2022 Black & Veatch

Water Report

About This Report

A decade since Black & Veatch first launched its annual analysis of the U.S. water sector, the global human infrastructure leader's latest overview of the industry finds it confronting opportunities and challenges — some old, some new.

Much as it was 10 years ago, aging infrastructure remains the top challenge among more than 300 U.S. water industry stakeholders surveyed for Black & Veatch's *2022 Water Report*. The aging of the sector's workforce also has intensified, with efforts to respond to increasing retirements of skilled staffers complicated by tight budgets and a tighter job market.

Data — so promising in helping utilities do more with less with infrastructure well past its prime — has gained remarkably more attention since 2012, but it's still not utilized to its full potential in heightening resilience and sustainability. Climate change — unmentioned in the 2012 report but now driving more frequent wildfires, droughts and flooding that threaten water supplies — joins evolving regulations and the race to safeguard assets from cyber predators as formidable issues.

All of these challenges highlight the need for greater investment in water systems, and help is there for willing water utilities with the resources and knowledge required to pursue it. Billions of dollars now available through the American Rescue Plan Act of 2021 (ARPA) and the Infrastructure Investment and Jobs Act (IIJA) present a generational, golden moment to invest in water infrastructure increasingly under strain from climate stresses, demographic shifts and the growing focus on sustainability.

This year's report dives into these issues and many more, giving an overview of what's changed — and what has not — in an industry with enormous potential to accelerate innovation in strategy, operations and funding.

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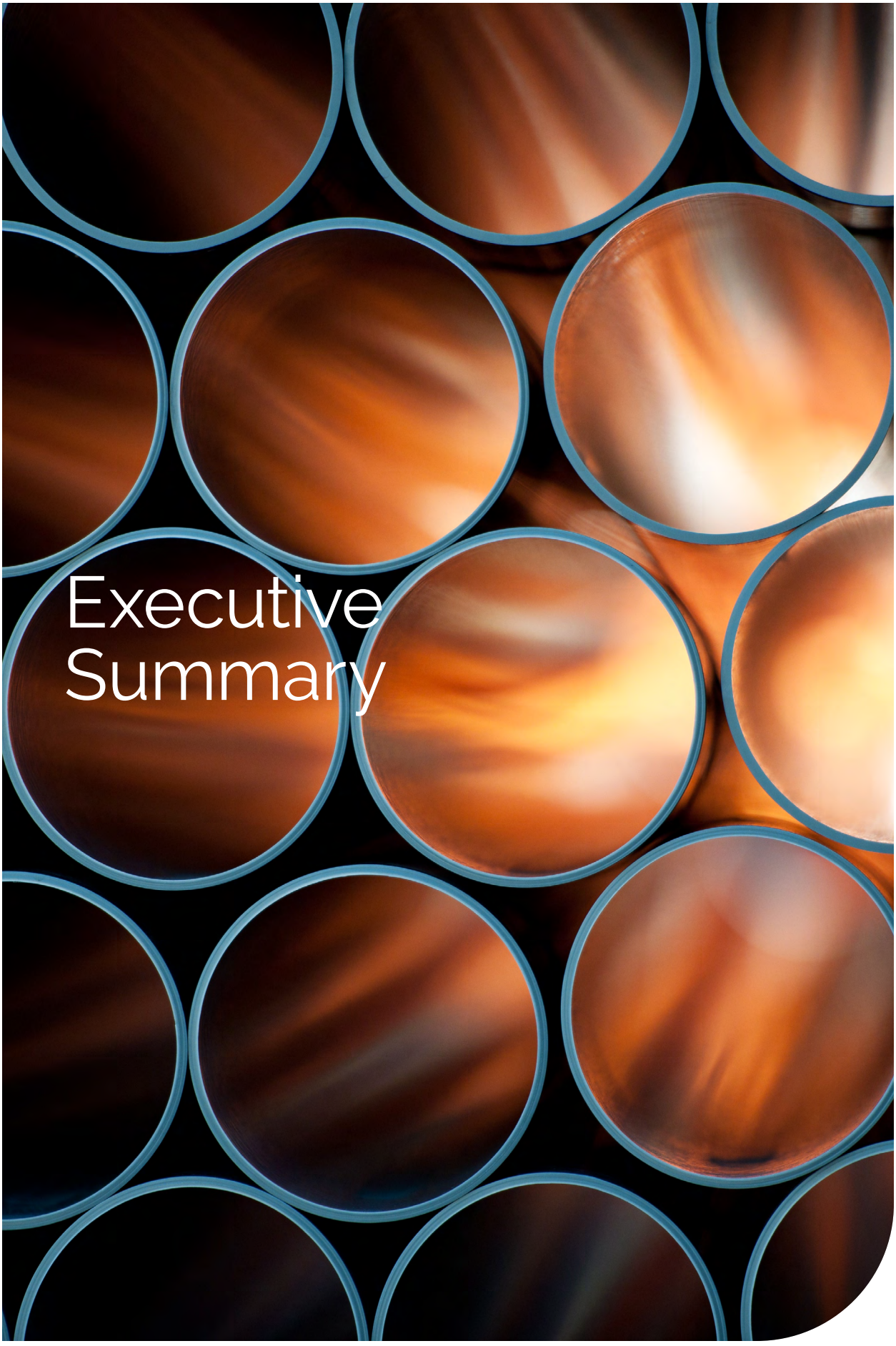

Executive Summary

As U.S. Water Sector Evolves, Embracing Technology, Sustainability is Paramount

When Black & Veatch first launched its annual assessment of the U.S. water industry 10 years ago, the sector was dealing with the lingering impacts of the financial crisis. Funding was deemed grossly inadequate to upgrade infrastructure that was well past its prime, and many communities struggled to match necessary investments with flat or declining revenue.

Yet the search for "green shoots"— signs of economic recovery — yielded some promise. Virtually everyone believed "sustainability" could carry significant benefits, though a unified definition was elusive. Data's vast potential in managing and optimizing assets was on the industry's radar, though actually seeing it in practice was another matter.

