate member of the Institute of Asset Management (IAM) and is an IAM-Endorsed Assessor for PAS 55.

TELECOMMUNICATIONS AND UTILITY AUTOMATION

BY **DAVID ROBERTS AND WILLIAM BIEHL**

As noted in the *Asset Management* analysis, more than 70 percent of respondents are expecting to achieve high levels of asset management maturity, or instill leading asset management practices within their organizations, during the next three years. Meeting this goal will highly depend upon a utility gaining increased functionality from its information systems in a manner that supports efficient decision-making. Utility telecommunications networks are the backbone of these systems and the primary enabler of automation.

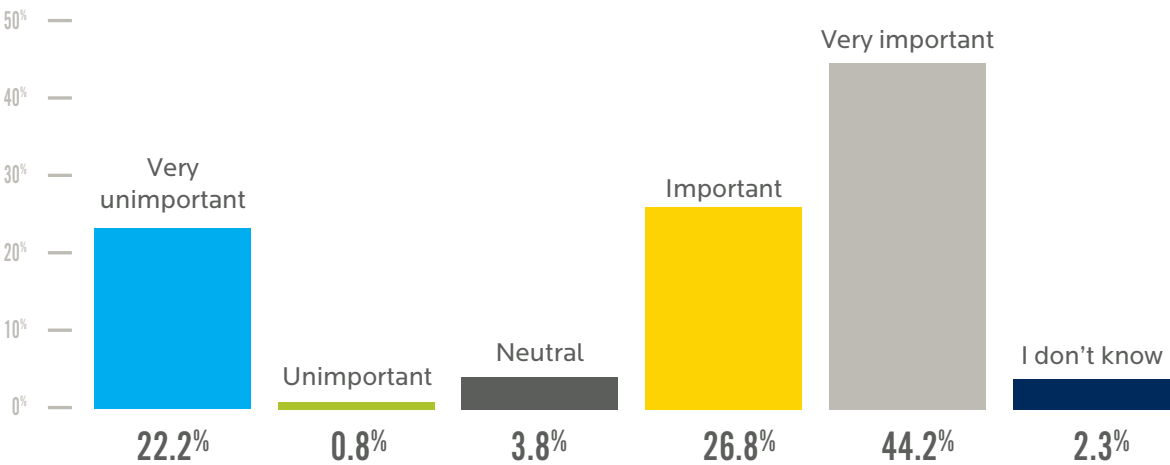
With utilities looking to continuously do more with fewer resources, both human and capital, industry leaders recognize the important role their networks will have in the future (Figure 21). Respondents also largely expect to keep using a combination of private (the utility owns the infrastructure) and public networks (services provided by a telecommunications carrier) (Figure 22). This hybrid approach works well for utilities in terms of managing costs and meeting certain reliability requirements.

Utilities are hesitant to have critical operations rely completely on third-party service providers. Service level agreements (SLAs) with phone or cellular telecommunications companies do not always align with specific needs of a utility. This is why, for certain network infrastructure, many utilities own and operate their own networks. For example, the SLA for response times to

service outages from third-party carriers may not be fast enough for critical assets, such as the collection of plant data or controlling pump stations. For these assets, it makes sense for utilities to own and maintain the systems where emergency and rapid response times are required.

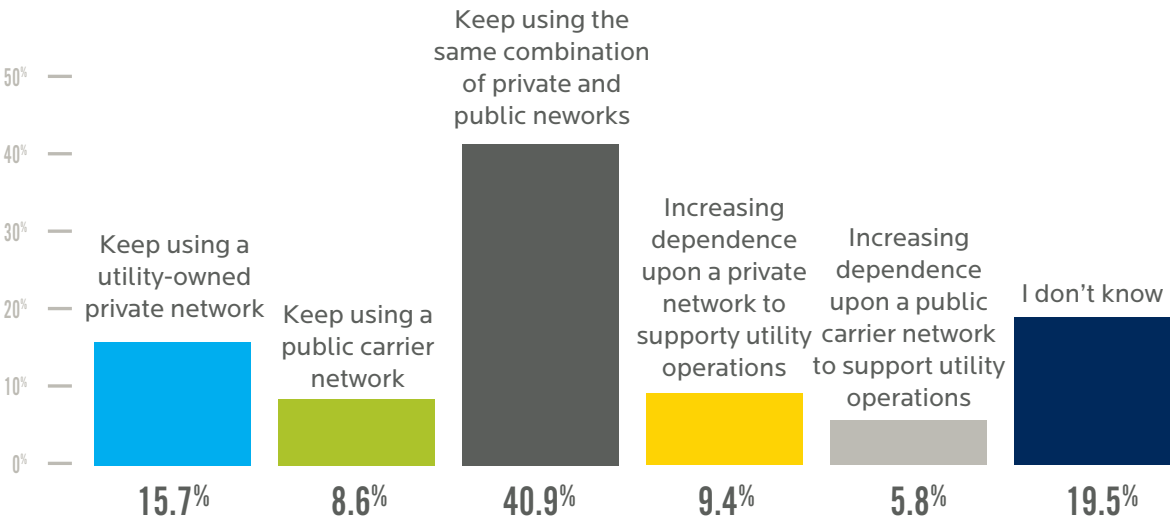
The traditional strategy the industry has used for critical operations is to own as much of their network as possible and then use public networks for additional services. However, public carrier systems are becoming more robust and some providers are improving their willingness to commit to providing critical service response times. As a result, many water utilities have, or are on a solid path to, adopting technologies that support highly mobile and connected workforces. In turn, this supports increased reliance on public carrier services.

FIGURE 21
IMPORTANCE OF TELECOMMUNICATIONS NETWORK



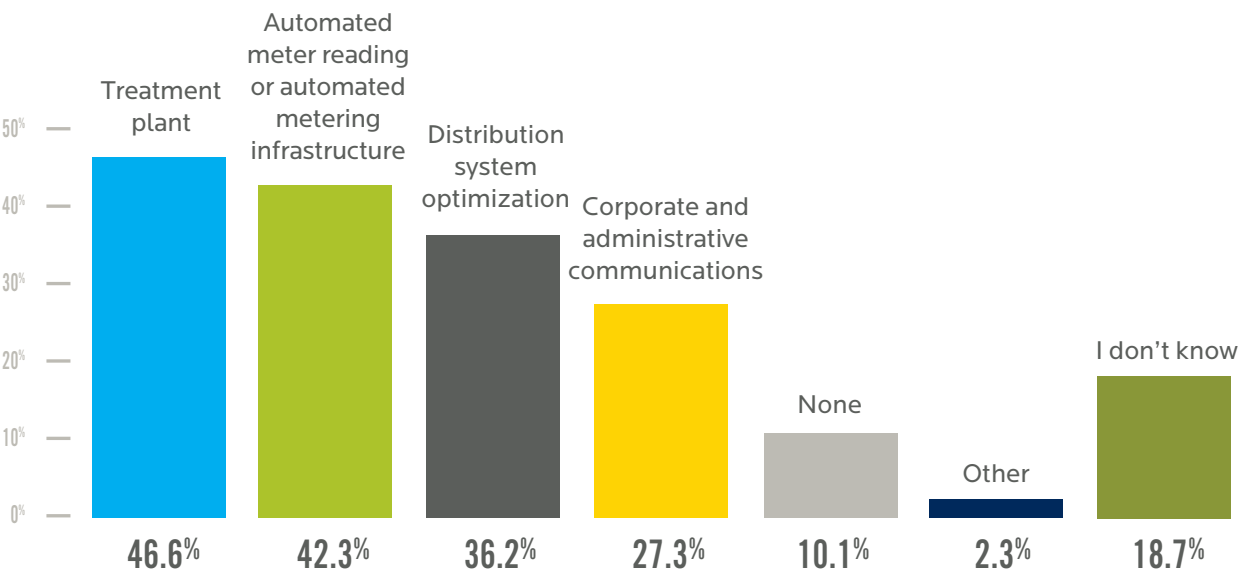
Source: Black & Veatch
Respondents were asked to rate how important they believe their organization's telecommunications network will be to future operations. More than 70 percent selected "Important" or "Very important."

FIGURE 22
MEETING FUTURE TELECOMMUNICATIONS NEEDS



Source: Black & Veatch
Respondents were asked to select the option that best describes future plans for their organization's telecommunications network.

FIGURE 23
TELECOMMUNICATIONS REQUIREMENTS PLANNING



Source: Black & Veatch
Respondents were asked if their utility is planning, reviewing or assessing the telecommunications requirements for any of the listed items.

Unlike major telecom and cable service providers that have adopted self-sensing and self-healing IP-based networks over the past decade, the electric, water and gas utility industries are just in the infancy stages of implementing such technology. The water industry is, however, showing increased interest in Smart Grid programs, with more than 40 percent of respondents stating that their organization is planning, reviewing or assessing telecommunications requirements for automated meter reading (AMR) or automated metering infrastructure (AMI) programs (Figure 23).

This data shows that utilities are planning for network improvements to support a variety of business and operational systems and applications, indicating a desire to improve information access and move data throughout a utility’s business network. Currently, utility managers, planners or engineers in many organizations cannot simply access data from different applications unless they request a special report from the appropriate department. Well-structured planning, across multiple applications in the utility enterprise, has the potential to increase the functionality of the information systems, enabling the right information to get to the right people to facilitate

effective decision-making are important aspects to effective asset management.

The focus on automation and asset management improvement does not just benefit utilities through increasing operational efficiencies and reducing costs. It can also help alleviate knowledge gaps that continue to widen as the industry faces workforce retirements. Automation captures this institutional knowledge. For example, implementation of document management systems help capture work processes, while treatment plant improvements build operational knowledge into the programs. According to utility IT managers, adoption of next-generation technologies could help entice the next generation of utility employees by providing greater job satisfaction and an opportunity to work with advanced tools and systems.

The water and wastewater industry typically holds onto legacy information and telecommunications systems for longer than private industry. This is understandable considering precious water utility investment dollars compete directly with other operational or capital improvement needs. Furthermore, many municipalities

plan investments around achieving maximum return on investments with many holding onto technology systems for 15 years or more. This is nearly double today's standard technology replacement cycle of eight years.

For water and wastewater utilities seeking to achieve maximum efficiencies through sound asset management and automation programs, strategic planning – and dedication to implementing this plan – is critical. As noted in the *Asset Management* analysis, utilities should first undergo a maturity assessment to identify gaps in their current practices and operations against best practices and/or their desired future state. Once gaps are identified, utilities should develop a plan for closing these gaps. Where telecommunications and automation are concerned, this can be met by developing a Technology and Automation Master Plan.

Technology and Automation Master Plans should have a focused budget allocated to identified improvements that are examined every two years to ensure alignment. Failure to complete a thorough master plan could result in systems growing organically in a manner that does not align with the utility's broader vision. These plans also should not extend too far into the future, or be too ambitious, or utilities will never achieve desired results. Master plans of this nature should be for five- to 10-year planning periods. Utilities must follow through on their identified improvements in incremental steps to achieve the greatest return on investment of technology systems as they age.

Perhaps the most important aspect of planning is not to conduct system planning in a vacuum. Ultimately, technology decisions and investments should be made to support desired operational outcomes. Technology and the telecommunications systems that enable data collection, storage and sharing, are the strategic enablers to achieving the organization's desired future state.



Cleveland Utility and Customers Benefits from Technology Advancements

BY **ROBERT BRNILOVICH**

In June 2011, Black & Veatch began working with Cleveland Water to improve operations. Primary areas of focus included inaccurate customer billing, staffing inefficiencies and complaints of poor customer service.

Black & Veatch worked with the city to stabilize its customer billing and information system, improve the collections process and enhance call center responsiveness. The results of this work, as reported in *The Cleveland Plain Dealer* on January 10, 2013, is that collection rates have improved to more than 98 percent and has yielded \$14 million per year in new revenue, which could grant customers a five-year reprieve from water rate increases.

The Cleveland Water Department is now in the process of installing an automated meter reading system throughout its system. Once fully implemented, the system will end the legacy practice of estimating bills when faulty meters go undetected for an entire billing cycle. This will allow for more accurate monthly customer bills and other customer services, such as online bill pay.

Robert Brnilovich is a Vice President in Black & Veatch's management consulting division, focusing on assisting water and energy utilities manage complex system integration efforts.

A NEED FOR ALTERNATIVES

BY **JOHN KERSTEN, BRUCE ALLENDER AND WILLIAM ZIEBURTZ**

From coast to coast the financial concerns weighing on U.S. water utilities impact nearly every aspect of their operations. Whether it's the challenges of aging infrastructure or water loss, the Top 10 Industry Issues reflect the difficulties of justifying competing capital and operating expenses with limited and often insufficient revenue.

Unfortunately, as a result of the all too frequent disconnect between funding/revenue levels and the demands for safe, reliable utility operations and capital spending programs, the U.S. water and wastewater utility industry is approaching a tipping point. To meet the needs of the next generation, many need to adopt, or accelerate, new management approaches and programs.

As discussed more fully in the *Asset Management* analysis, the challenges of managing capital costs, operational expenses and other cost drivers makes it important to have a firm understanding of a utility's assets. While experience and industry knowledge can provide a solid understanding of a system's condition, the complexity of many utility infrastructure projects encourages operators to adopt a rigorous, scientific approach to determining the condition of their systems.

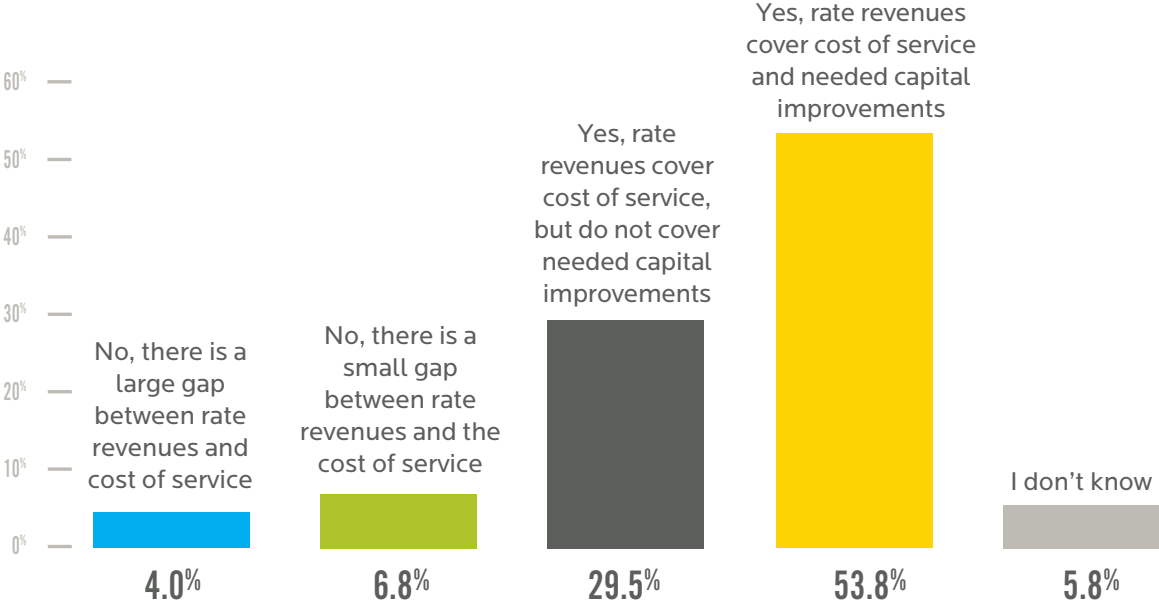
Traditional asset management programs provide a more detailed foundation for the effective deployment of capital and encourage the support of key stakeholders. This is critical as more than 40 percent of all respondents indicated some shortfall between revenue and the ability to meet their comprehensive financial needs, which include large capital improvement programs (Figure 24).

While the pre-2008 solution to funding shortfalls would often arrive in the form of growth and increasing demands, the new economic reality reflects the complex interplay between customers, financial markets and local policymakers that shape the financial health of the utility. The result is that utility managers are being asked to do more with less, often far less, or find alternative means of addressing utility issues.

Perhaps reflecting the difficulties of balancing these dynamic perspectives and requirements, municipal authorities with independent boards responded that their rates were typically more in line with expenses than utilities operated under municipal departments (Figure 25) that are dependent upon city councils approving recommended rate increases.

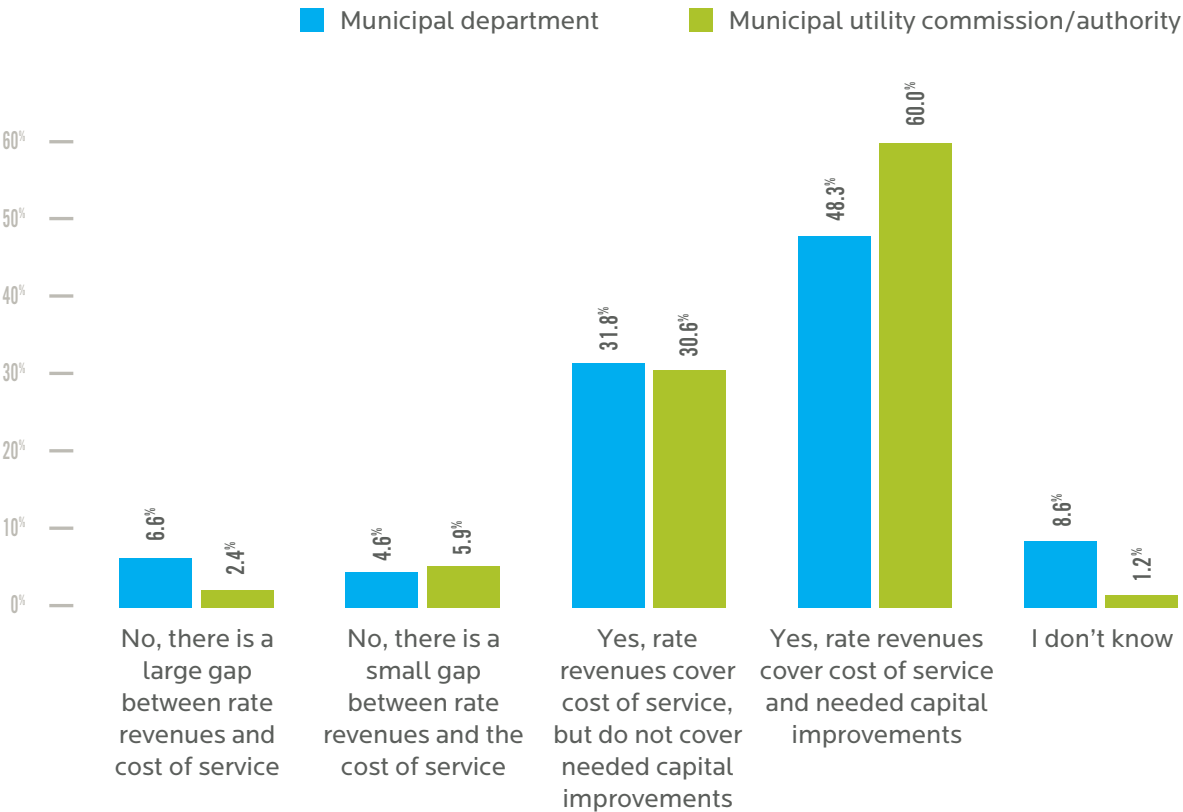
Of those respondents who indicated revenues from rates do not fully cover financial needs, nearly 47 percent (Figure 26) indicated rate increases of at least 10 percent would be required to cover costs and make necessary capital improvements.

FIGURE 24
REVENUES VERSUS COST OF SERVICE



Source: Black & Veatch
Respondents were asked if revenues generated under their utility's current rate structure fully cover the cost of providing water and/or wastewater services as well as necessary capital improvements.

FIGURE 25
REVENUES COVER COST OF SERVICE – BY ORGANIZATION TYPE



Source: Black & Veatch

FINANCIAL OVERVIEW

There appears to be a disconnect between responses to this question and the overall top industry concerns. The issues of managing capital costs, managing operational costs and funding or availability of capital represent three of the top five overall issues. Yet, nearly 54 percent of responses stated rate revenue is covering operating costs and capital improvements. This likely reflects the omission of key costs like renewal/replacement and debt service on capital improvements, or the substitution of “approved budgets” for actual needs.