A decade later, many of those takeaways remain. Black & Veatch's *2022 Water Report* — based on expert analyses of a survey of more than 300 stakeholders in America's water, wastewater and stormwater sectors — magnifies how so many things have grown more complex.

As infrastructure continues to age, so are the industry's workers, heading in droves into retirement and taking their skills and institutional knowledge with them, posing formidable staffing dilemmas in a historically tight jobs market. The embrace of data in driving decision-making — a key in enabling utilities to do more with less in this new frontier of "digital water" — is recognized for its promise but still lags in adoption. "Cybersecurity," "climate change" and "decarbonization" — unmentioned in the 2012 report — have emerged as pressures the industry can't ignore. Concerns about evolving regulations are deepening.

Yet opportunities and optimism abound. Funding through spending measures such as the American Rescue Plan Act of 2021 (ARPA) and the $1.2-trillion Infrastructure Investment and Jobs Act (IIJA) present a generational opportunity to invest in long-overdue water projects. The big problem: Many utilities, while insisting they'll pursue some of that infusion they so craved a decade ago, aren't quite sure how to go after it.

Welcome to the complicated world of water, where old ways of thinking are giving way, albeit relatively slowly, to what's new

Welcome to the complicated world of water, where old ways of thinking are giving way, albeit relatively slowly, to what's new and possible in addressing chronic pain points in 2022 — the 50th anniversary of the Clean Water Act — and beyond.

ABOUT THE AUTHOR

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and possible in addressing chronic pain points in 2022 — the 50th anniversary of the Clean Water Act — and beyond.

Pipes and Peers: The Nagging Challenges of Age

A decade ago, survey respondents were declaring aging water and sewer infrastructure as the industry's foremost concern. That hasn't abated; in perhaps the least surprising data point, nearly two-thirds of respondents — 63 percent — to this year's survey still put it atop the list, down nearly 12 percentage points from a year ago.

From there, the latest findings get more telling.

Over time, workforce-related issues have ascended in the rankings, with the challenge of hiring qualified staff — not included as a survey option in 2012 and ranked No. 14 in 2017 — now rising to No. 2. The industry's aging workforce jumped three spots to No. 4 over the past decade, just behind increasing or expanding regulations — an issue that ranked fifth in 2012 *(Figure 1).*

The exodus of older skilled workers is headache-inducing for many water utilities, who now look to fill the void through automation, outsourcing and an ever-thinning pool of recruits who enjoy more career options and greater leverage for various reasons. Fewer people generally seek out water utility work, and the pursuit of their talents has devolved into a bidding war that hamstrings utilities — especially the smaller ones — saddled with tight budgets.

Data: A Path to Resilience, Sustainability

The unrelenting hands of time that impact all infrastructure systems and those who've managed them are stoking awareness of everything data can do. Going digital can help water utilities get more efficient and resilient through actionable information to evaluate

Figure 1

From your perspective, what are the most challenging issues facing the water, wastewater, and stormwater industry today?

Source: Black & Veatch

	Rank	
	2022	2012
Aging water and wastewater infrastructure	1st	1st
Hiring of qualified staff	2nd	—
Increasing/expanding regulation	3rd	5th
Aging workforce	4th	7th
Funding or availability of capital	5th	3rd
Justifying CIPs and/or rate requirements	6th	—
Managing capital costs	7th	2nd
Water conservation	8th	11th
System resilience	9th	—
Managing operational costs	10th	4th/7th*
Treatment technology	13th	6th
Information technology	14th	9th

— A dash indicates the answer wasn't included in 2012

* Managing energy costs and Chemical cost asked in 2021

Figure 2

What efforts is your utility practicing to enhance sustainability? *(Select all that apply)*

Source: Black & Veatch

71.6%
Proactive replacing of infrastructure

60.2%
Asset managment progam

40.9%
Water conservation initiatives

28.4%
Green energy

28.4%
Analytics and dashboards to empower operation discussions

25.0%
Industrial and commercial implementation of water reuse

23.9%
Nutrient removal

20.5%
High quality wastewater apart of water supplu portfolio

19.3%
New user rate structures

15.9%
New personnel training approaches

8.0%
New financial modes

4.5%
Stormwater as part of the water supply portfolio

and optimize the asset performance while tipping them off to potentially looming failures.

Yet so often, it's a missed opportunity. Roughly seven in 10 respondents say they're collecting "lots of data," though slightly more than one-quarter believe they are leveraging it effectively. They're losing out, given that precisely harnessing data — and broader artificial intelligence technologies — offers abundant rewards, from providing a holistic view of the water system to enhancing efforts to track consumption, drive efficiencies, save energy and prioritize investment dollars, heightening resilience and sustainability.

Since its absence entirely by name in Black & Veatch's water report a decade ago, sustainability has proven to be much more than just a buzzword. Some 72 percent of survey respondents now say their enterprise has sustainability goals and the means to measure them, up roughly 7 percentage points from last year. Slightly more than half say separately they've adopted sustainability goals without pressure from community or regulatory forces.

All the while, nearly two-thirds cast sustainability as a critical strategic focus in the water sector, though one-third say sustainability "sounds good" but isn't a priority. Seven in 10 from utilities that serve more than 500,000 customers deem sustainability a priority, compared with 58 percent of those who serve fewer than that population threshold, showing the elements of divergence that our reports have demonstrated between systems big and small across various technology and workforce fronts.

Approaches to greater sustainability vary, with proactive replacement of infrastructure leading the way at 72 percent, followed by asset management programs (60 percent) and water conservation initiatives (41 percent). As decarbonization gains momentum across all utilities, nearly 30 percent of water sector respondents say they're pursuing initiatives involving green energy, with an identical showing for using analytics and dashboards to empower operational discussion *(Figure 2).*

Funding: Welcomed Help from Uncle Sam

Without question, inadequate funding and the numbing price tag of needed infrastructure upgrades have been years-long headwinds for the industry. Nearly 40 percent of respondents believe funding for capital projects will not be enough over the next five to 10 years. By a two-to-one margin over their bigger counterparts, utilities with fewer than 500,000 customers think that'll be the case. Overall, 34 percent say funding will be sufficient, while 16 percent believe it'll merely meet the requirement.

But when it comes to confidence or optimism about whether such long-awaited, approved help from federal taxpayers will help turn the tide, results are mixed.

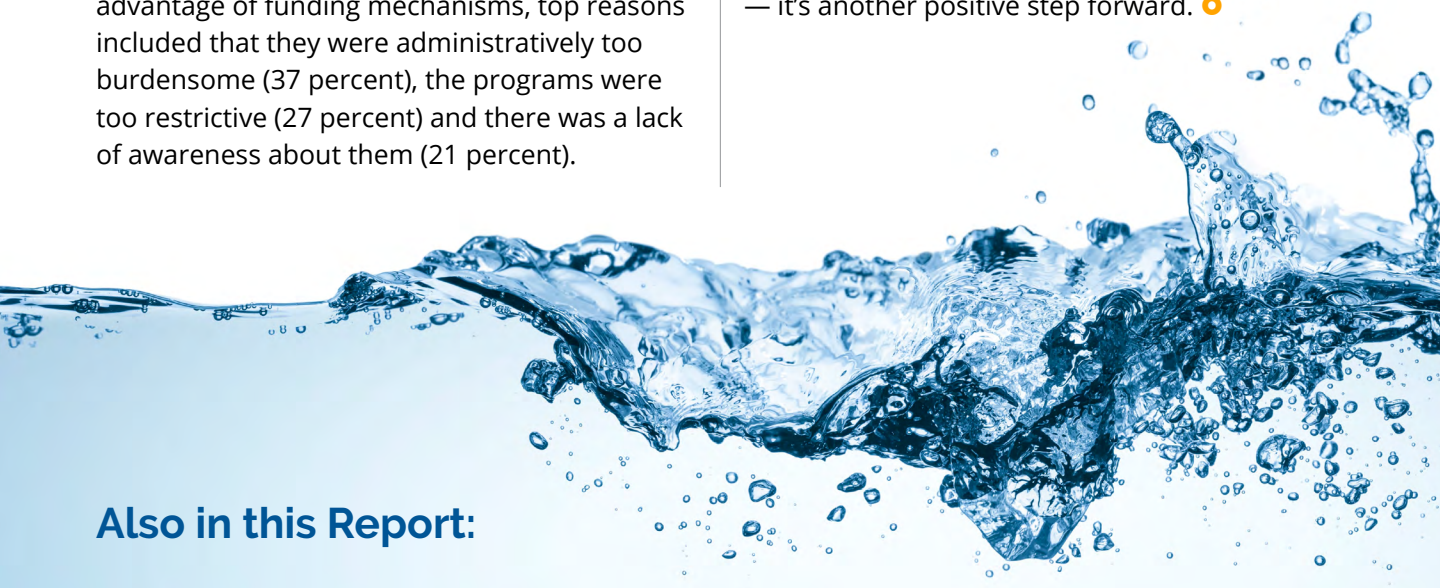
Feeding into state revolving funds as part of partnership between states and the U.S. government, tens of billions of dollars from the IIJA over the next five years will go to critical water investments, including projects involving drinking water and sewers. Billions more are bound for cities and counties under ARPA.

A combined 58 percent of respondents say they're pursuing ARPA funds, with one-third intending to seek IIJA money intended for water infrastructure and resiliency efforts. Yet when pressed why their organizations haven't taken advantage of funding mechanisms, top reasons included that they were administratively too burdensome (37 percent), the programs were too restrictive (27 percent) and there was a lack of awareness about them (21 percent).

Asked separately whether they're accelerating capital projects because of new state or federal funding sources, just one-third of respondents said they "might or might not" — the top reaction. One-quarter reported "probably yes," with one in five "probably not."

As described later in this report, the IIJA represents more of a lifeline to the water industry — not a panacea, given that more long-term investment will be essential to addressing decades of underinvestment.

But in a sector rife with challenges — from ridding contaminants in drinking water to thwarting cyber criminals, and confronting and tackling climate change's effects ranging from hurricanes to flooding, droughts and wildfires — it's another positive step forward.



Also in this Report:

Cleaner Water

Fifty years since the passage of the Clean Water Act, new regulation — including more stringent nutrient removal standards and the need to address new contaminants — largely will drive technology investment in U.S. wastewater treatment plants. But many in the sector anticipate adding new technologies that bolster resiliency and cut their energy and carbon footprints.

Climate Change

Widely labeled an existential threat, climate change is forcing more water utilities to adopt diverse strategies meant to make them more adaptable and resilient to severe and increasing weather events such as hurricanes, flooding, droughts and wildfires. A new influx of federal spending on water infrastructure may advance that resiliency push for climate adaptation, which will require planning, funding and multiple yet integrated strategies.

Cybersecurity

With attacks by hackers against U.S. utilities grabbing more headlines, more than 90 percent of water industry respondents to Black & Veatch's survey prioritize cybersecurity investments as important. But are the nation's water utilities truly doing enough to beef up their defenses in a sector now closely looking the Washington, where compliance mandates — at least minimum ones — could be looming?

A Decade Later: Water Sector Doing More with Less

A decade since Black & Veatch first launched its annual "water report" in 2012, some of the industry's biggest challenges linger: The sector still grapples with fading infrastructure, an aging workforce and financial obstacles.

Yet the march of time has brought to light new opportunities that appeared to draw little notice a decade ago. The ascension and promise of data in driving decisions for those proactively deploying such "smart water" solutions continue to grab mindshare, and utilities are addressing the surging, pressing need for robust defenses against cyberattacks.

Make no mistake: Unlike in 2012, digitalization and resilience now play two of the most profound roles in deciding the sector's direction, partly in response to the sector's aging assets and the escalating worries about the effects of climate change.

All around, it's an industry focused on doing more with less in serving the growing population as it migrates to digital systems and increasingly turns to data to compensate for shrinking staffs and lessen environmental impacts.