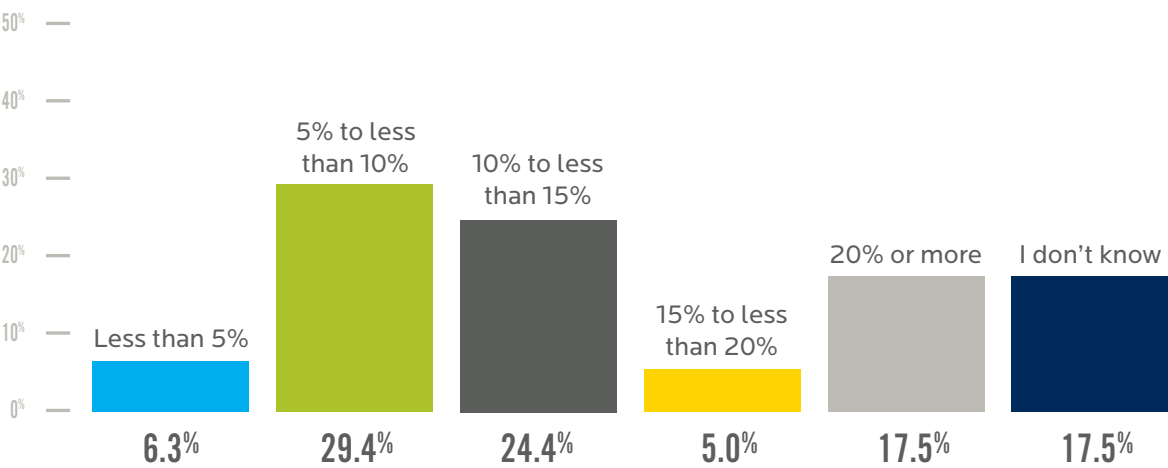
Finding a way to increase the adequacy of approved budgets continues to be a key requirement for utilities seeking a path toward long-term success. The need for more education regarding the value of water is evident in Figure 27, where nearly 60 percent of respondents indicated their customers have no or little understanding of the gap between current rates and the cost of providing safe and reliable water and/or wastewater services.

Another interesting survey data point, however, is the viewpoint of more than two-thirds (69 percent) of respondents that believe or take a neutral view that customers will support increased rates to fund capital spending (Figure 28). This is in stark contrast to the difficult approval processes observed for many utilities

where proposed rate increases, particularly for utilities that fall into the municipal department category, are slashed, delayed or outright denied by city leaders. Unfortunately, what is lost on many leaders who ultimately decide between raising rates or placating vocal constituents is that a small increase to maintain infrastructure is substantially more cost-effective for customers than large rate hikes in the future to pay for the replacement of deteriorating infrastructure.

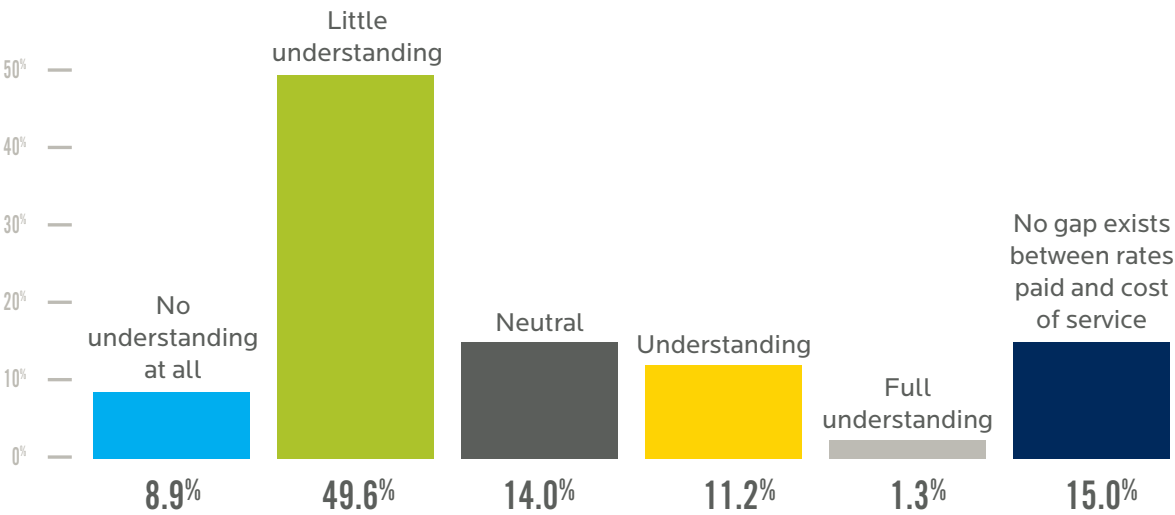
The inability of many water and wastewater utilities to push through rate increases has resulted in reactionary asset management practices in many cases. Rather than proactively fixing, renewing and maintaining critical infrastructure, utility managers have no choice but to address items as each fails. For most utilities, large-scale programs that gain funding are those that are required by federal or state regulations, such as nutrient removal, sanitary or combined sewer overflows and drinking water quality requirements. The continuing practice of deferred infrastructure maintenance has gone on too long, and it is now time to “pay the piper.” Massive overhauls of buried infrastructure to meet consent decree requirements, enhance reliability and save precious water resources are already under way or in the planning stages.

FIGURE 26
RATE INCREASES NEEDED TO COVER COSTS



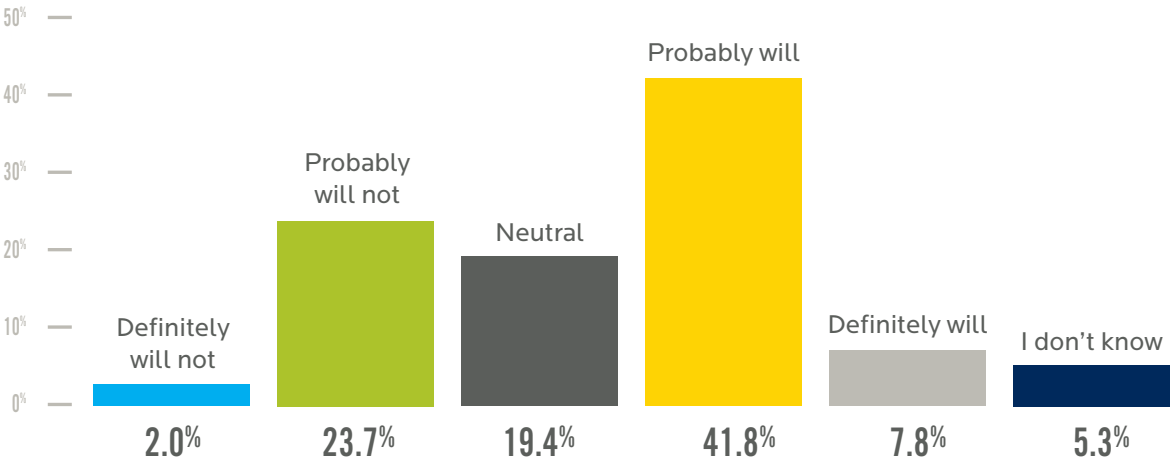
Source: Black & Veatch
Respondents who indicated that current rates do not cover cost of service and necessary capital improvements were asked to select the range in which rates needed to rise to cover the cost of providing services and implement necessary capital improvements.

FIGURE 27
CUSTOMER UNDERSTANDING OF COSTS VERSUS RATES



Source: Black & Veatch
Respondents were asked how well their consumers understand the gap between current rates and the cost of providing safe and reliable water and/or wastewater services.

FIGURE 28
CUSTOMER WILLINGNESS TO PAY INCREASED RATES



Source: Black & Veatch
Respondents were asked whether or not they believed customers are willing to pay increased rates to support capital spending requirements.

FINANCIAL OVERVIEW

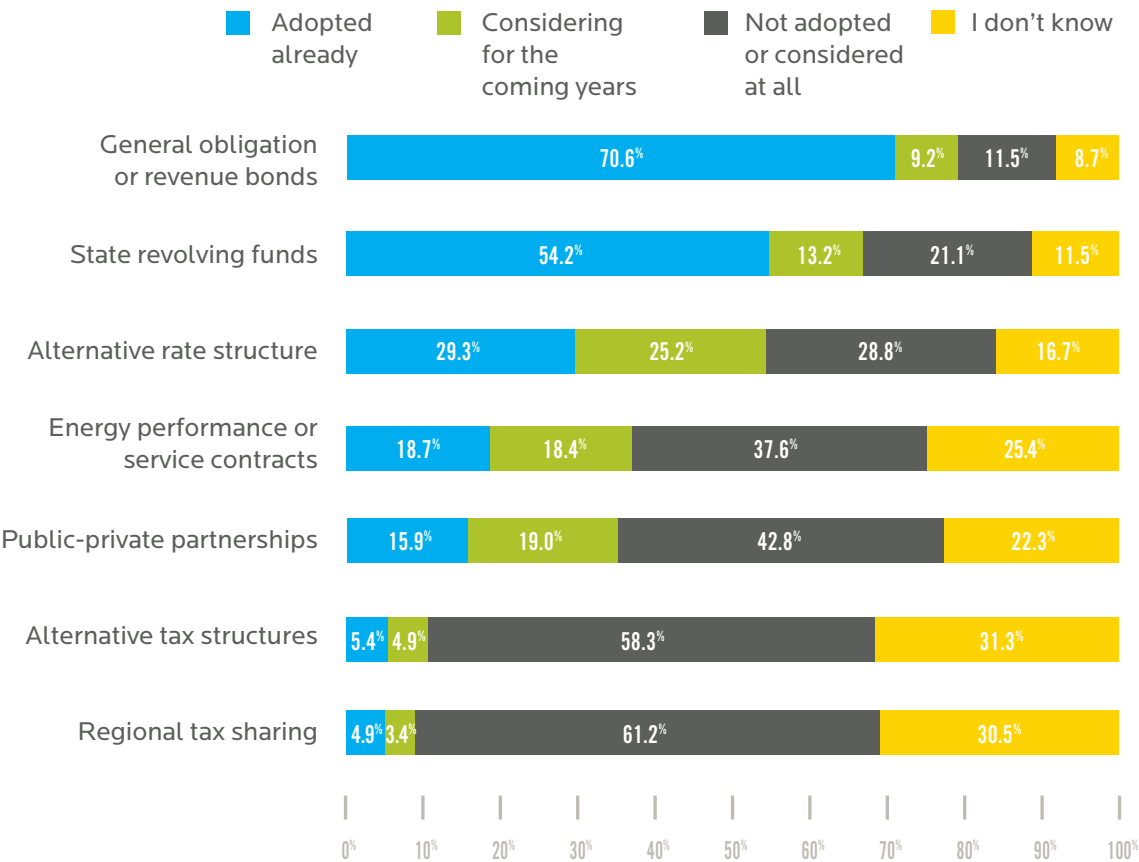
Financing these programs is going to be extremely challenging for many utilities. Many in the finance community are concerned that traditional approaches to obtaining bond market capital may no longer be sufficient to meet the massive needs of the industry, particularly given the post-recession aversion to risk. Yet, nearly 80 percent of respondents have or are planning to utilize municipal general obligation or revenue bonds to finance capital programs (Figure 29). Nearly 70 percent believe state revolving funds will help lesson the burden. This also is highly unlikely given the current fiscal constraints/ policies of the federal government, which largely fund state revolving fund programs.

Pursuit of alternative financing, shared revenue and public private partnerships remain a limited endeavor for most utilities. As reflected in Figure 29, the financing model remains focused on a market (municipal bonds)

that some experts believe may be too small to service its needs. In many instances, we are seeing parallels between today's U.S. water and wastewater industry and the challenges the industry had in the 1980s that ultimately led to privatization of the entire UK industry (see *Water Privatisation in England and Wales*).

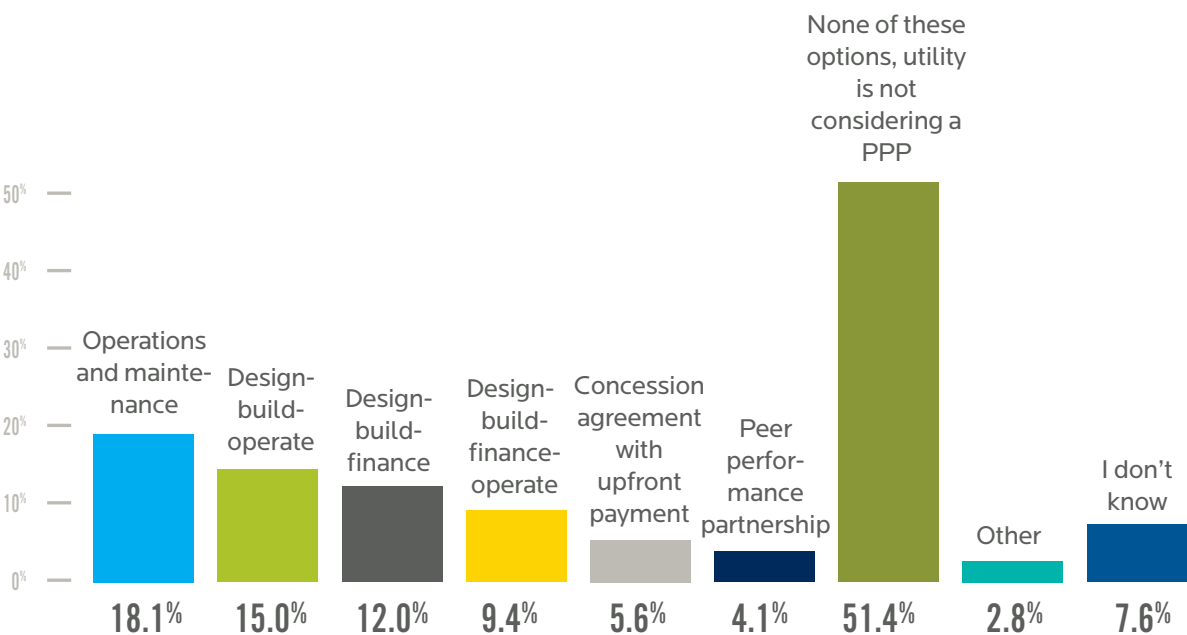
Although by no means a trend, it is interesting to note a potential shift in the view towards public-private partnerships (PPP). While slightly more than half of utility industry respondents stated their organizations are not considering PPPs (Figure 30), in the past 12 months, there have been several examples of water and wastewater utilities in the United States turning to the PPP model to help maintain or improve service and/or meet regulatory requirements.

FIGURE 29
FINANCING PROGRAMS



Source: Black & Veatch

FIGURE 30
PUBLIC-PRIVATE PARTNERSHIPS UNDER CONSIDERATION



Source: Black & Veatch
Respondents were asked to indicate which types of public-private partnerships their utility has either adopted or is considering to support capital improvement programs.

It is no surprise to see that nearly 20 percent of industry respondents are considering operations and maintenance (O&M) contracts (Figure 30). O&M contracts are currently the most common and well-understood form of PPPs in the U.S. water and wastewater industry. O&M contracts range from outsourcing of the complete existing systems, which may include customer service, billing and collection, to outsourcing O&M for specific assets such as treatment facilities. The drivers for utilities to outsource their O&M vary across the country. Some reasons include cost of service, aging workforce and regulatory compliance.

Black & Veatch is also seeing increased interest (and has participated in) design-build-finance (DBF), design-build-operate (DBO) or design-build-finance-operate (DBFO) models. These programs involve awarding a single contract to the private sector to provide the design, construction, financing and/or operations components of a new project under an integrated delivery model. DBO

and DBFO arrangements typically include longer term (greater than 15 years) O&M agreements.

The advantage of design-build models is the integrated delivery and innovation that the private sector can provide in constructing and operating new assets. Successful projects provide clients with lower overall life cycle costs and transfer of risk associated with design, construction and operations and maintenance activities to the private sector over the term of the agreement. Design-build contracts also typically provide utilities with guarantees associated with project cost, schedule and asset performance.

These delivery mechanisms are particularly beneficial to organizations that have financing challenges, are facing fines associated with noncompliance with environmental regulation or have a need to implement a project, such as an environmental or water supply program, through a compressed schedule.

Unlike the full privatization model prevalent in the UK, a few large and smaller municipalities have engaged in long-term concession agreements with private entities. These arrangements involve turning over the day-to-day operations and implementation of the capital improvement program to a private company. Under a concession, the city agrees to pay a fee associated with the performance and service levels provided back to the utility from its private sector partner. The company, in turn, provides the city with an upfront payment to, at a minimum, pay off the debt associated with the system. In some cases, the upfront payment has also funded city programs or obligations after defeasing system debt. The most recent concession agreements in the United States have been structured to ensure the utility or city maintains ownership of its assets.

Looking to the future, consumers throughout the United States are sure to find their water and sewer bills requiring a larger portion of household budgets than in the past as utilities fund much-needed infrastructure investments. With significant portions of U.S. water and wastewater systems aging, or in need of significant funding to meet regulatory standards, the question for many utilities will be whether they choose to explore new financing options on their terms, or wait until they are forced to accept a less than desirable arrangement to avoid default, bankruptcy or other negative financial or operational consequences.

Black & Veatch advises its clients that these agreements, or other financing mechanisms, are most beneficial when they are integrated into the utility's planning process. This will help utilities negotiate with the private sector from a position of strength versus a necessity to accept terms because of a lack of options.



Water Privatisation in England and Wales

BY **PETER MARTIN**

In England and Wales, the provision of water and wastewater services was moved from the public to the private sector in 1989. This change was part of a broader government strategy, which also encompassed the telecom and energy sectors, to privatise the ownership and management of public assets.

For 16 years prior to privatisation, water and wastewater services in England and Wales were the preserve of catchment-based public water authorities. During the 1980s water authorities became increasingly affected by limits on public sector borrowing that were imposed to contain inflation. It was challenging to fund asset maintenance and improvement. In addition, the cost of meeting water quality and environmental directives set by the European Union (EU) grew.

The government's solution to meet the funding gap was to change the water authorities into private companies. Because 99 percent of households were already connected to the water supply network and 96 percent also connected to the sewerage system (Water Companies Association, *Waterfacts*, 1992) opportunities for organic growth by the new "water companies" were limited. As a result, investment was made more attractive by the formation of holding companies that were able to undertake other forms of commercial activity and own the new water companies. Public capital was injected into the holding companies, which were then successfully floated on the London Stock Exchange. England and Wales' 10 private water and wastewater companies were formed. There are also a number of smaller water-only companies

that have existed in private ownership for many years.

Along with the creation of the water companies came a new regulatory framework. Ensuring drinking water quality fell to the Drinking Water Inspectorate (DWI). The Environment Agency also came into being.

The new water companies were natural monopolies. There was no competition in the market because customers were in essence unable to change their water services provider. As a result an economic regulator, Ofwat, was created to control water bills and set service levels. This was achieved through a system of 'comparative competition', central to the administration of which is the five-yearly regulatory review cycle.

Ofwat has a statutory duty to ensure companies can finance their regulated function; i.e., water and wastewater services. This is achieved through a price control mechanism. Revenue allowances are set to fund CAPEX and OPEX and a reasonable return on invested capital. To reward efficiency and good service, the system generally allows companies to retain, for the five-year regulatory review period, savings attributable to efficiency. This creates an incentive. The existence of multiple water companies allows Ofwat to make comparisons and reward the best performers.

The water industry in England and Wales has matured since 1989. Most water companies have undergone several changes in ownership and structure. During the past six years, a sector that was largely publicly listed has become substantially owned by institutional investors. In the first six years after privatisation, the water companies invested £17 billion. This investment is compared to £9.3 billion invested by the water authorities in the six years before privatization (The World Bank Group, *Water Privatization and Regulation in England and Wales*, 1997).