Shifting Priorities

Comparing results of our survey of more than 300 U.S. water industry stakeholders for this year's water report to Black & Veatch's similar polling a decade earlier yields some intriguing takeaways about the perceived challenges, then and now.

The survey began with the main issues affecting the industry, and to little surprise, aging infrastructure topped the list, as it did in 2012. The second largest challenge in 2022 — hiring of qualified staff — wasn't an option in the 2012 survey. This, coupled with concerns regarding aging workforce (also rising on the survey from seventh to fourth), displays significant strain to find human capital resources throughout the industry *(Figure 3).*

Though federal support is on the way, current investment does not match need. The recently approved Infrastructure Investment and Jobs Act (IIJA) earmarks **$82.5 billion** in critical water investments, with the largest portions allocated to improving safe drinking water and sanitation — commitments that will help revitalize aging infrastructure. While the opportunities presented by this investment may be part of the reason cost concerns lowered from the second spot in 2012 to seventh in 2022, apprehension remains, as 39 percent of respondents said current investments would not be enough.

According to a **report coordinated by the US Water Alliance and the American Society of Civil Engineers**, the United States would need to increase its investment in water infrastructure by $2.2 trillion over the next 20 years, or roughly $109 billion per year to close the water industry's current investment gap. Even though availability of funding, managing capital costs, and managing operational costs dropped in

Figure 3

From your perspective, what are the most challenging issues facing the water, wastewater, and stormwater industry today?

Source: Black & Veatch

	Rank	
	2022	2012
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Hiring of qualified staff	2nd	—
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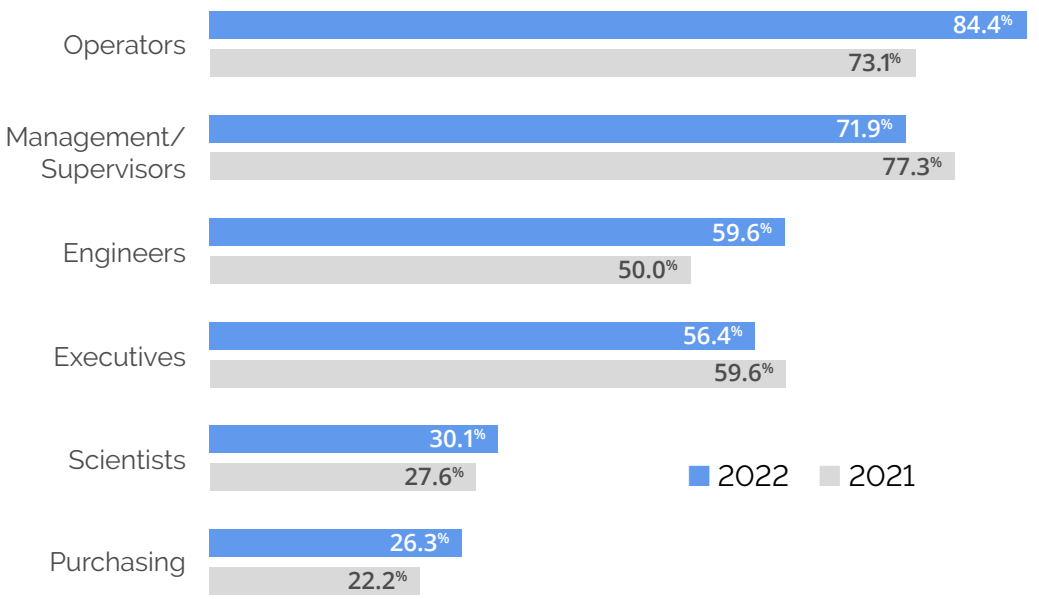
— A dash indicates the answer wasn't included in 2012
* Managing energy costs and Chemical cost asked in 2021

Figure 4

For each of the following job categories, how significant will the impact of employee retirements be over the next five years? *(Select one per row)*

Source: Black & Veatch



concern over the past decade, they remain within the top 10 issues affecting the industry. Another element of costs — justifying capital costs — comes in prominently in the sixth spot.

Though the IIJA throws a lifeline to a water industry in need of funding, it should not be mistaken with a complete solution. Ongoing and forward-thinking investment will be crucial to long-term success.

Workforce Woes

Hiring of qualified staff has become such a concern — especially as the "Great Resignation" era and an aging workforce converge to place demand for workers at an all-time high — that it's taken the second highest spot on the list in 2022. By comparison, it ranked 14th in our 2017 survey results.

As workers age out and retire, the workforce to replace them is dwindling rapidly, especially among field roles that cannot yet be automated. When asked what roles are impacted most by the changing workforce, operators and managers stood out as the top two *(Figure 4)*.

The Development of Data

Though aging infrastructure and workforce development shape how owners and operators approach projects and plan for the future, digitalization and data collection offer solutions.

In some ways, data was to 2012 what cryptocurrency is to 2022, seen by the public as the Silicon Valley's latest futuristic, albeit inaccessible, offering. But the importance of the tool was not lost on the public — a 2012 report by the World Economic Forum declared data the newest economic asset, like currency or gold.

Figure 5

Which is the main challenge for improving asset management in your organization? *(Select one)*

Source: Black & Veatch

50.6%
Developing the required systems and processes needed to improve asset management

17.6%
Too much data without quality information for decision making

16.5%
Defining what asset management is and communicating it to the workforce

11.8%
Lack of asset management capabilities in the workforce

3.5%
Getting senior management buy-in to improve asset management

Ten years later, the necessity of data collection for any business is widely accepted, though barriers to effective interpretation and use remain, especially in utility industries. Nearly seven in 10 respondents to Black & Veatch's latest survey reported they collect "lots" of data, although 41 percent admit they are not leveraging it effectively.

When asked what they found to be the main challenge for improving asset management, nearly one-fifth — 18 percent — of respondents selected "too much data without quality information for decision-making," while "developing the required systems and processes" — which nowadays often include data collection and management — was the highest concern *(Figure 5).*

Over the past decade, the data collected has flipped from being considered too little to being too much. Or rather, after years of collecting data with no specific plan, utilities are feeling overwhelmed by the task of making the abundance of information useful. To turn data into an advantageous asset, creating master plans for data analysis, extrapolating long-term trends and gleaning action items from the revelations it offers will be imperative.

Leveraging Digitalization to Do More with Less

The beauty of digitalizing systems is its potential for data collection and analysis, which can be used to better understand almost anything, predict or anticipate potential failings in assets, and drive enhanced decision-making processes. For many utilities, tracking long-term trends through data has become the key to boosting efficiency, mitigating water loss and strengthening system resilience.

As the water industry workforce diminishes and aging infrastructure assets place greater importance on resilience, data analysis can step up, helping operations run more smoothly with fewer workers than ever. Though the past 10 years have seen significant change and new challenges, they also have brought the technology that water utilities need to overcome the rising obstacles.

The **Aging Workforce** and the **Rise of the Machine**

Beyond the ongoing challenges created by its aging infrastructure, America's water industry is grappling with a serious crisis of workforce availability. In a 2020 report, the American Public Works Association (APWA) found that more than half of all water and wastewater utilities nationally have just one or two employees. Eighty-five percent have three or fewer.

Compounding matters is that the industry's workers are skewing older. Only 10 percent of the water sector's workforce in water occupations roles is aged 24 or younger, according to the APWA, while the median worker age is 42.8.

As these older workers fade into retirement or switch careers, their expertise follows, leaving utilities — notably those that haven't yet embraced digitalization — scrambling to deal with the erosion of the necessary knowledge about things like document systems, asset history, training

protocols, maintenance procedures or the often-temperamental complexities of continuously aging assets.

Many underlying factors make replacing long-time employees complex. Fewer people generally are choosing to work for utilities out of perceptions that, despite the work's importance, the career path is simply not enticing. Fewer working professionals are staying in one field for their entire career. And attracting candidates with diverse skillsets from an already limited pool increasingly involves a bidding war that utilities dealing with tight budgets struggle to win against larger counterparts able to offer more in wages and benefits. Often to compensate, utilities are outsourcing more of their functions.

All this comes against the backdrop of intensifying efforts to embrace digitalization, data analytics, artificial intelligence and, in some cases, advanced simulation technologies such as digital twins — a real-time digital counterpart of a physical object or process, using historical and current data to help predict asset performance, provide better insights and generally help with overall data accessibility. While these new technologies have their own complexities, data-driven efforts boost efficiency and automate processes, ultimately providing the opportunity for more capacity from the available resources.

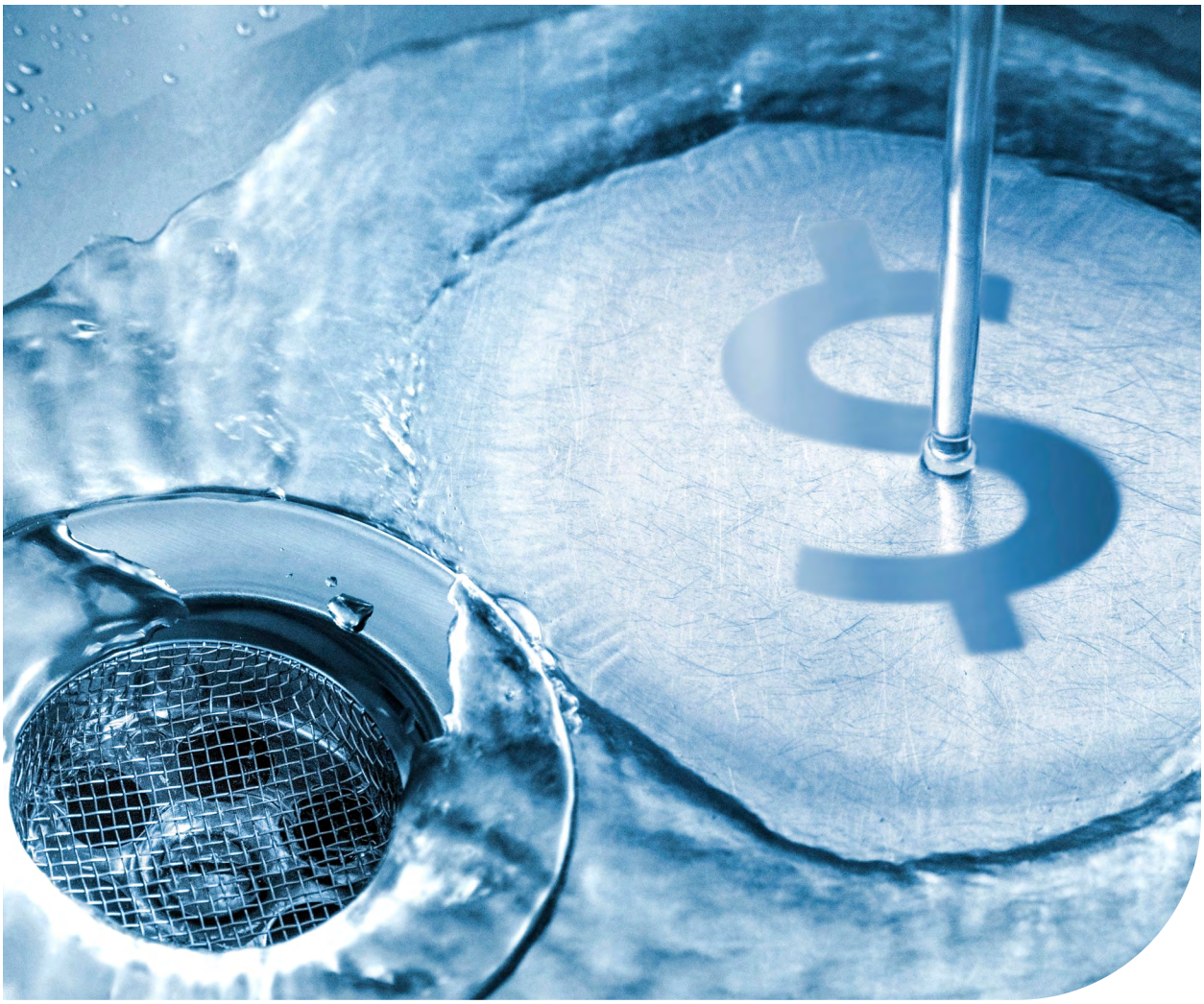
But the effectiveness of digital solutions hinges on the willingness of the water industry and its workers to embrace them, which can be tenuous. A survey of more than 300 water industry sector stakeholders for Black & Veatch's *2022 Water Report* found that half of water utilities have felt technological resistance from their staff, likely stemming from concerns that automation displaces people from their jobs and that machines simply can't measure up to human decision-making, or from previous tedious or failed attempts at synchronizing new technologies with legacy assets.