Capital investment has remained high at £85 billion from 1989 to 2010 (Water UK, 2011). During this period, according to Ofwat, water bills were 30 percent lower than they would have been without regulation (Ofwat's response to the Independent Review of Charging

Household Water and Sewerage Services, 2011). Water quality is high. In 2010, according to the DWI, 99.96 percent of all tests met quality standards (Drinking Water Inspectorate, Letter to Ministers, 2011). Compliance with discharge consents rose from 97 percent in 1996 to 99.8 percent in 2004 (Department of Environment, et al, *The Development of the Water Industry in England and Wales*, 2006).

These successes have not been unchallenged. Water companies have been accused by some customers and politicians of manipulating economic regulation to generate excessive profits. The progress of work to reduce leakage has been a frequent source of criticism.

Concern has also been expressed that owners of some water companies are investing insufficient revenues back into the regulated businesses. This is seen, in part, as leading to high levels of borrowing in the sector. In 2010, Severn Trent noted that water company debt had risen from £0 to £33 billion between 1989 and 2010, while gearing over the same period had risen from 0 percent to 72 percent (Severn Trent Water, *Changing Course*, 2010).

Competition has also proved challenging. In 1989, it was envisioned that a competitive market for large volume users would develop. This market failed to happen to any significant degree. As a result, it is likely that measures to stimulate competition will be incorporated into future legislation.

Peter Martin is an Associate Vice President and Technical Solutions Director in Black & Veatch's water business. He is based in the company's Redhill office (UK).

REDEFINING SUSTAINABILITY

BY CINDY WALLIS-LAGE

The 2013 Black & Veatch *Strategic Directions in the U.S. Water Industry Report* reflects the outlook of an industry whose ability to deliver services and thrive is constrained by economic, regulatory and environmental uncertainties. Upon close inspection, it is clear that these issues represent an opportunity for the industry to re-evaluate the business of water and redefine what it means to be sustainable. To achieve this, industry leaders must reshape their organizations across many fronts and, where applicable, apply global best practices and proven methodologies as noted within this report.

This report explores industry concerns about maintaining reliability and quality of service, addressing aging infrastructure issues, and asset management. While many organizations are working to address these challenges, most solutions typically manifest in siloed solution sets. This limits their efficacy to specific outcomes or consequences and not necessarily the broad-based root problems facing water utilities.

The interrelated nature of today's industry challenges requires a new management outlook. A shift toward holistic asset management increases the chance that utilities will survive economic and social changes brought about by market fluctuations, as well as the ravages of time and climate. Understanding the foundational assets enables truly sustainable operations for the entire enterprise.

The term "sustainability" suffers from becoming synonymous with "greening" or being environmentally friendly within the water and wastewater industry. For struggling utilities, sustainability must encompass the three elements of the triple bottom line: financials, community and the environment. However, the balance between the three elements must reflect the specific conditions of a given community versus a one-size-fits-all approach. Doing so will help improve and sustain utility operations now and in the future.

Newton's third law of motion provides a metaphor for the current fiscal environment of the water and wastewater industry: for every action there is an equal and opposite reaction. What most organizations fail to realize is that inaction is a policy. In this case, the reaction to a policy of inaction is compounding operational and financial challenges. The longer this goes on, the fewer choices an organization will have in financing large capital programs to renew and replace aging infrastructure that is failing to meet the needs of the community. A policy of action, where utilities seek out and implement the best funding mechanisms for their programs – potentially including private sector capital, provides choice and competition that will ultimately benefit the utility, its customers and the environment.

Addressing the people side of sustainability is also a proven method for meeting strategic goals. Investments in the social side of the business of water can help address consumption challenges and create a platform to educate consumers about the connection between affordability (rates) and reliability. Black & Veatch's experience in managing customer services process implementation and operational efficiency programs has shown that informed endusers make better choices about consumption. In addition, customer education programs make for a more informed and receptive public that could ease the

anxiety levels of elected bodies that must implement rate changes on their constituents.

Workers, too, are critical stakeholders for water and wastewater utilities. As an aging population of industry workers retire, it is imperative to include recruitment and training as part of sustainability planning. In addition, technology can help capture institutional knowledge and incorporate this into day-to-day workflows and operations that will carry an organization through the coming “brain drain.”

Including financials and stakeholders as part of an overall strategic sustainability plan does not preclude traditional environmental considerations. Resource planning, which includes “green” and “conservation” targets, will be part of the solution set.

Negative supply impacts brought about by changing weather patterns, such as drought, flooding or a combination of the two, challenge water utilities to explore new means of shoring up supply. Indeed, with the “wise and efficient use of water” rightly becoming a cultural norm, the next step is an extension of the planning horizon in which industry looks at ways to extend the water life cycle by 20 years or more.

For water utilities, sustainability planning must include business continuity planning. Creating a strategy that includes asset management, resource planning and investment requires addressing the realities of today’s competitive industry rather than the industry of the past. Organizations must look beyond their traditional service mentality and seek ways to meet the needs of their customers with a long-term business approach.

Managing supply is just the beginning. Meeting customer expectations while delivering sustainable financial performance is the goal. This is critical because the financial hurdles facing aging water and wastewater systems are significant. Repairing and, if necessary, replacing infrastructure requires large capital expenditures as do incremental fixes to address water loss. Reduced funding means utilities must look to

alternative financing mechanisms, efficiency programs, and technological fixes to support investment. Educating end users about the impacts of consumption and the importance of stewardship nets a greater understanding about the value of water.

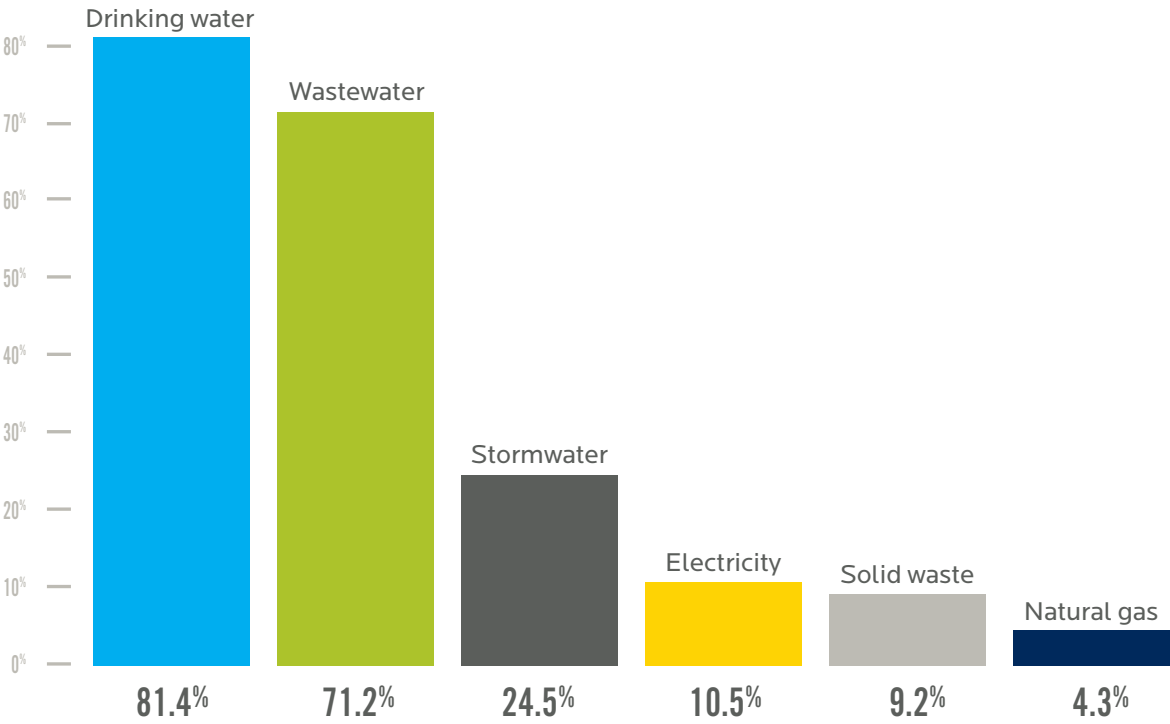
The 2013 Black & Veatch *Strategic Directions in the U.S. Water Industry Report* begins this conversation by highlighting the interrelated themes shaping the future of the industry. Recognizing the value of water acknowledges that the choices utilities make today must not be restricted to one or two variables because that’s the way things have always been done. True sustainability lies in the systems that support reliability being patterned on fully informed, holistic decision-making.

A POLICY OF ACTION, WHERE UTILITIES SEEK OUT AND IMPLEMENT THE BEST FUNDING MECHANISMS FOR THEIR PROGRAMS, PROVIDES CHOICE AND COMPETITION THAT WILL ULTIMATELY BENEFIT THE UTILITY, ITS CUSTOMERS AND THE ENVIRONMENT.

The following charts provide additional information on specific subject matter covered within this report.

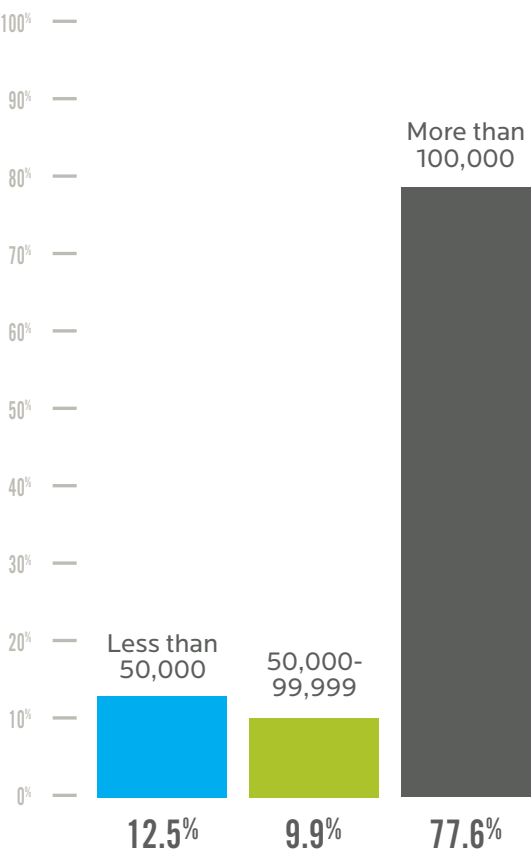
ADDITIONAL RESPONDENT INFORMATION

RESPONDENTS BY TYPES OF SERVICES PROVIDED



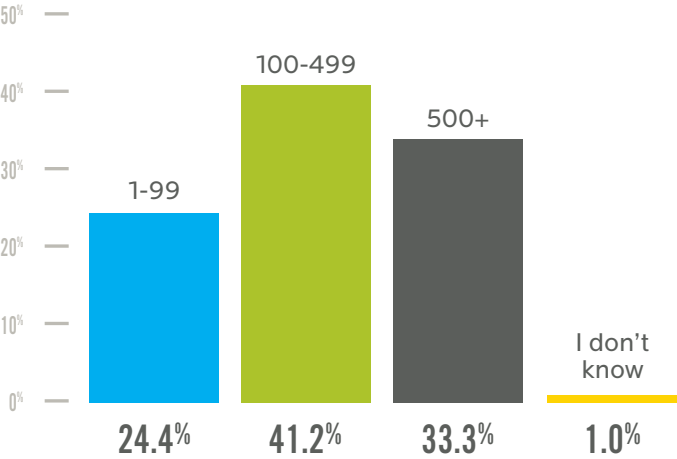
Source: Black & Veatch

RESPONDENTS BY POPULATION SERVED BY UTILITY



Source: Black & Veatch

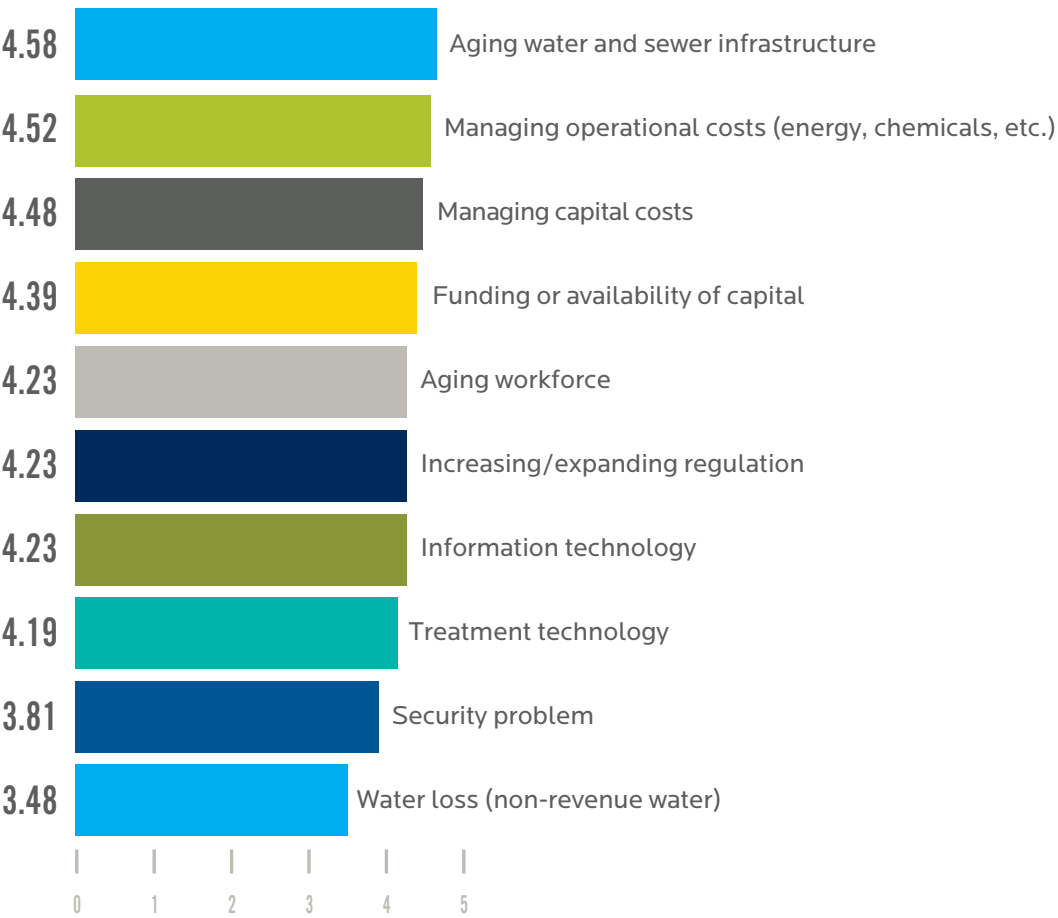
RESPONDENTS BY NUMBER OF EMPLOYEES IN UTILITY



Source: Black & Veatch

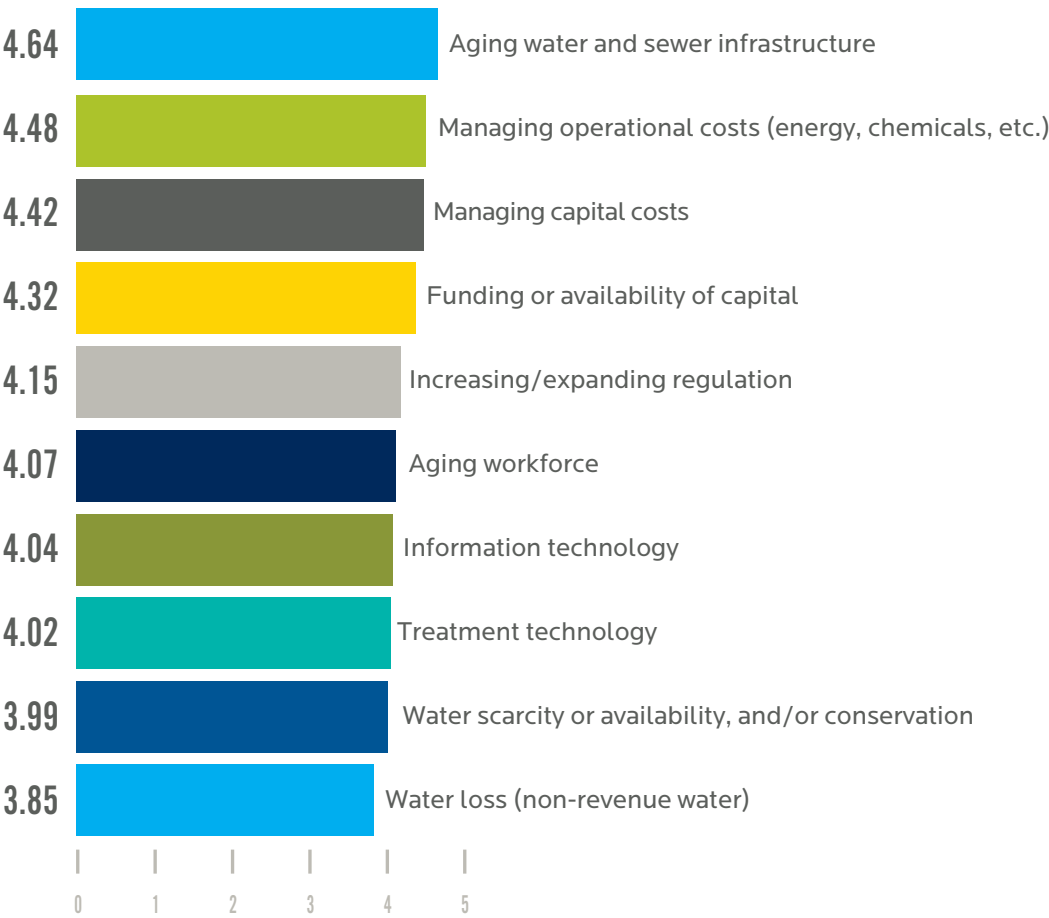
TOP 10 INDUSTRY ISSUES BY REGIONS SERVED

TOP 10 INDUSTRY ISSUES – NORTHEAST



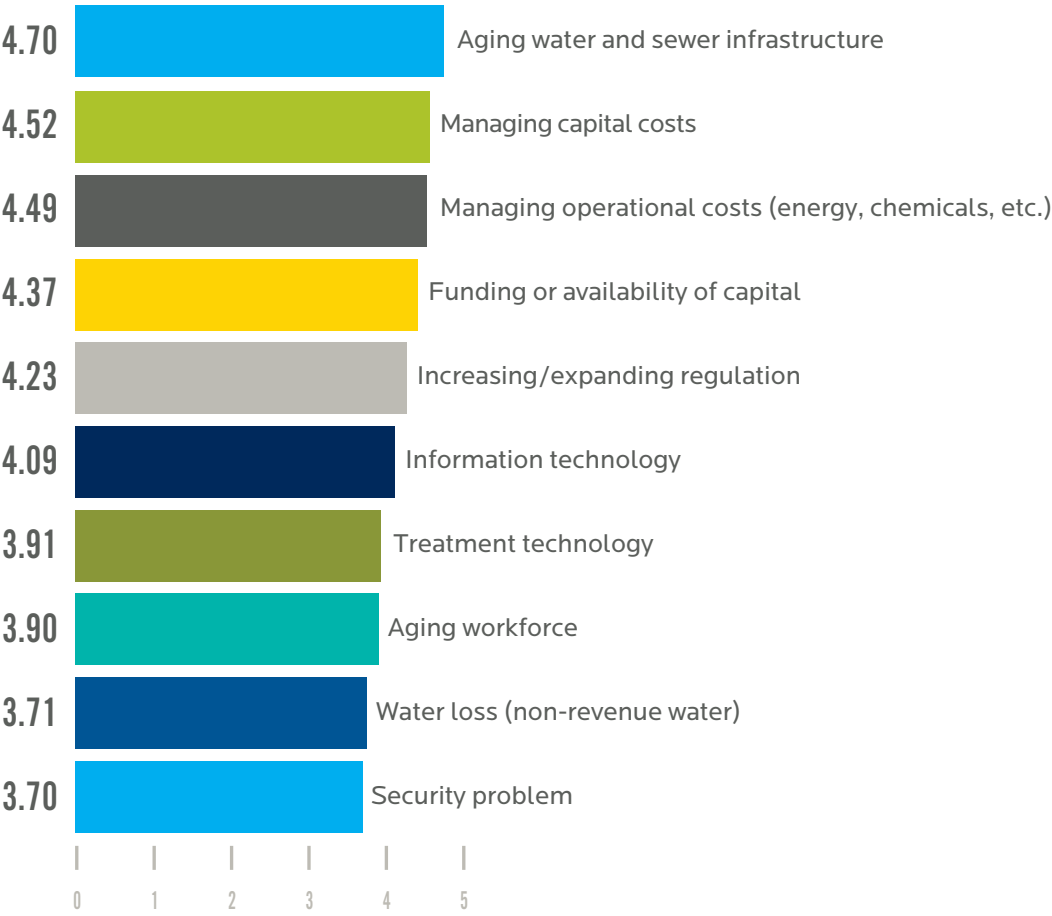
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TOP 10 INDUSTRY ISSUES – SOUTHEAST