Yet resolving — or at least easing — the dilemma of a dwindling workforce and the resulting loss of institutional knowledge can be found in digital solutions. Better knowledge management and training systems help ensure that new professionals have resources that can supplement knowledge gaps in an array of settings, from how best to react during a disruption to pinpointing if and why an asset isn't running properly. They also make data and information more accessible for all workers new and experienced, in addition to providing opportunities to gather more preventative action items rather than just reactive measures.

While this capability encroaches on the roles of human workers, staff likely have nothing to fear as utilities continue to rely mightily on decision-making by actual people. When asked whether they lean more on experienced technical staff to make sound decisions, or data and intelligence to drive responses and action, half of the survey's respondents said they put their faith equally on both.

Moving forward, the water industry's response to the disruptions of an aging workforce where potential recruits are in high demand and enjoy other employment options will rest on digitalization and data analytics. The question is whether system operators and managers are willing to embrace these tools in a mutually beneficial manner.

Funding



The American Rescue Plan, the Infrastructure Act and You: What's Your Plan?

Having done more with less for so long, the water and wastewater industry finally is getting a needed injection of aid. The hundreds of billions of dollars destined for cities and counties under the American Rescue Plan Act of 2021 (ARPA) and the trillion-dollar Infrastructure Investment and Jobs Act (IIJA) offer a once-in-a-generation opportunity for state and local governments to invest in long-delayed water, wastewater and stormwater projects.

Unsurprisingly, aging infrastructure remains the chief challenge for the industry, according to Black & Veatch's *2022 Water Report* survey of more than 300 stakeholders across the water and wastewater landscape. Financial concerns also command top spots, with respondents pointing to funding and availability of capital (No. 5), justifying rate requirements (No. 6), managing capital costs (No. 7) and managing operational costs (No. 10) as major challenges.

Against this backdrop, utilities eagerly have been awaiting the new resources within the IIJA and the second tranche of ARPA money, with nearly 40 percent responding they plan to use the new state or federal funding to press ahead and accelerate capital projects, reflecting an urgency in making long-delayed upgrades to aging infrastructure. One-third were slightly

less committal with their responses of "might or might not," perhaps suggesting a slower approach to identifying goals, mapping out meaningful investments and engaging stakeholders throughout the process.

Yet, overall optimism is high, with a combined 95 percent of respondents expressing confidence that their organization would be able to make use of the new funding mechanisms. Half of them cast themselves as "extremely" or "very" confident.

Opening the Purse Strings

With increased money into the state revolving funds (SRF) and other programs through the IIJA — and ARPA money available to some cities and counties for water, wastewater and sewer projects — utilities have additional financial resources available. When polled on which sources of funding they have considered for capital projects, most utilities pointed to "other federal grant programs" as the primary option *(Figure 6).*

This is a large bucket, containing a range of government programs under the Federal

Figure 6

Which of the following sources has your organization looked into for capital project funding? *(Select all that apply for each source)*