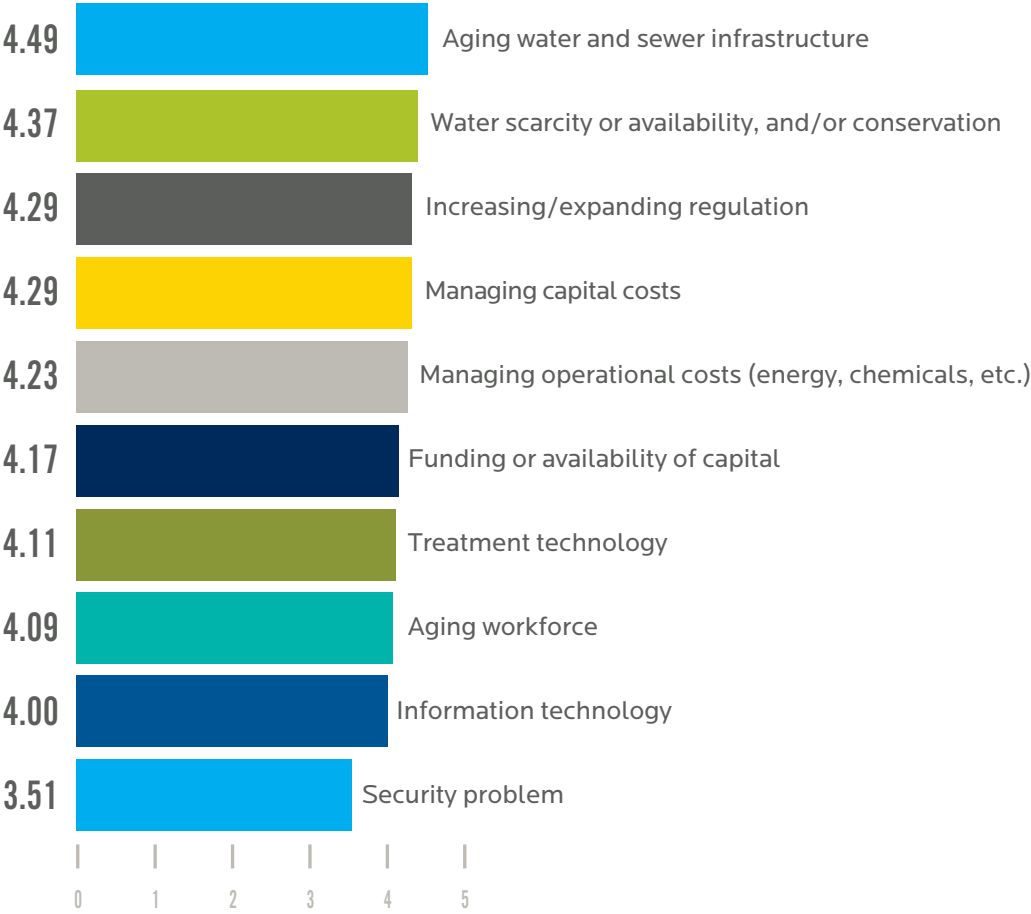
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TOP 10 INDUSTRY ISSUES – MIDWEST



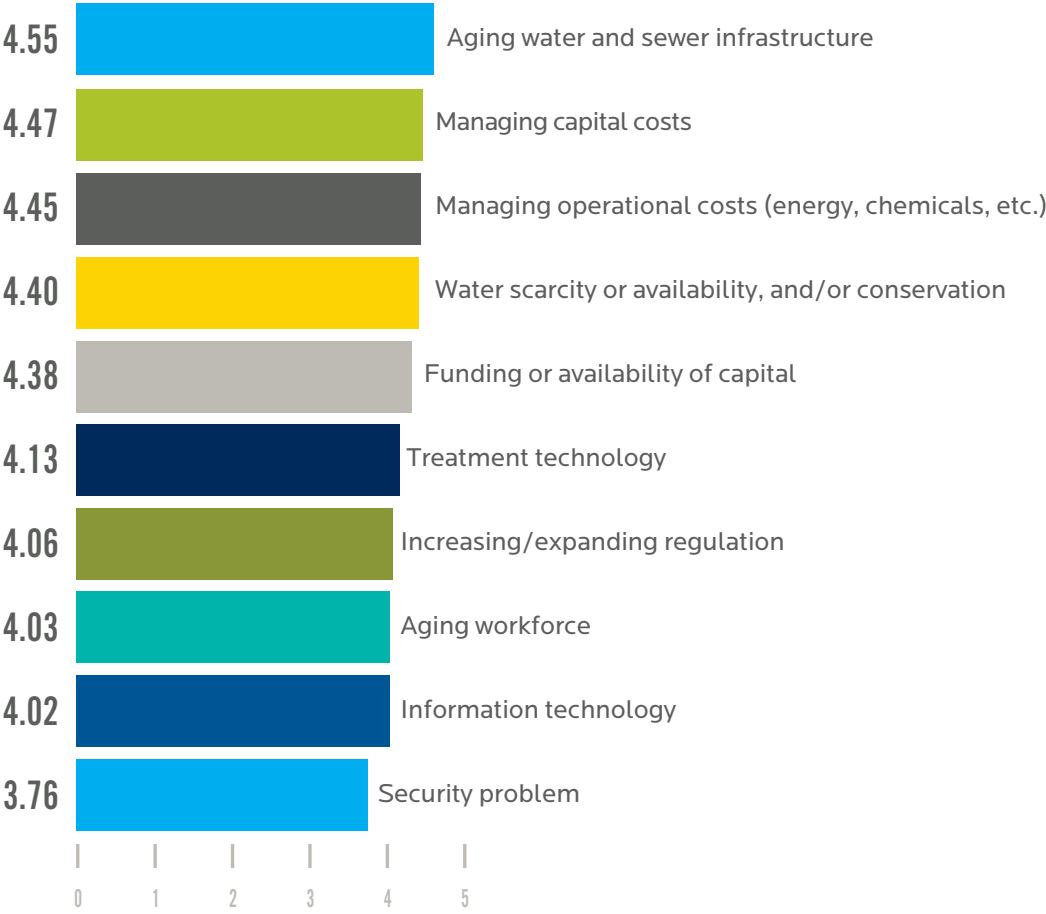
Source: Black & Veatch

TOP 10 INDUSTRY ISSUES – ROCKY MOUNTAIN



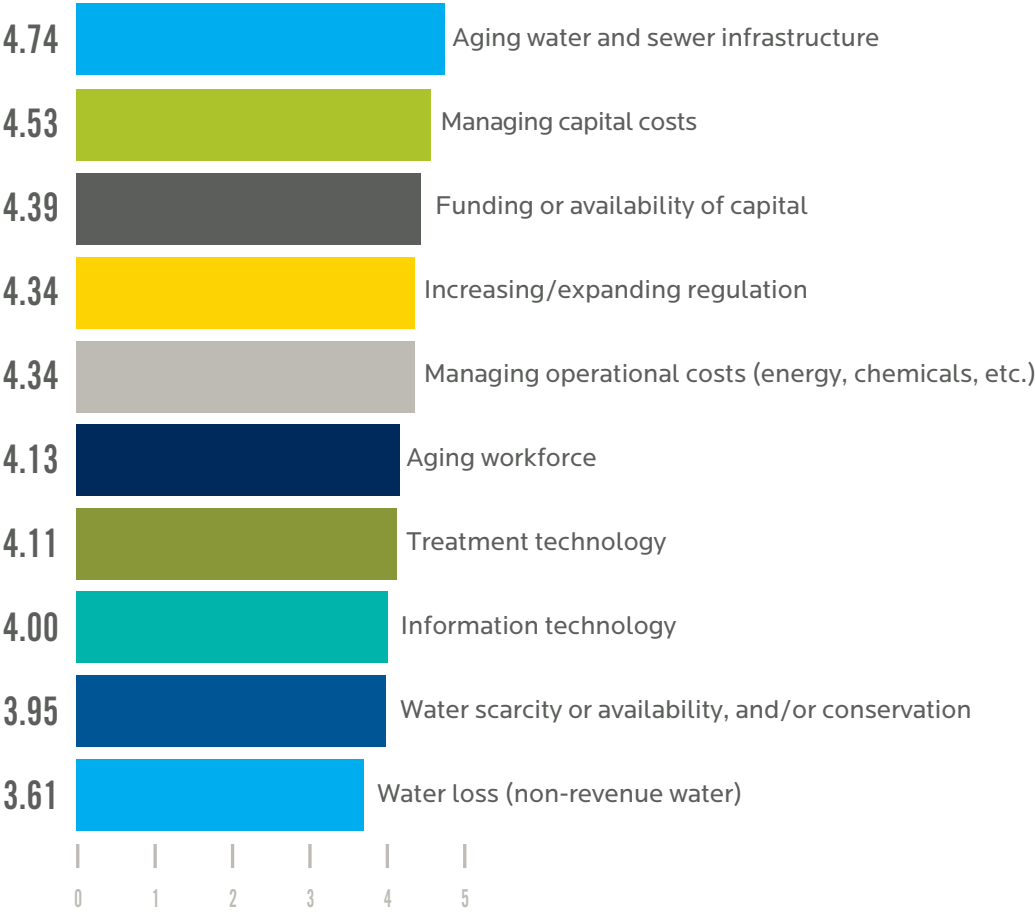
Source: Black & Veatch

TOP 10 INDUSTRY ISSUES – SOUTHWEST



Source: Black & Veatch

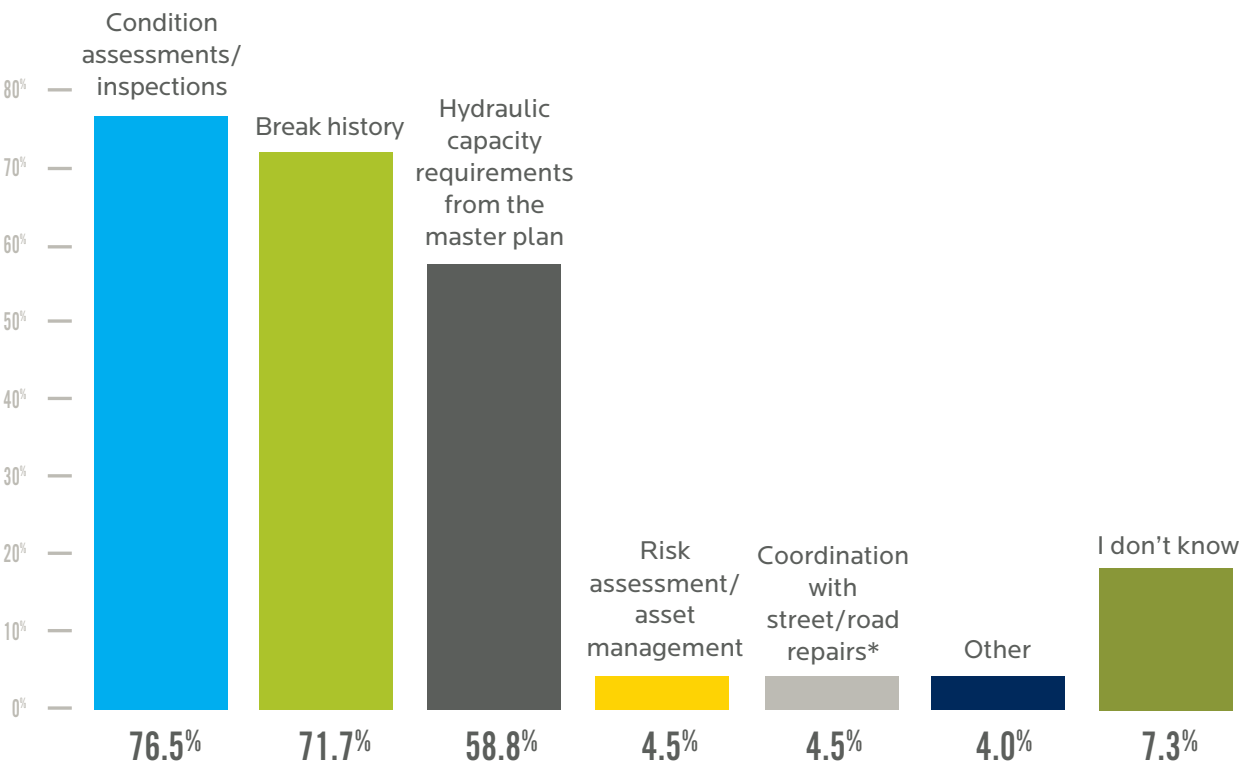
TOP 10 INDUSTRY ISSUES – NORTHWEST



Source: Black & Veatch

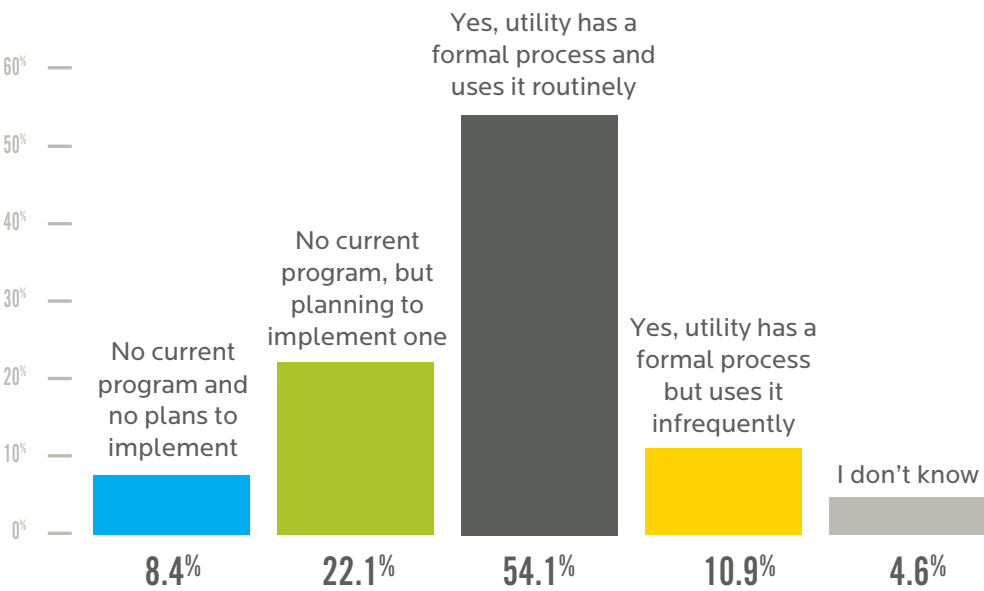
BURIED INFRASTRUCTURE

METHODS FOR IDENTIFYING MAINS/PIPELINES FOR REPLACEMENT



Source: Black & Veatch
*Denotes write-in responses

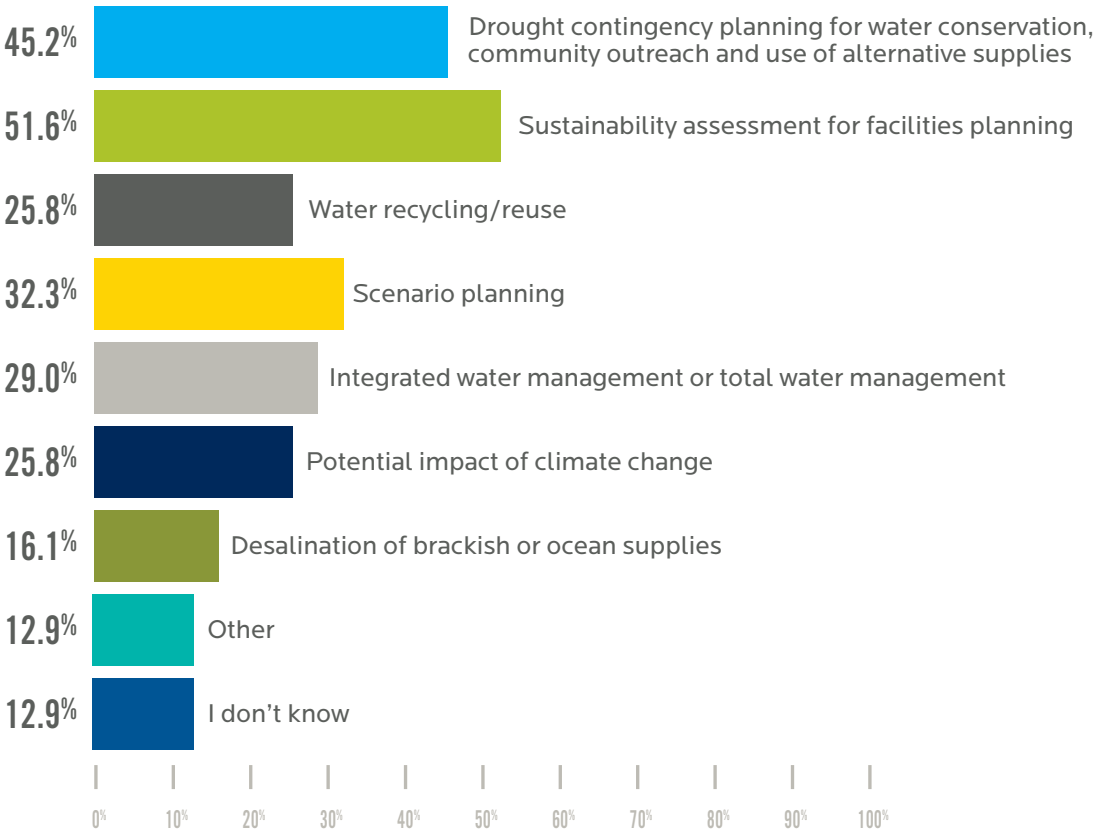
PROCESS FOR ASSESSING PIPE/MAIN CONDITIONS



Source: Black & Veatch

SUSTAINABILITY

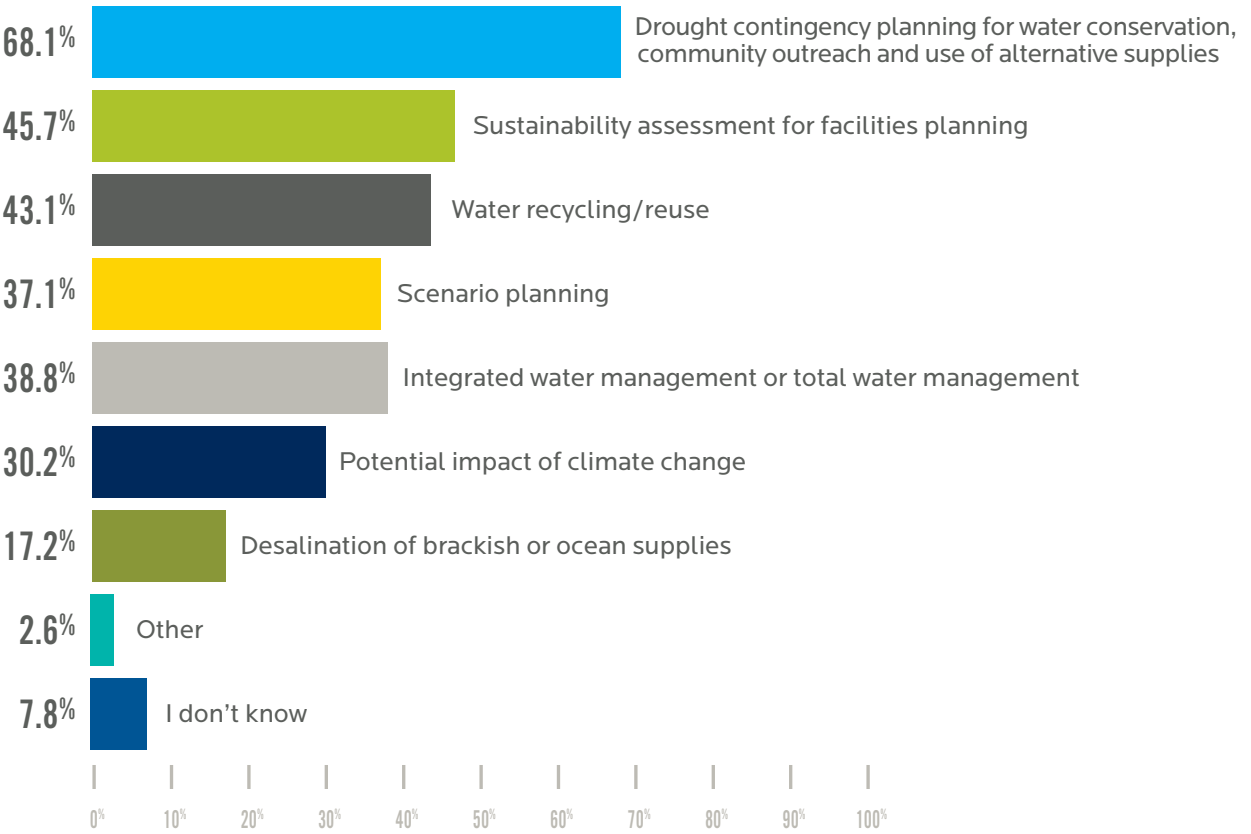
LONG-RANGE WATER SUPPLY PLANNING – NORTHEAST