Source: Black & Veatch

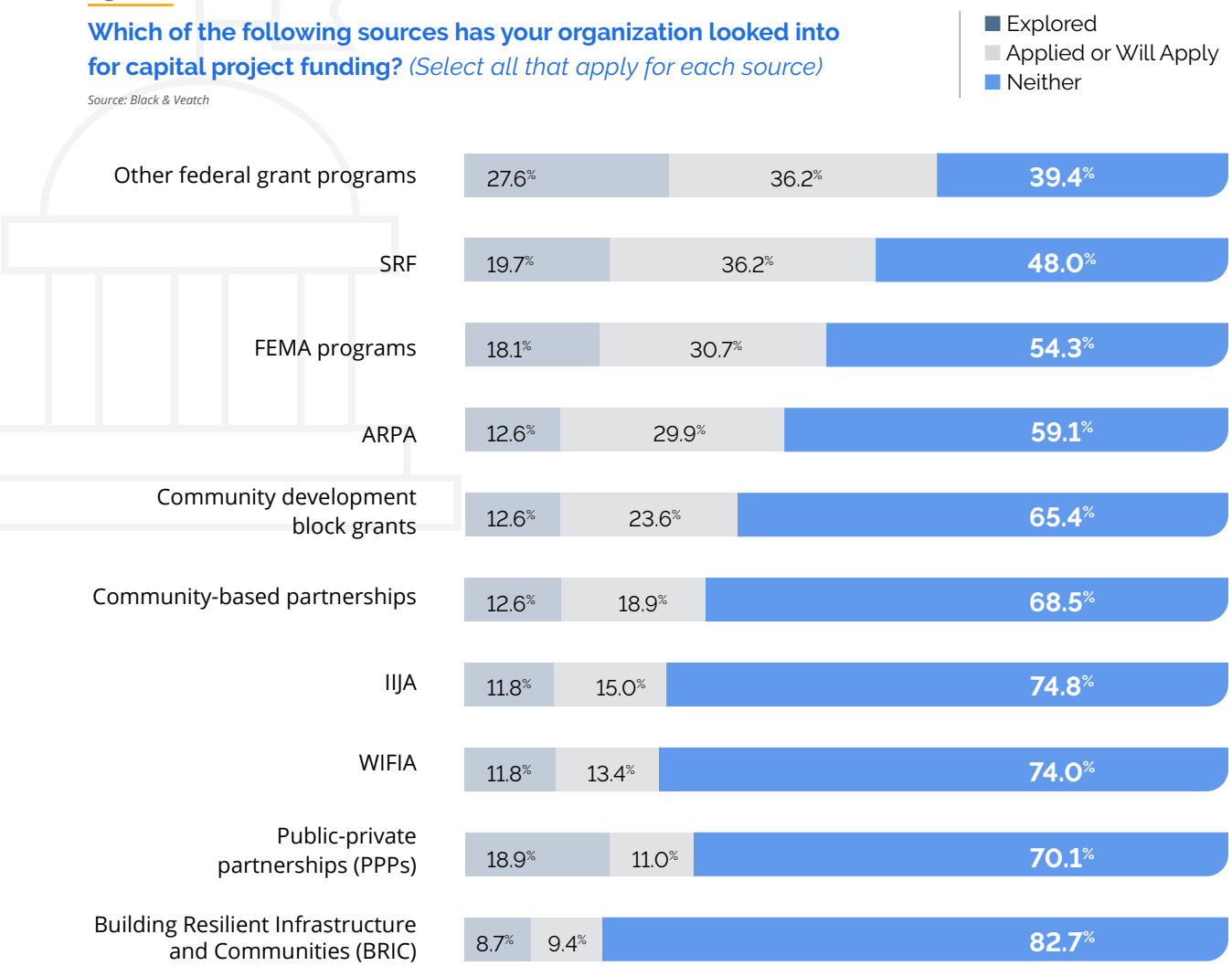


Figure 7

Which of the following funding sources will you pursue? *(Select all that apply)*

Source: Black & Veatch

29.4%
ARPA: $350B for state and local fiscal recovery fund

28.6%
ARPA: $10B for capital projects fund

23.0%
IIJA: $55B for water infrastructure

11.1%
IIJA: $46B for resiliency

5.6%
IIJA: $65B for broadband

2.4%
IIJA: $73B for power and grid

Emergency Management Agency (FEMA), Food and Drug Administration (FDA) and U.S. Department of Agriculture (USDA), among others.

SRFs came in second. Established in the 1990s, this revolving fund provides loans and other assistance for eligible water infrastructure projects, with repayments and interest flowing back into the fund. Most of the new IIJA funding will come through two existing SRF channels: the Clean Water State Revolving Fund (CWSRF) and the Drinking Water State Revolving Fund (DWSRF). Each program will receive $11.7 billion over five years through the IIJA. Also of note are the new funds dedicated to lead service line replacement and PFAS, all of which will come through the drinking and clean water SRF programs, largely as grants and principal forgiveness loans.

FEMA programs were third-most noted: it's worth pointing out that FEMA funding appears three times — under the first, third and last option (Building Resilient Infrastructure and Communities, or BRIC, which also is a FEMA program). With FEMA rating so highly, this suggests that utilities lean heavily on disaster money — from the next tornado, flood, wildfire, etc., — to fund their capital repair and replacements projects.

COVID Relief vs. the Infrastructure Bill

When it comes to which new funding sources utilities plan to pursue, COVID relief through ARPA dominated the top two spots, with ARPA's allocated $350 billion for state and local fiscal recovery coming in at No. 1, followed by ARPA's $10 billion for capital projects *(Figure 7).* This may be because as of the timing of this article, ARPA money already had been available for almost a year, whereas the new money into the SRFs will be available to states in the fall.

ARPA, also called the COVID-19 Stimulus Package, is the well-publicized $1.9 trillion economic stimulus bill passed in March 2021 to speed up the U.S. economy's recovery from the impacts of the COVID pandemic and the ongoing recession. This was followed by two IIJA categories — $55 billion for water infrastructure and $46 billion for resiliency.

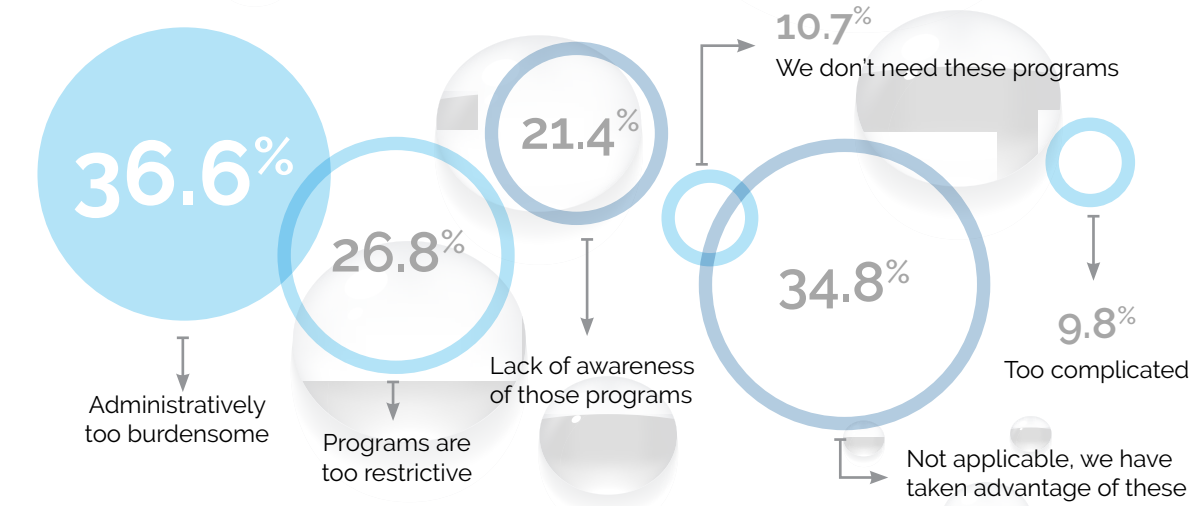
It is important to note that while all utilities have access to the new IIJA money, only certain utilities, cities, counties can access ARPA money for water and wastewater. Where states, counties and cities have had a budget shortfall due to COVID or have needed additional relief funding because of COVID, the money has gone to direct COVID relief. Only in some communities, where there is a budget surplus and/or the funding is not needed for COVID relief efforts, has the money been considered for water or wastewater projects.