Source: Black & Veatch

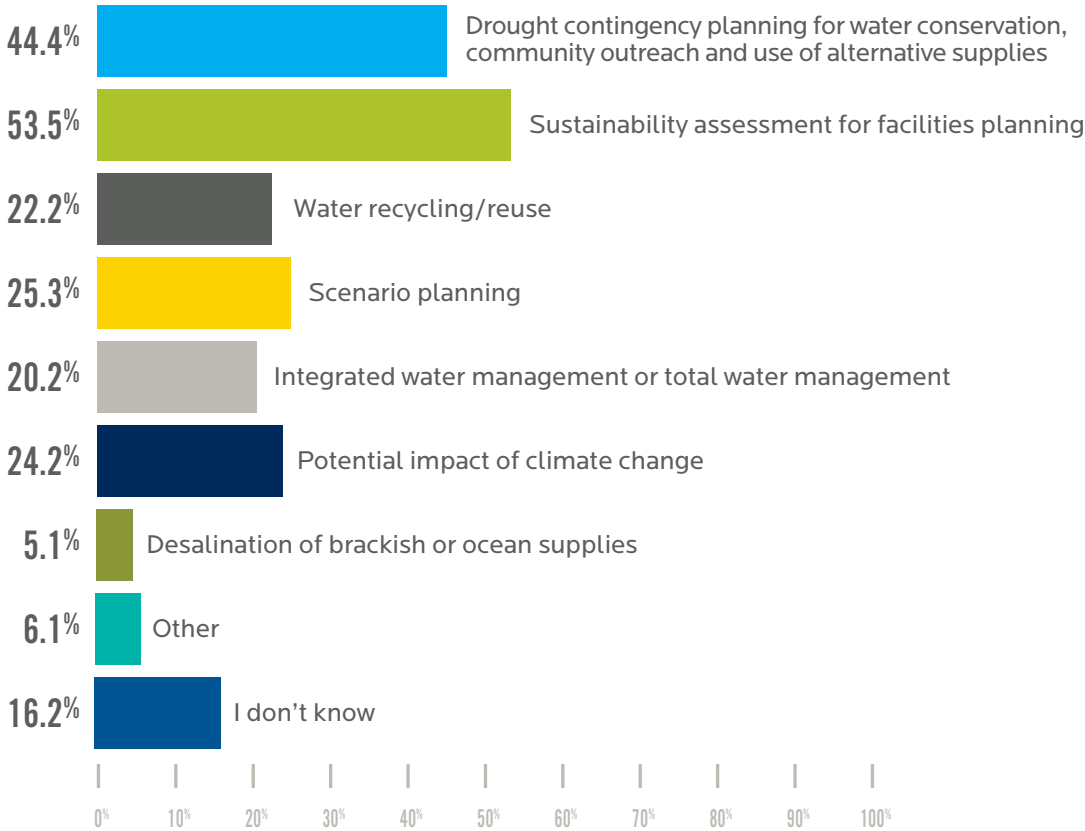
APPENDIX

LONG-RANGE WATER SUPPLY PLANNING – SOUTHEAST



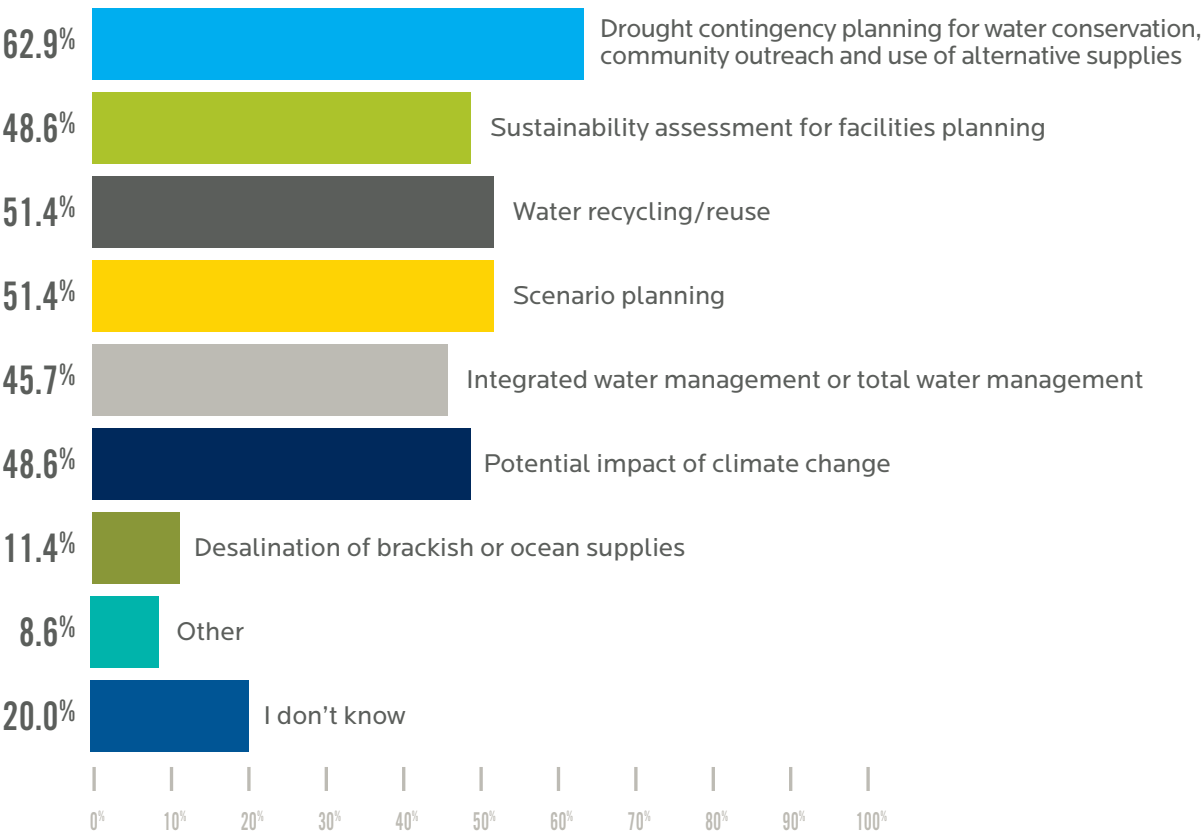
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LONG-RANGE WATER SUPPLY PLANNING – MIDWEST



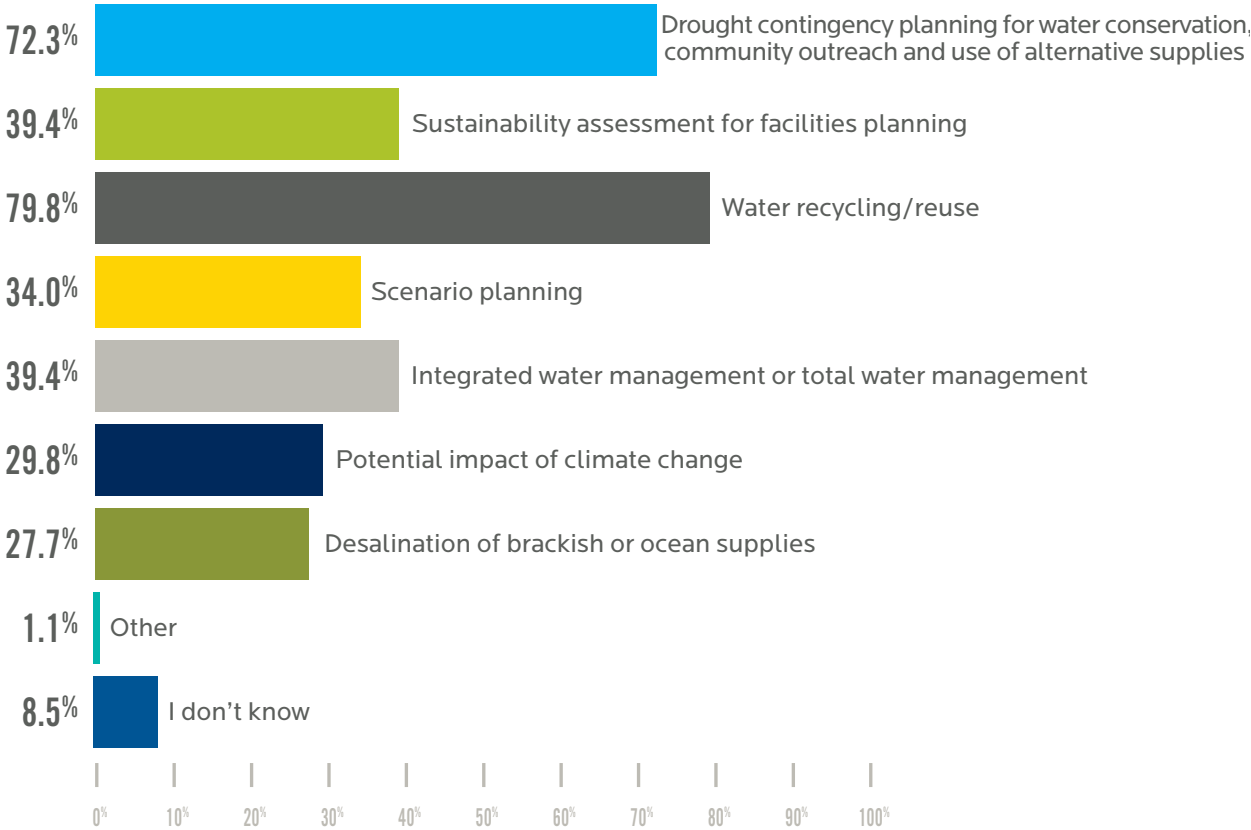
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LONG-RANGE WATER SUPPLY PLANNING – ROCKY MOUNTAIN



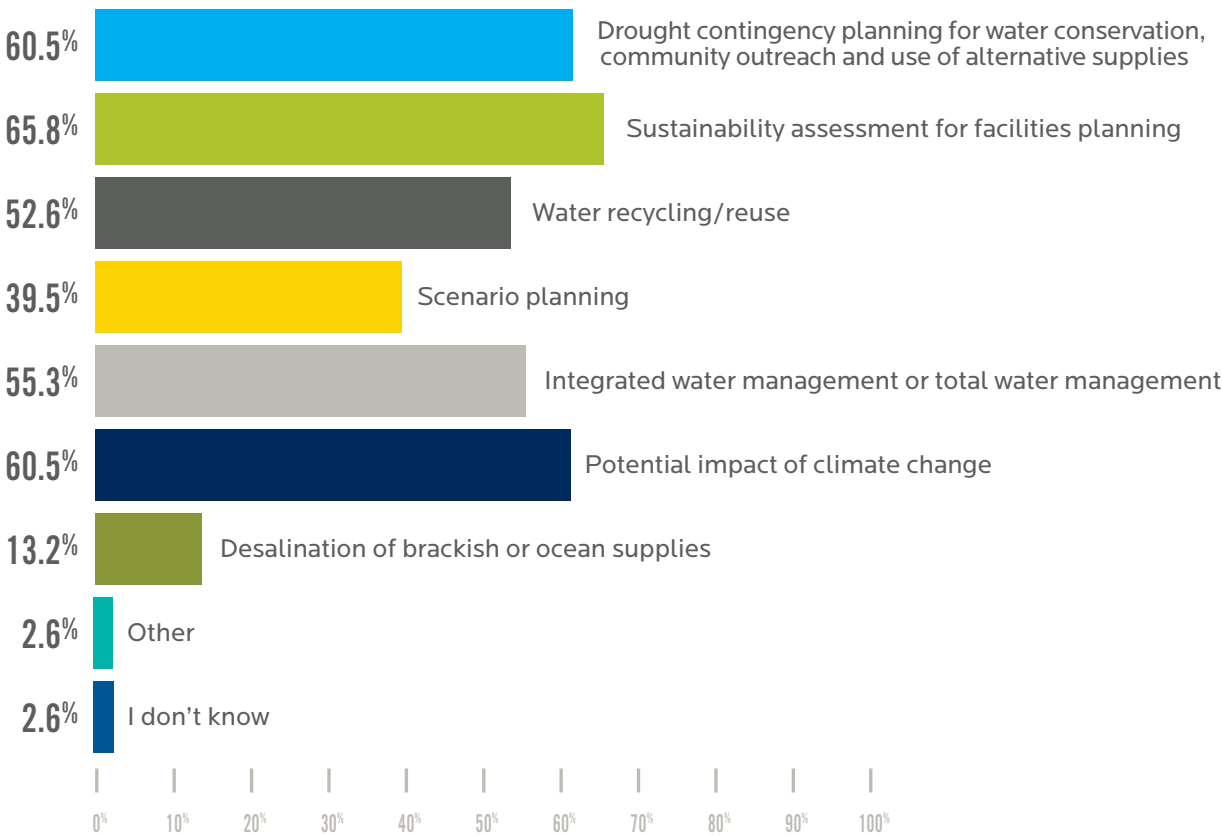
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LONG-RANGE WATER SUPPLY PLANNING – SOUTHWEST



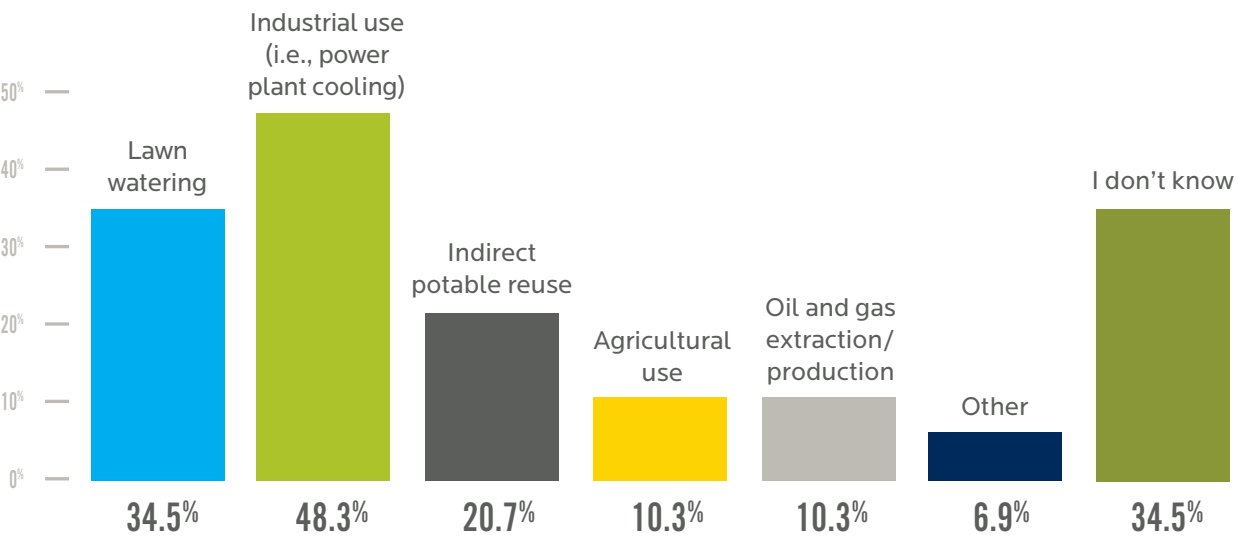
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LONG-RANGE WATER SUPPLY PLANNING – NORTHWEST



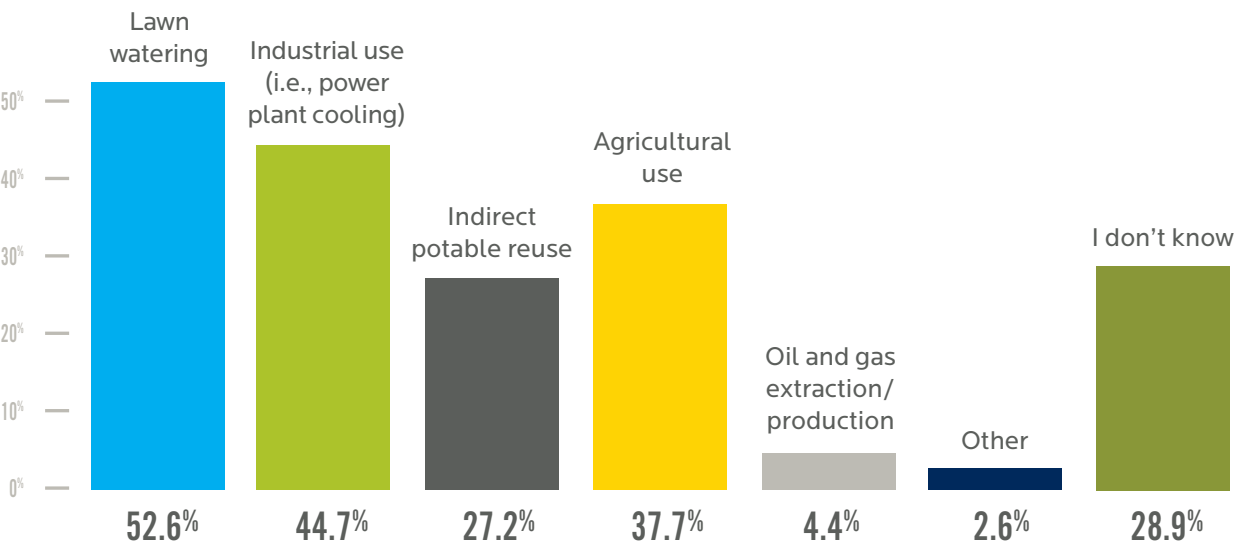
Source: Black & Veatch

OPPORTUNITIES TO USE RECLAIMED WATER OR WASTEWATER – NORTHEAST



Source: Black & Veatch

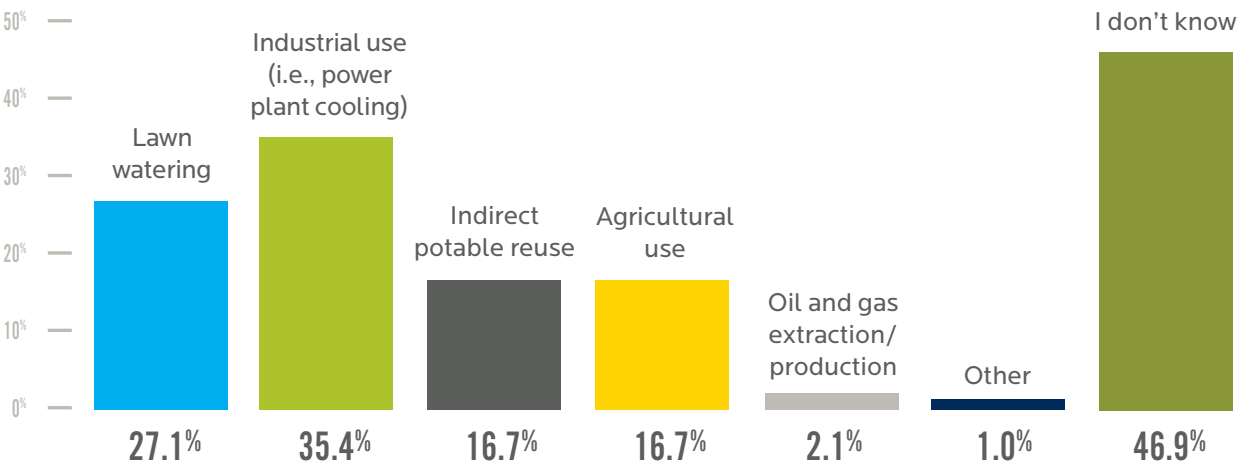
OPPORTUNITIES TO USE RECLAIMED WATER OR WASTEWATER – SOUTHEAST



Source: Black & Veatch

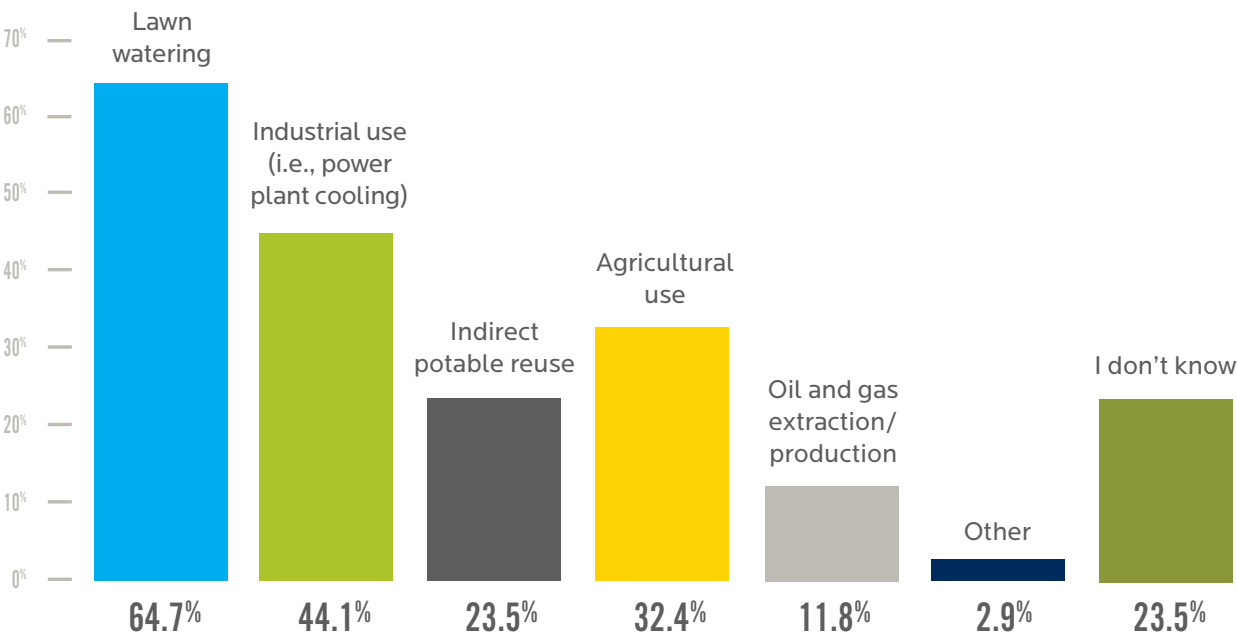
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OPPORTUNITIES TO USE RECLAIMED WATER OR WASTEWATER – MIDWEST



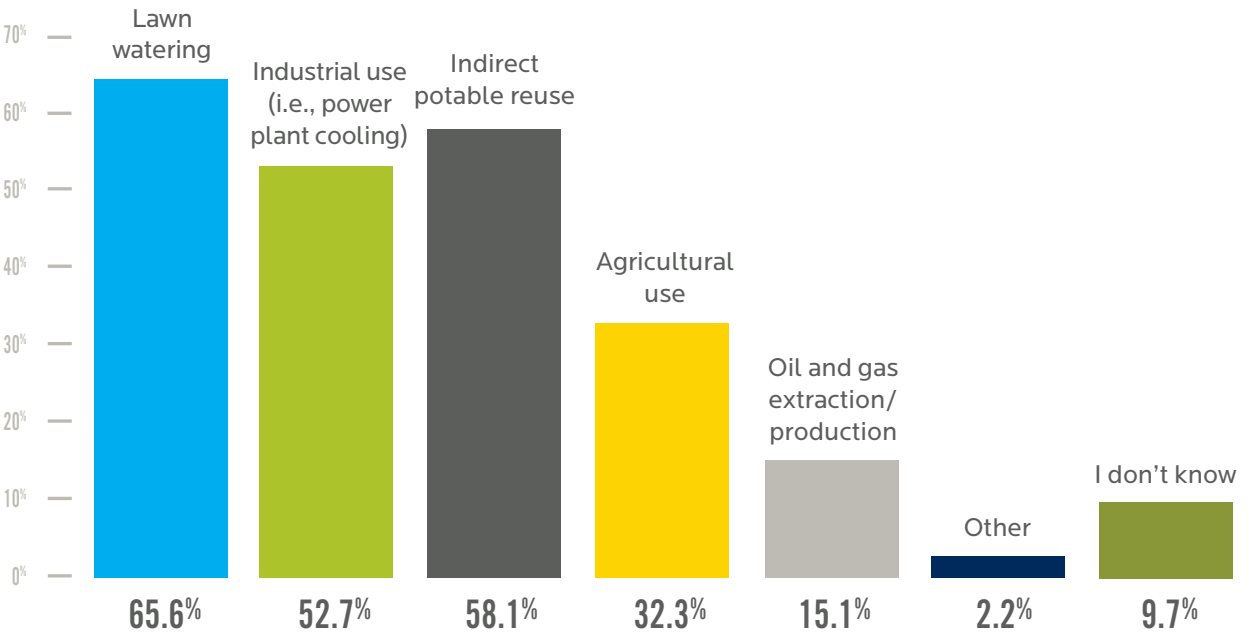
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OPPORTUNITIES TO USE RECLAIMED WATER OR WASTEWATER – ROCKY MOUNTAIN



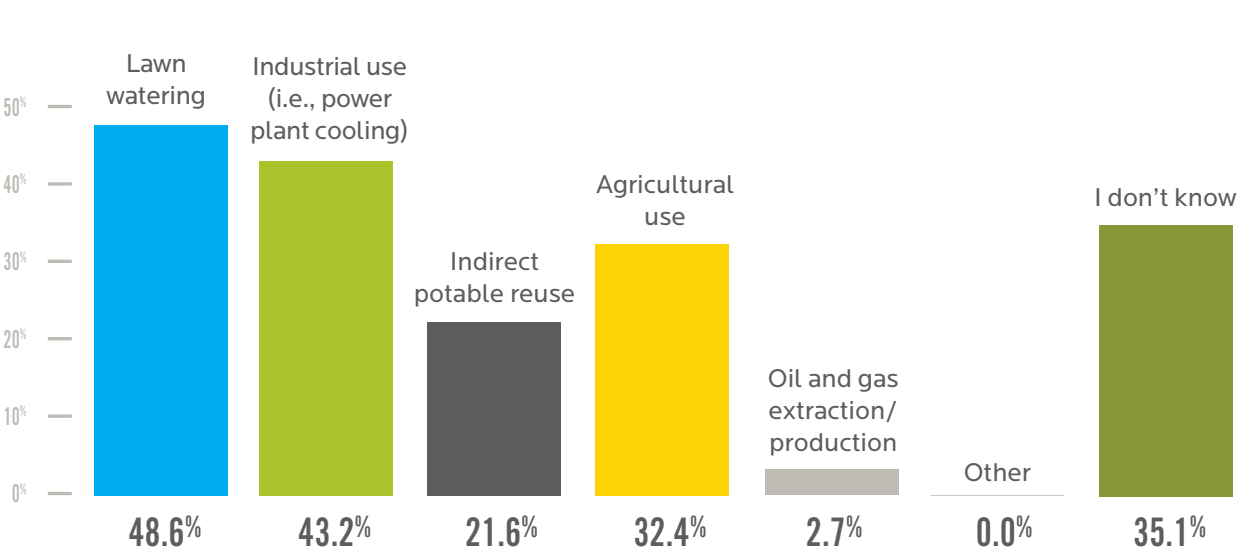
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OPPORTUNITIES TO USE RECLAIMED WATER OR WASTEWATER – SOUTHWEST



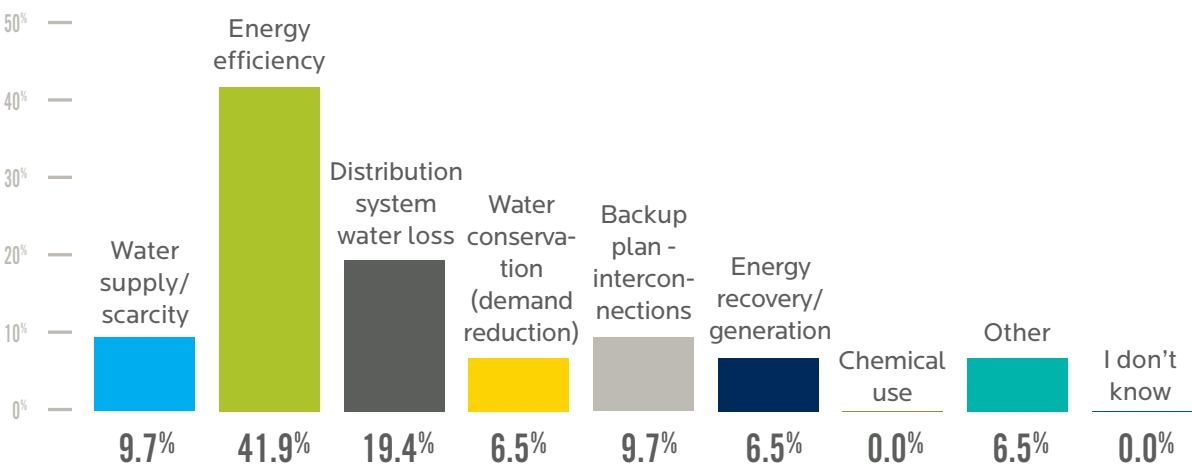
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OPPORTUNITIES TO USE RECLAIMED WATER OR WASTEWATER – NORTHWEST



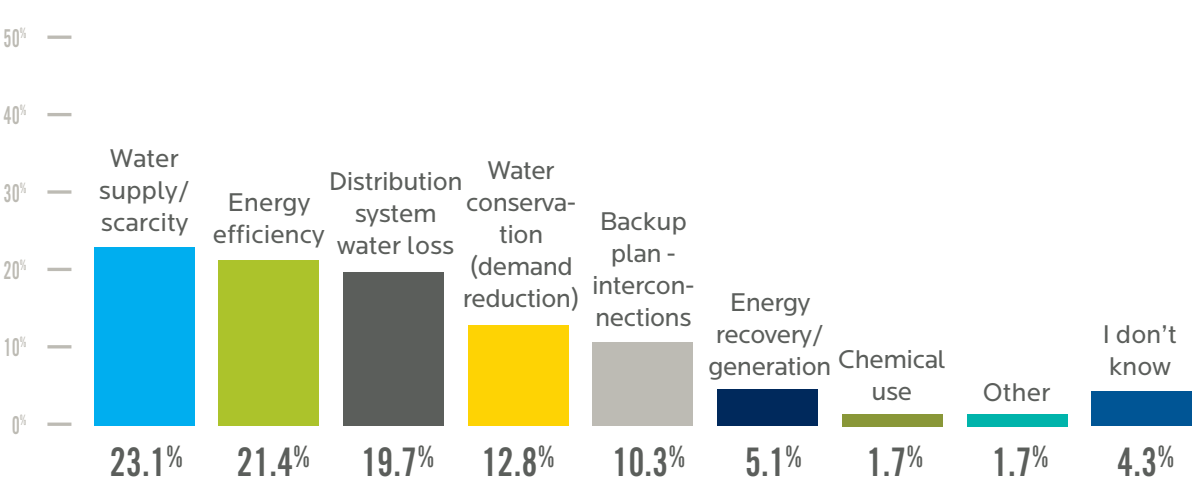
Source: Black & Veatch

MOST SIGNIFICANT SUSTAINABILITY ISSUES – NORTHEAST



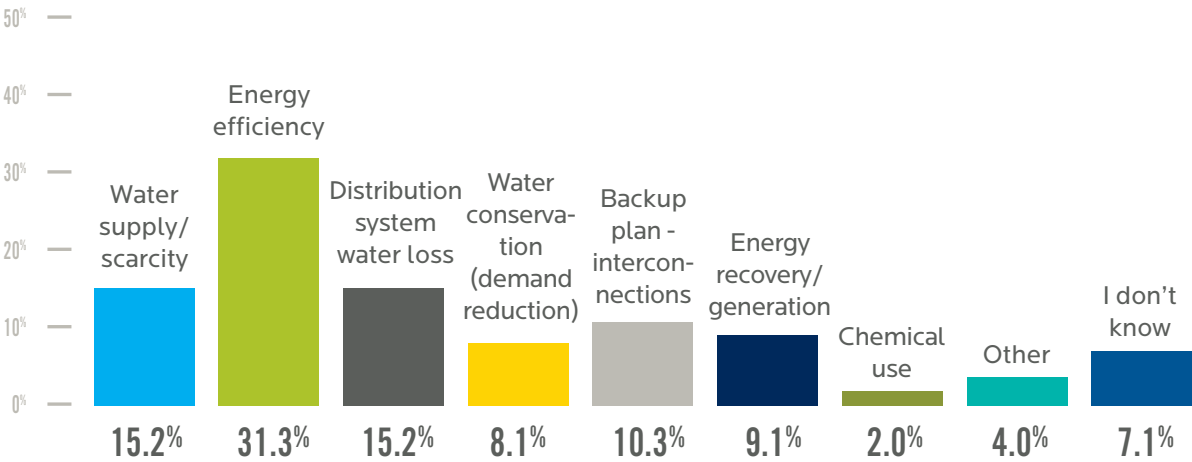
Source: Black & Veatch

MOST SIGNIFICANT SUSTAINABILITY ISSUES – SOUTHEAST



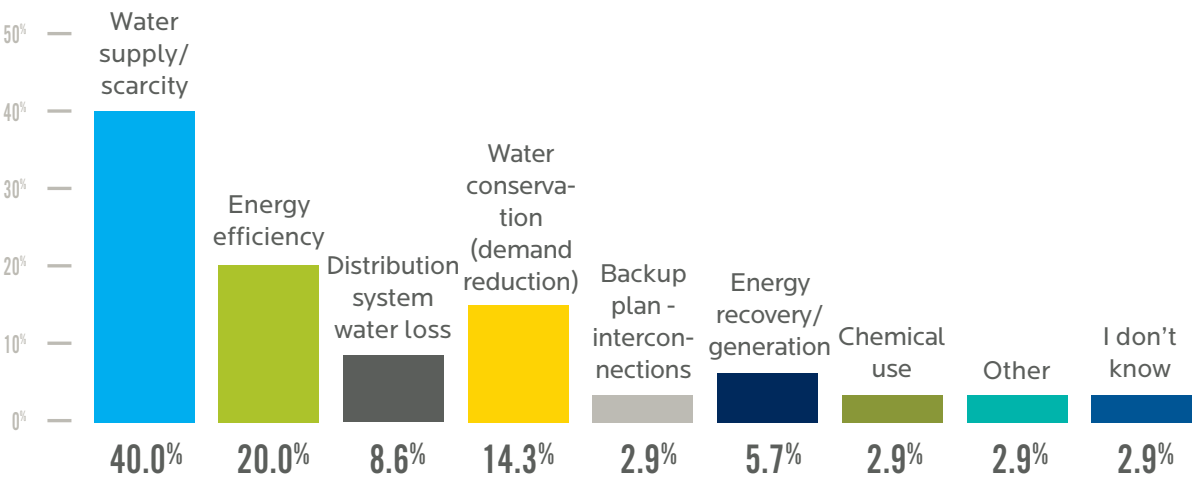
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MOST SIGNIFICANT SUSTAINABILITY ISSUES – MIDWEST



Source: Black & Veatch

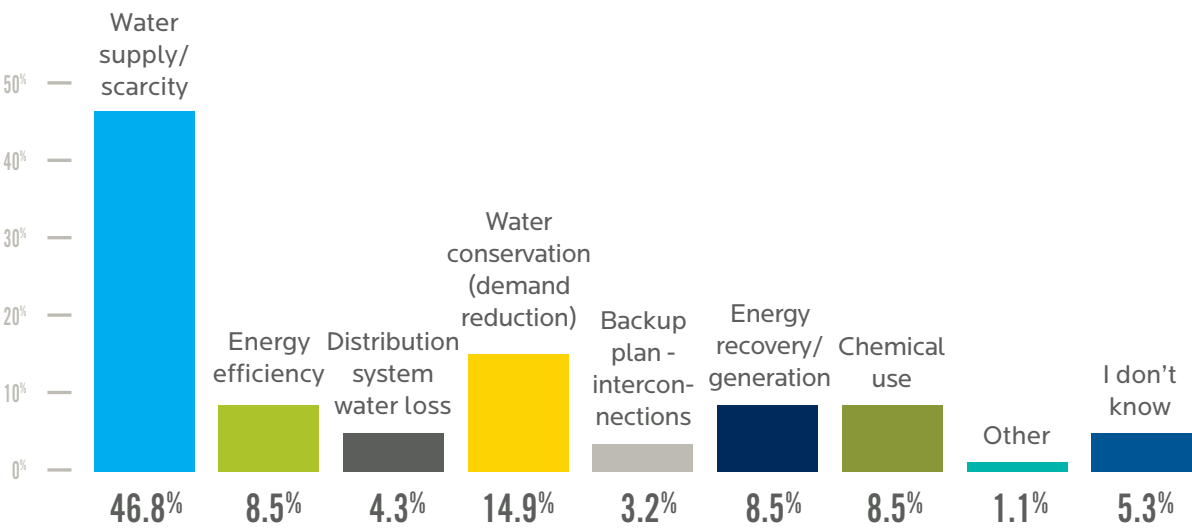
MOST SIGNIFICANT SUSTAINABILITY ISSUES – ROCKY MOUNTAIN



Source: Black & Veatch

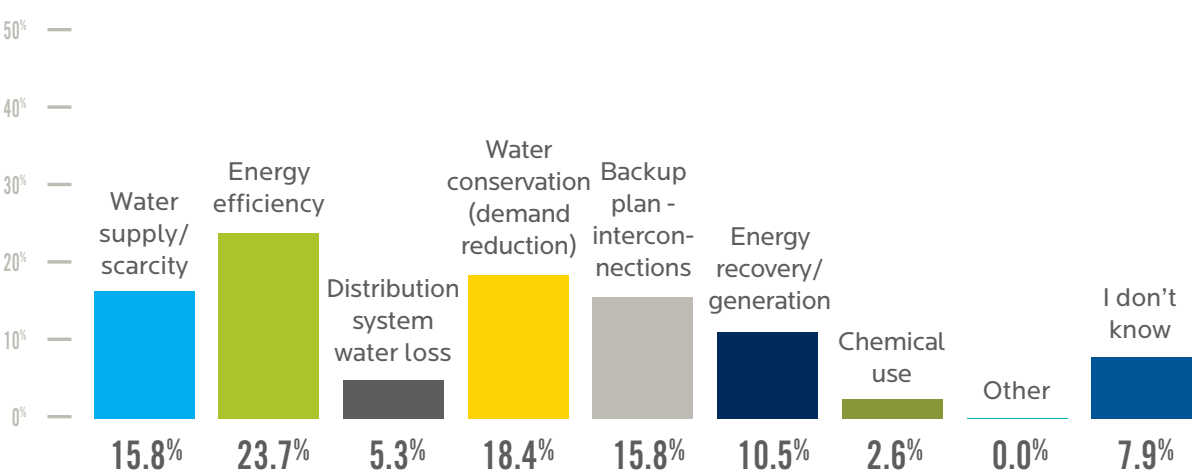
APPENDIX

MOST SIGNIFICANT SUSTAINABILITY ISSUES – SOUTHWEST



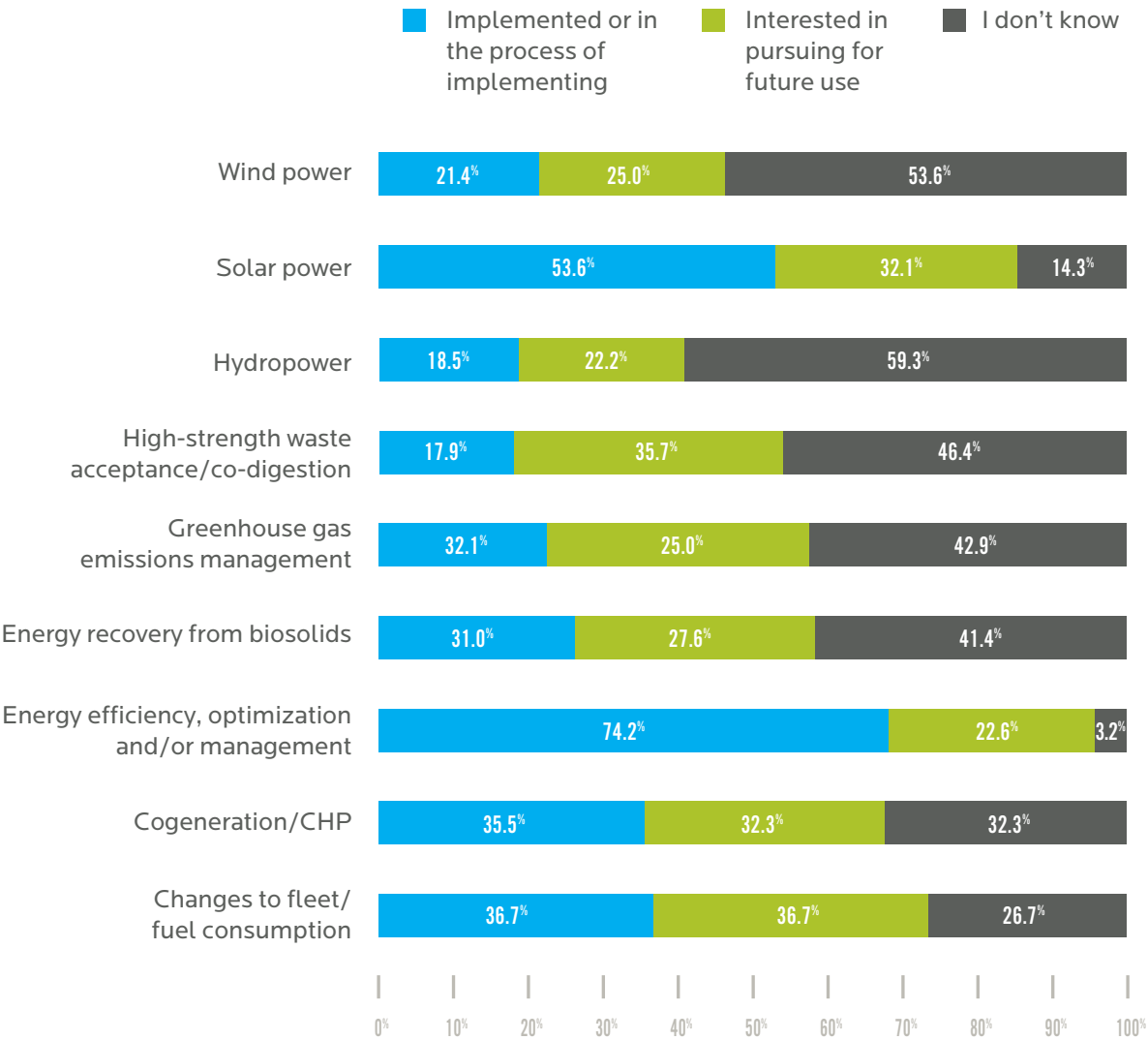
Source: Black & Veatch

MOST SIGNIFICANT SUSTAINABILITY ISSUES – NORTHWEST



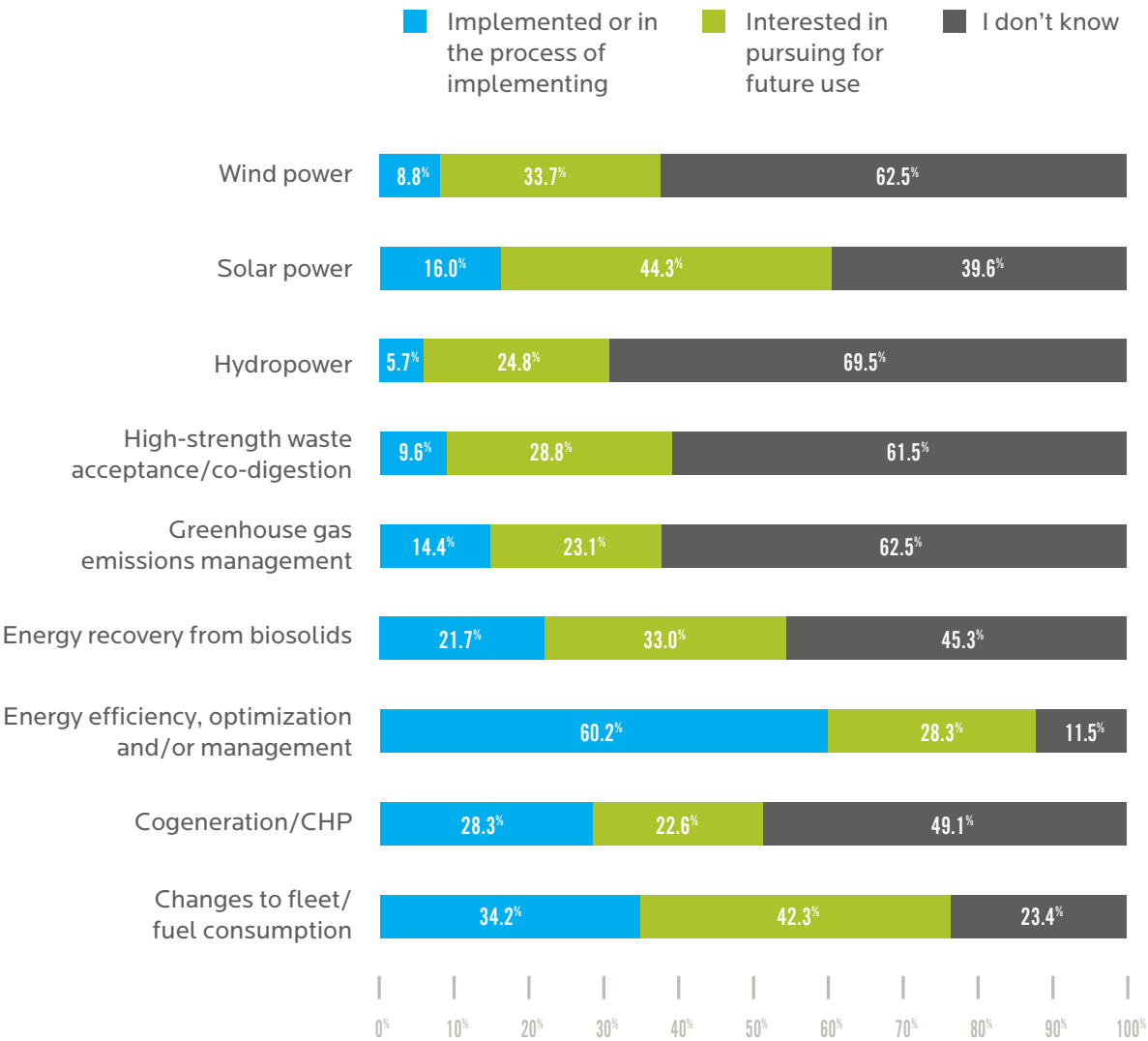
Source: Black & Veatch

ENERGY EFFICIENCY, GENERATION OR RECOVERY PROGRAMS – NORTHEAST



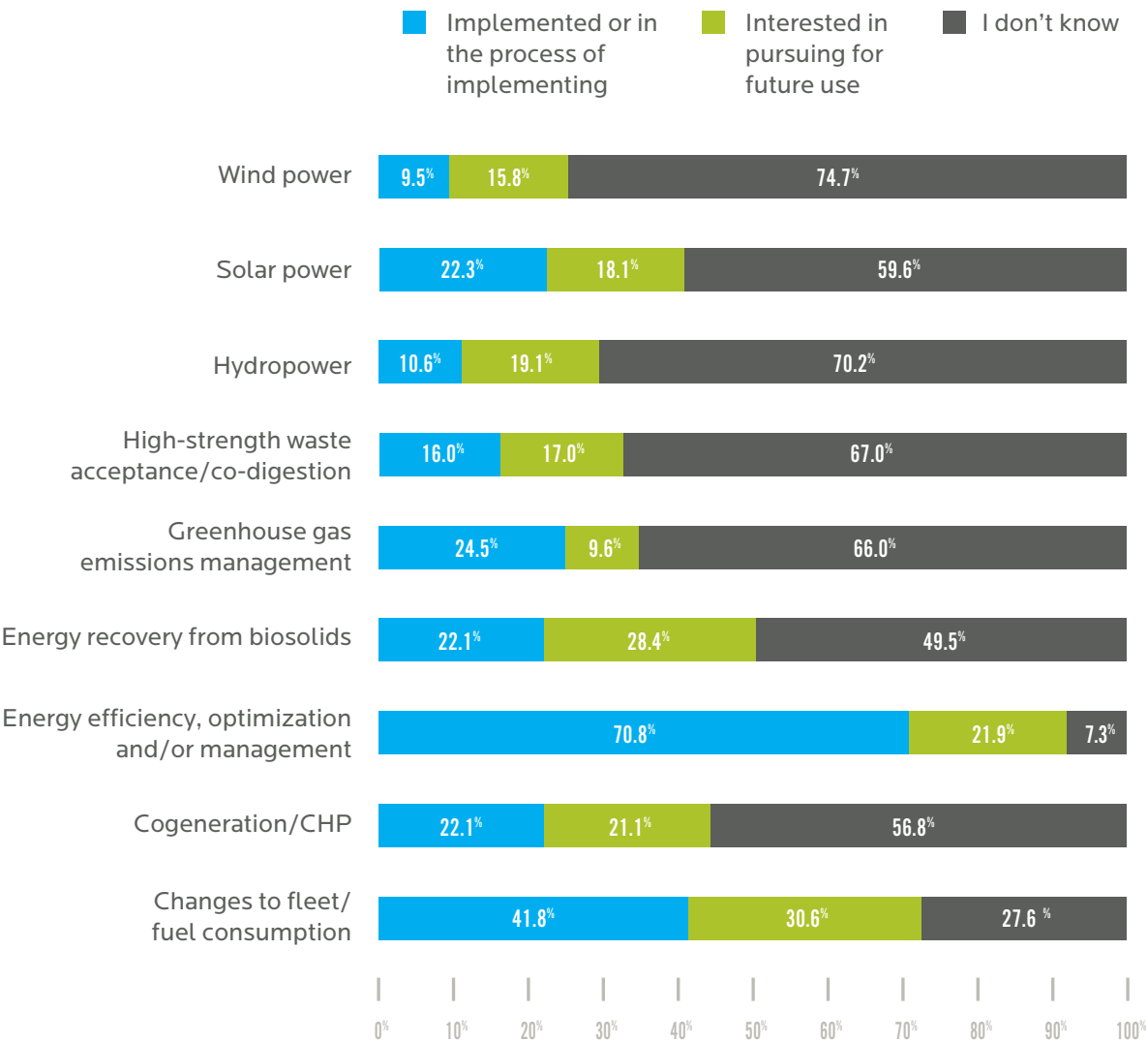
Source: Black & Veatch

ENERGY EFFICIENCY, GENERATION OR RECOVERY PROGRAMS – SOUTHEAST



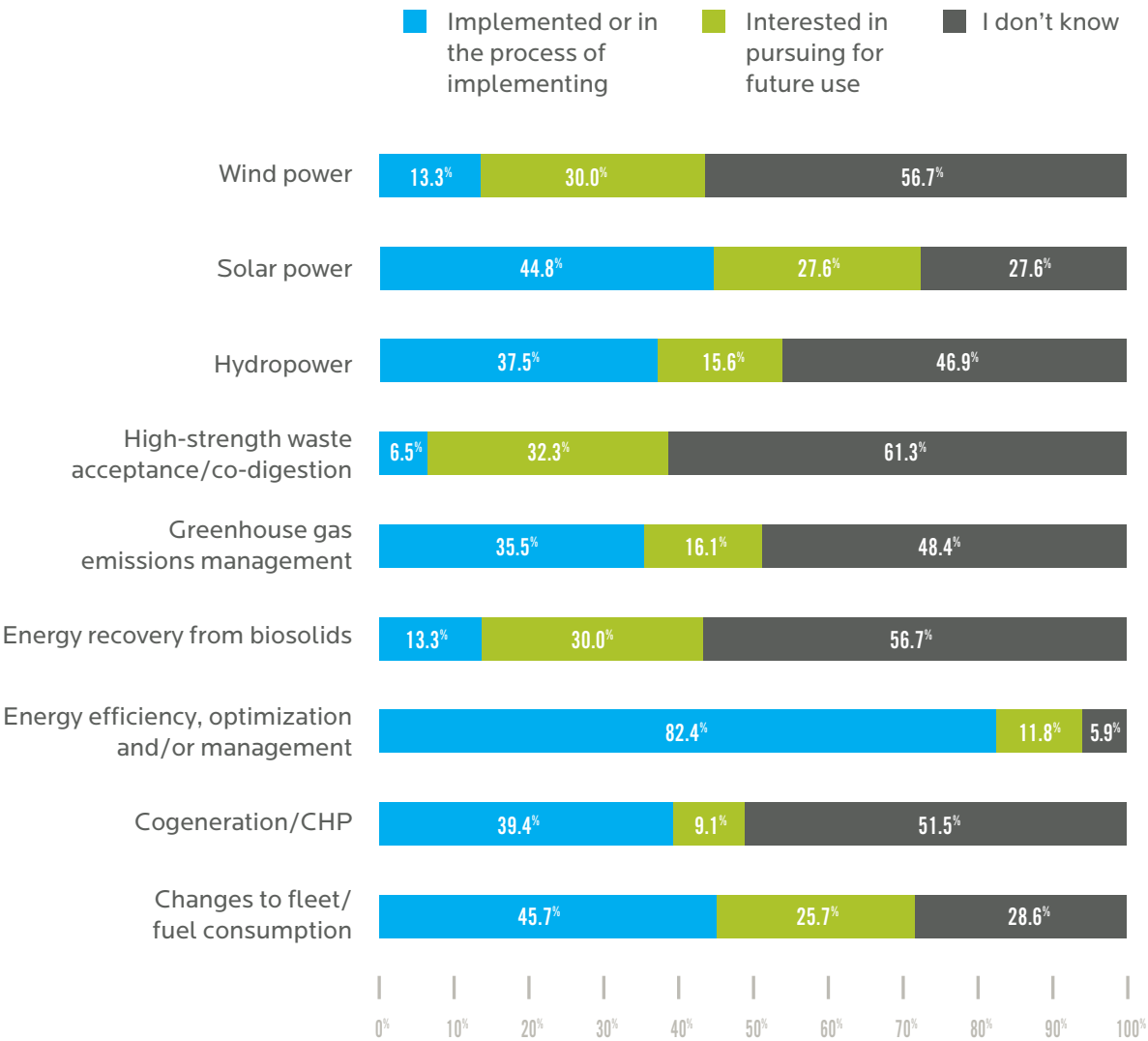
Source: Black & Veatch

ENERGY EFFICIENCY, GENERATION OR RECOVERY PROGRAMS – MIDWEST



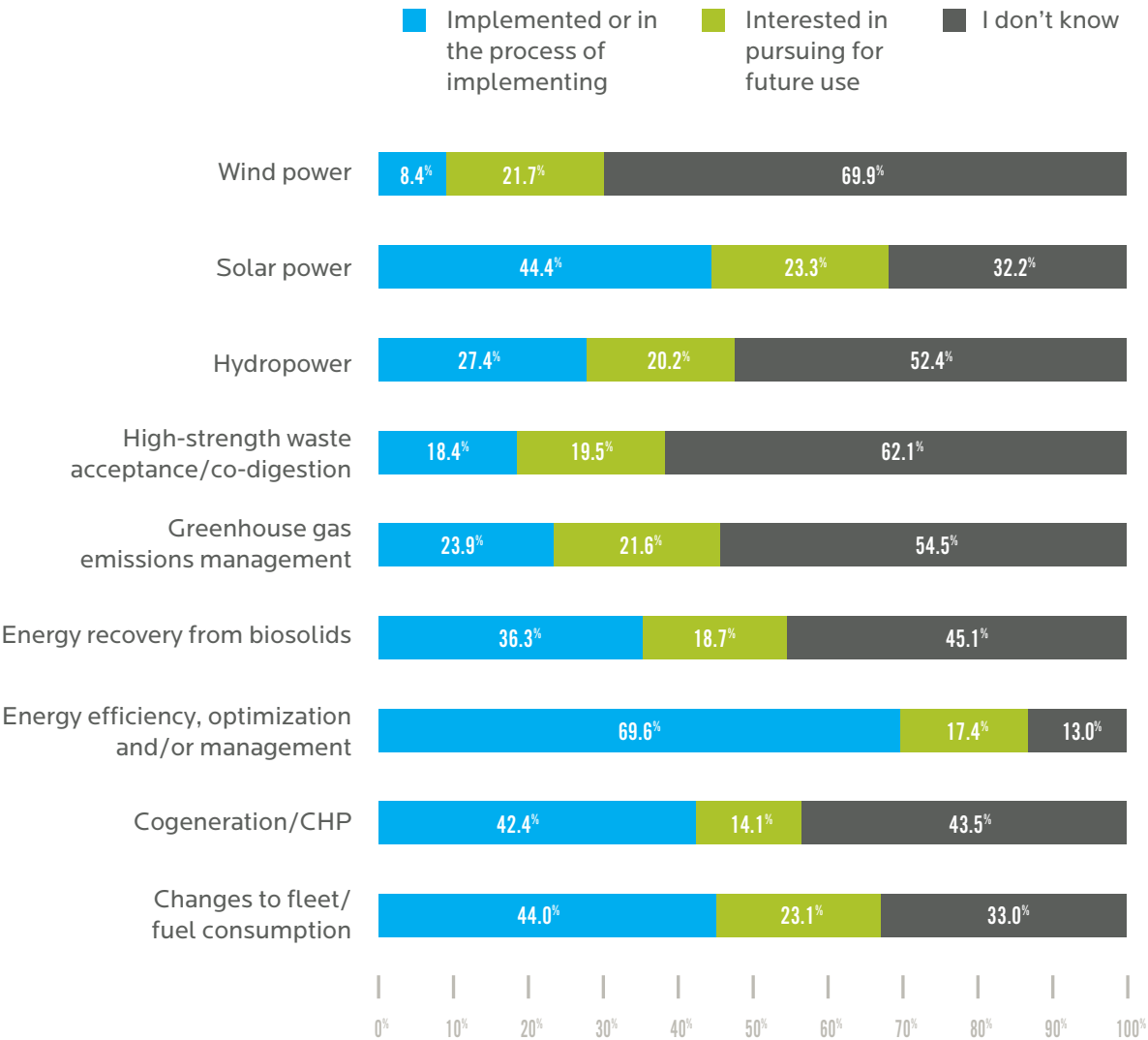
Source: Black & Veatch

ENERGY EFFICIENCY, GENERATION OR RECOVERY PROGRAMS – ROCKY MOUNTAIN



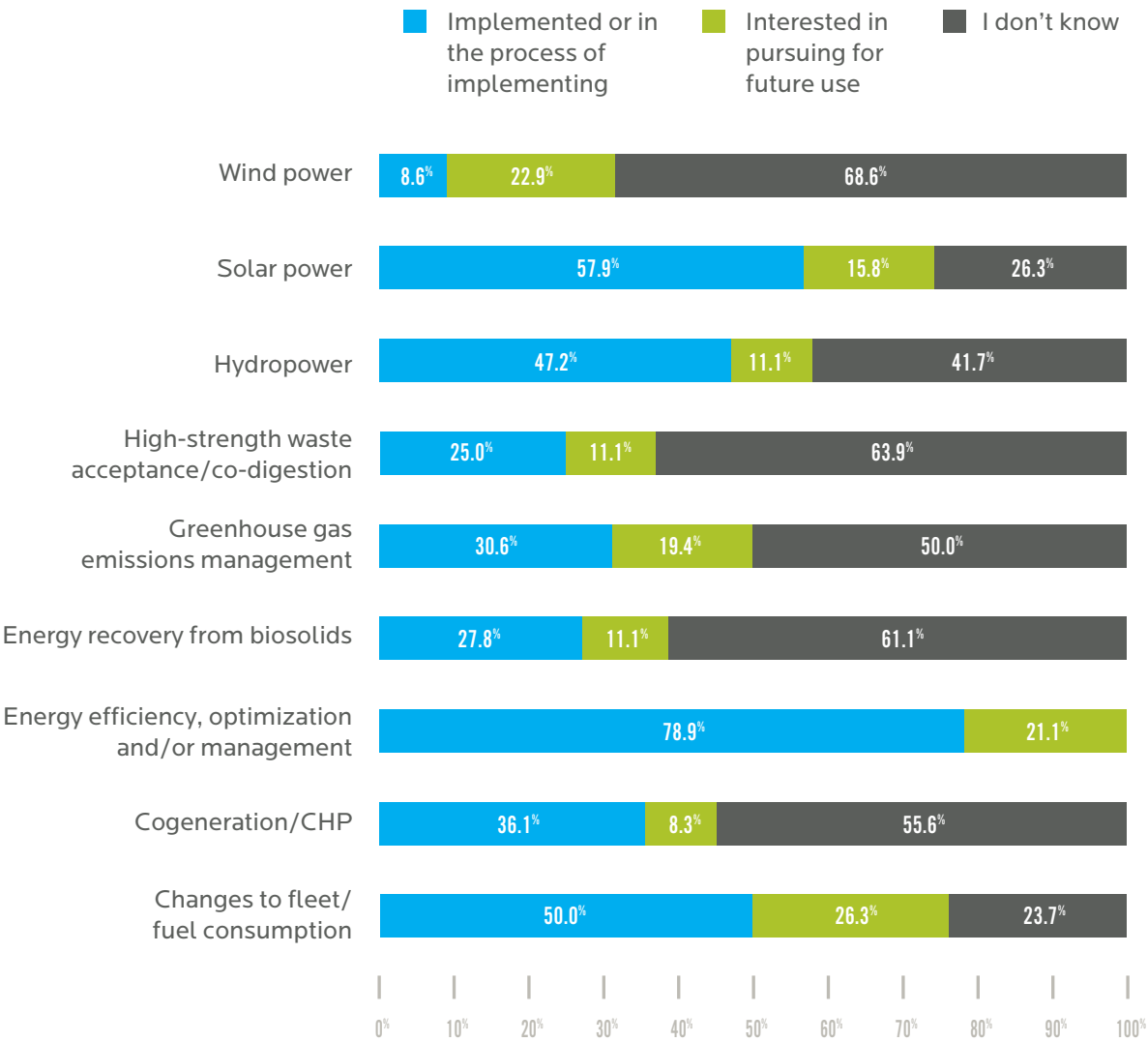
Source: Black & Veatch

ENERGY EFFICIENCY, GENERATION OR RECOVERY PROGRAMS – SOUTHWEST



Source: Black & Veatch

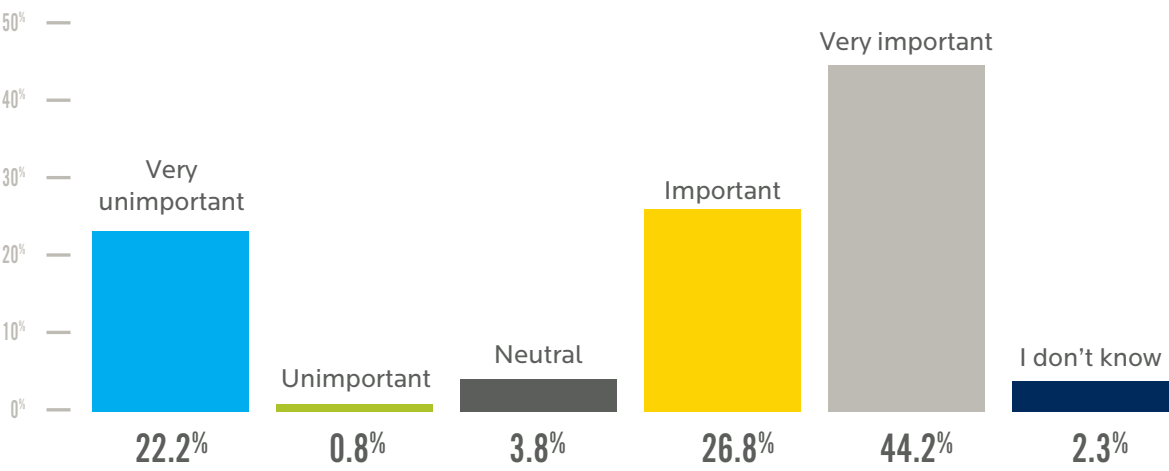
ENERGY EFFICIENCY, GENERATION OR RECOVERY PROGRAMS – NORTHWEST



Source: Black & Veatch

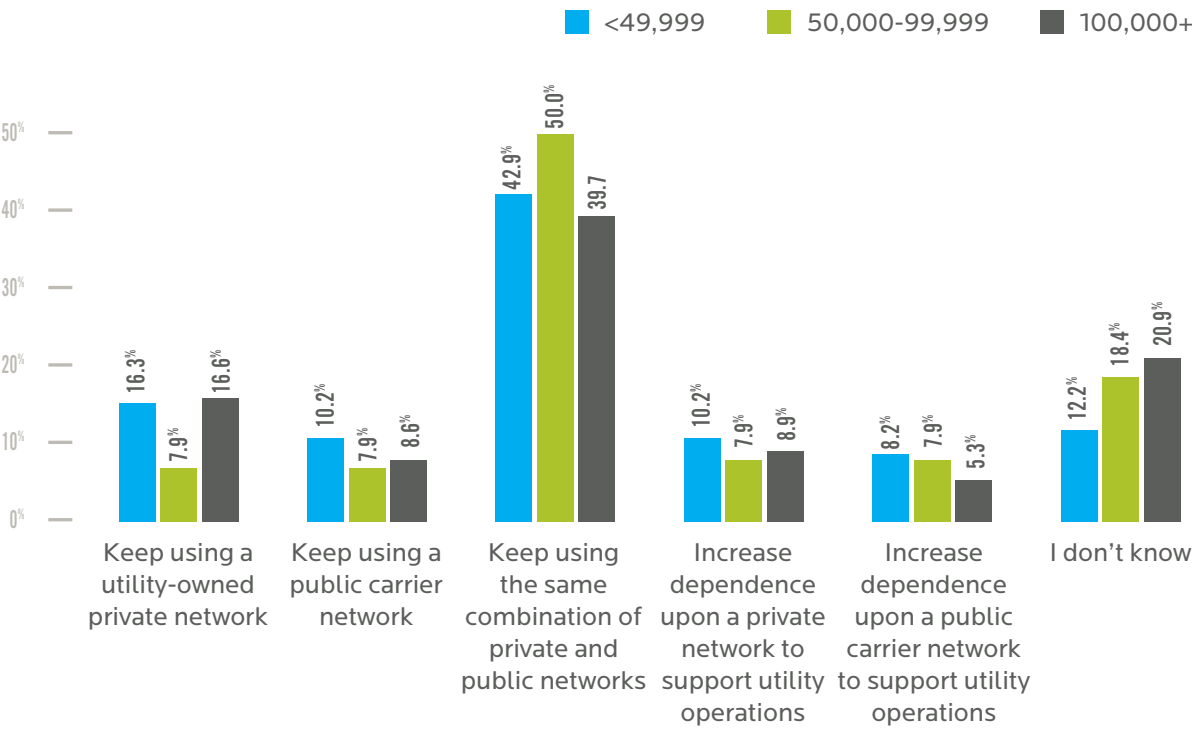
OPERATIONAL ENHANCEMENTS

IMPORTANCE OF TELECOMMUNICATIONS NETWORKS – BY POPULATION SERVED



Source: Black & Veatch

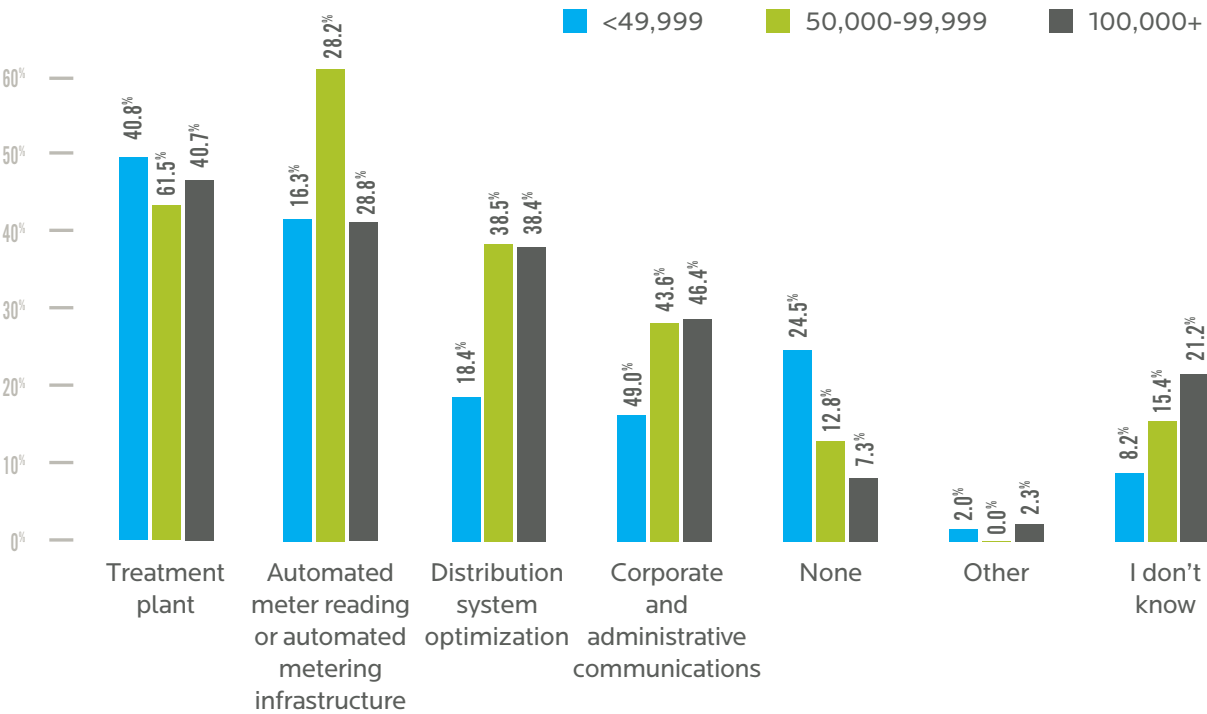
MEETING FUTURE TELECOMMUNICATIONS NEEDS – BY POPULATION SERVED



Source: Black & Veatch

APPENDIX

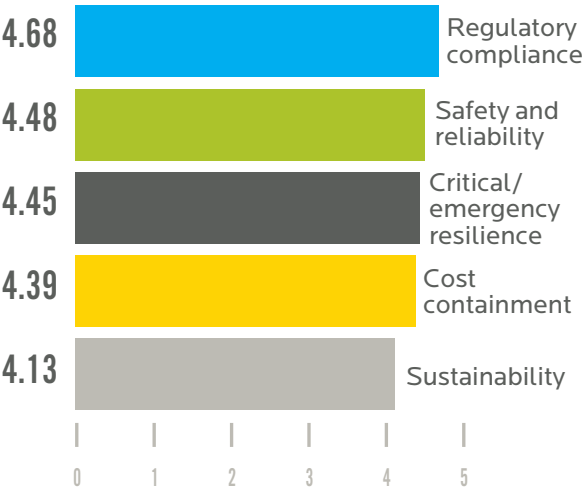
TELECOMMUNICATIONS REQUIREMENTS PLANNING – BY POPULATION SERVED



Source: Black & Veatch

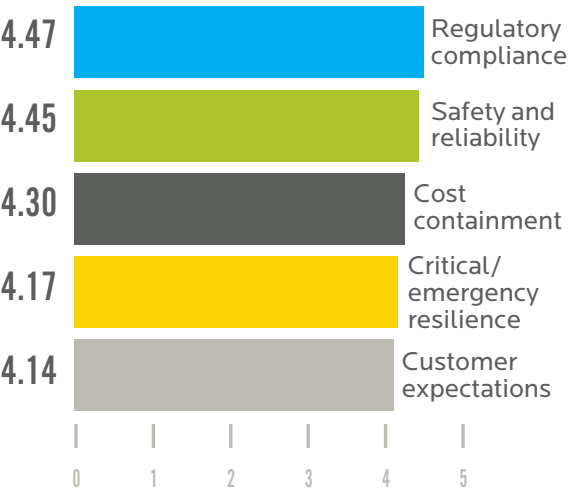
FINANCIAL OVERVIEW

TOP 5 INFRASTRUCTURE INVESTMENT DRIVERS – NORTHEAST



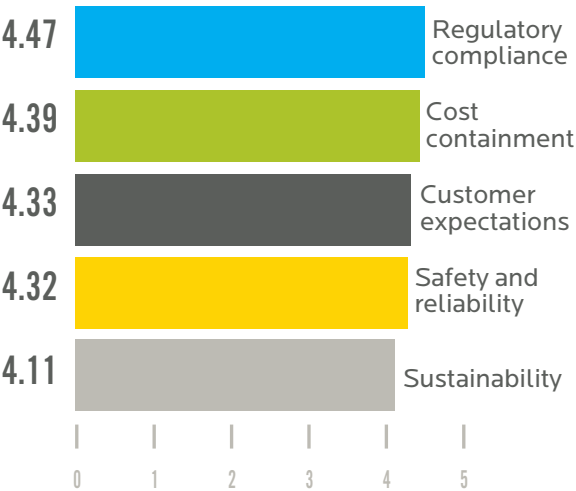
Source: Black & Veatch

TOP 5 INFRASTRUCTURE INVESTMENT DRIVERS – SOUTHEAST



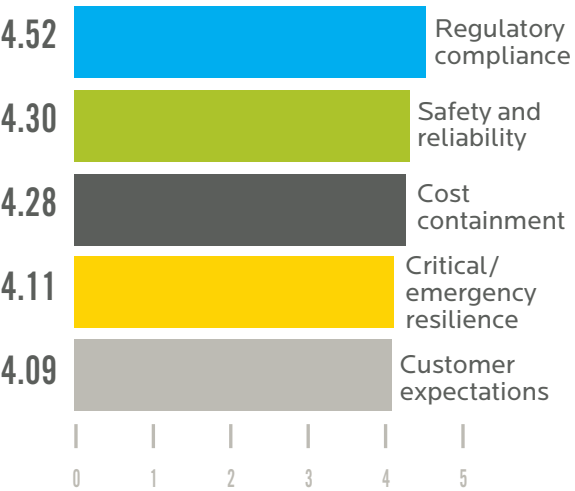
Source: Black & Veatch

TOP 5 INFRASTRUCTURE INVESTMENT DRIVERS – MIDWEST



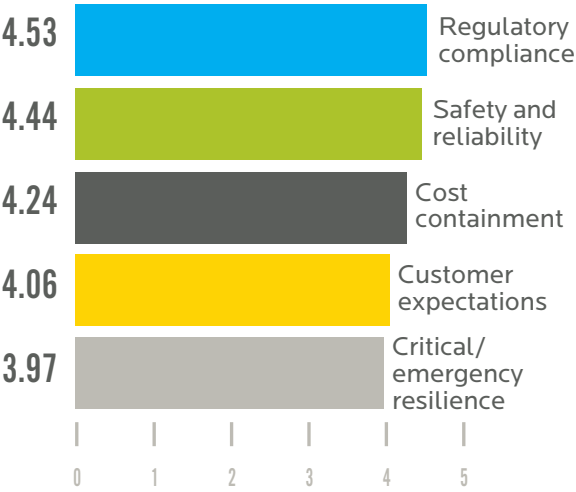
Source: Black & Veatch

TOP 5 INFRASTRUCTURE INVESTMENT DRIVERS – SOUTHWEST



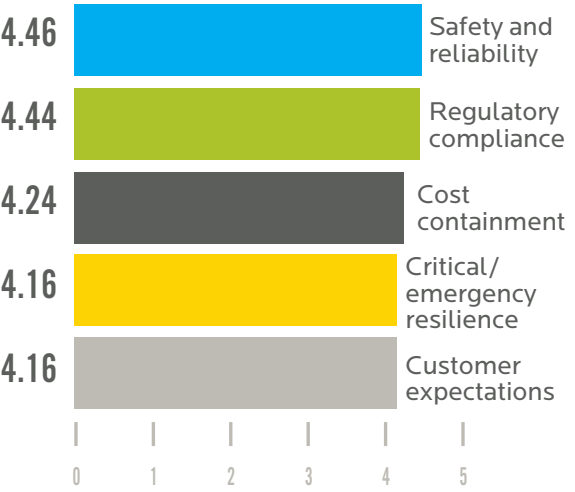
Source: Black & Veatch

TOP 5 INFRASTRUCTURE INVESTMENT DRIVERS – ROCKY MOUNTAIN



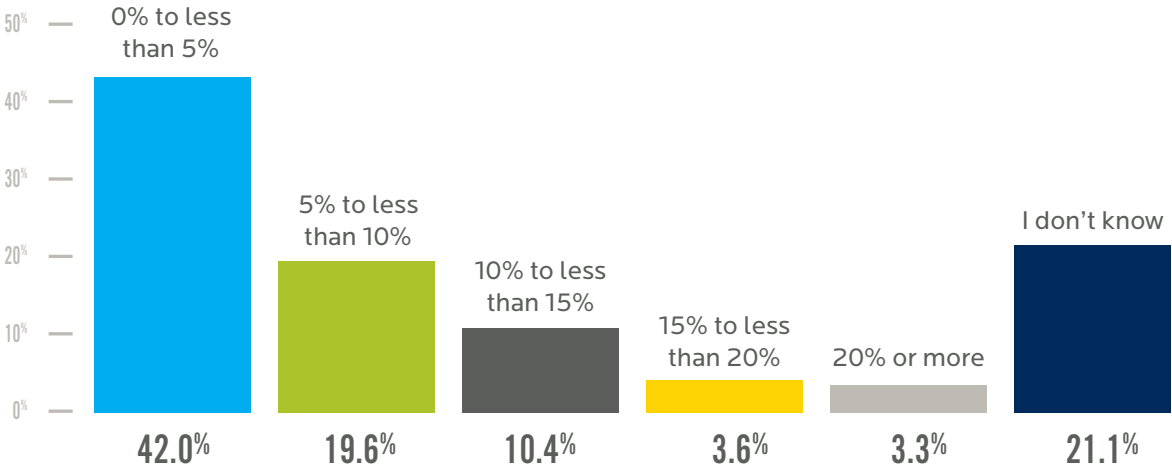
Source: Black & Veatch

TOP 5 INFRASTRUCTURE INVESTMENT DRIVERS – NORTHWEST



Source: Black & Veatch

ANNUAL BUDGET FOR EMERGENCY REPAIRS



Source: Black & Veatch

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