The survey also found that a combined 78 percent of utilities said they plan to pursue funding from these new mechanisms, leaving 22 percent stating that they were not inclined to take

Figure 8

What are the main reasons why your organization has not taken advantage of some of the above programs? *(Select all that apply)*

Source: Black & Veatch



advantage of the new programs. Why? Paperwork seems to the main reason; when asked about barriers, respondents blamed administrative burden, overly restrictive programs and a lack of awareness as their top three obstacles *(Figure 8).*

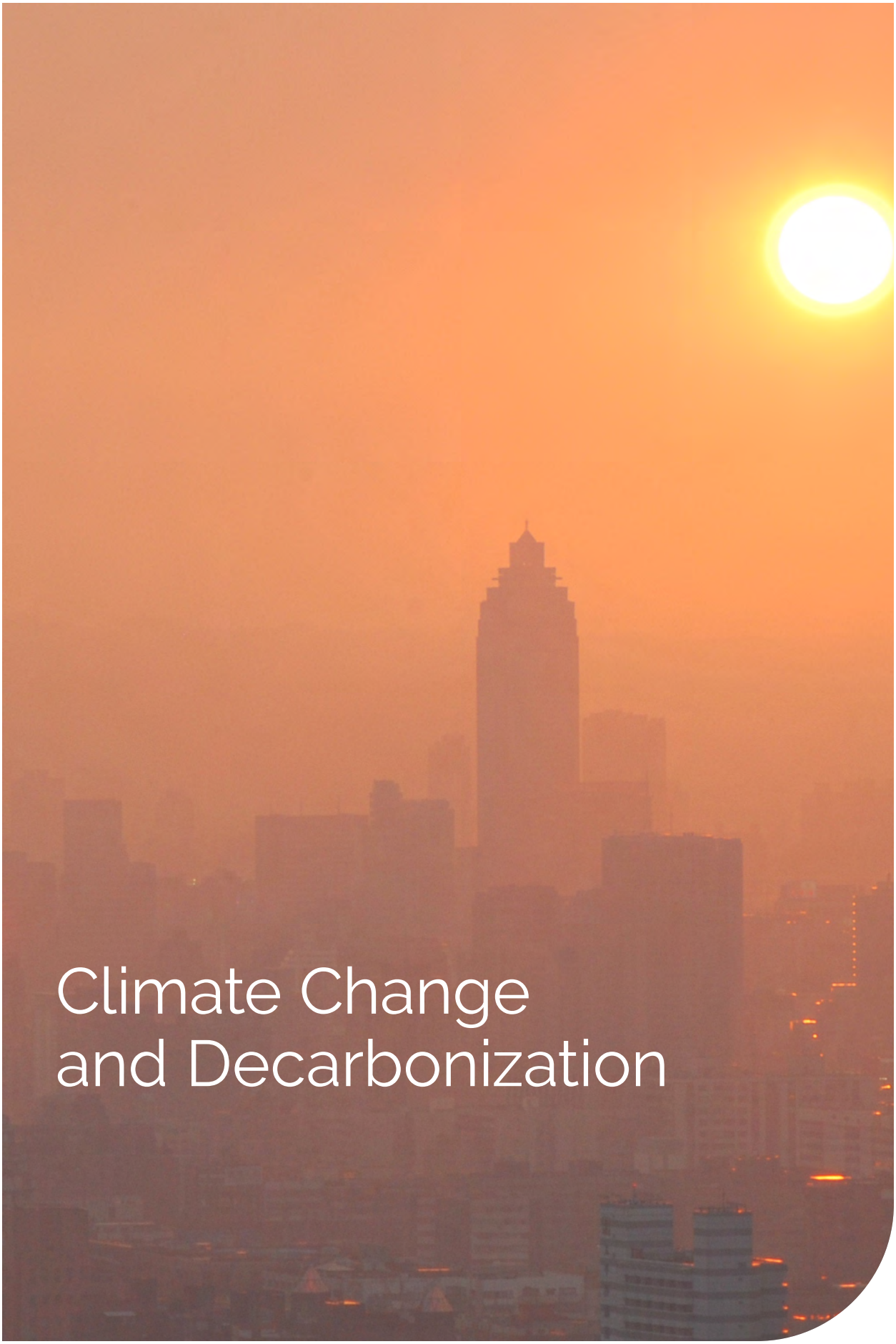
But most of the water industry would say that the processes required to apply for state and federal funding always have been considered administratively burdensome, requiring mandatory reporting, waivers, additional provisions and extensive paperwork.

For example, the CWSRF and DWSRF always have contained the American Iron and Steel provision that requires recipients to use iron and steel products produced in the United States. Historically there have been occasional waivers issued for water and wastewater treatment products that are not manufactured in the United States. The IIJA expands this provision to require any "manufactured goods" be sourced domestically, which is an extreme burden to place on utilities. Not only might this increase the cost of projects, it also could lead to significant delays due to supply chain challenges. Yet to be determined are what waivers and carve-outs may be available to utilities. For example, products made in the United States could be certified along with previously waivered products to expedite delivery and avoid impact to critical path delivery.

And it's worth mentioning that the administrative burden isn't only on the applicants; the increased volume of applications means that states may have to increase staffing levels to sufficiently address the incoming flood of paperwork. Without sufficient staff available, states may find possible delays and bottlenecks when it comes to processing, administrating and monitoring compliance.

Investing in Our Water

It's not too bold to state that America's water, wastewater and stormwater infrastructure needs a boost after decades of underinvestment. This new funding provides tens of billions of dollars to ensure clean, safe drinking water and critical wastewater and stormwater management service in communities across the nation. There will be challenges and utilities may have to be patient, but water is critical to health, environmental and economic development. Any investment into water infrastructure can provide the resilience needed to ensure safe, secure access to water, for all.



Climate Change and Decarbonization

Climate Adaptation Strategies Gaining Momentum

Climate change has been labeled by President Biden, other elected leaders and environmental groups as an existential threat, with critical human infrastructure under siege from more frequent and intense weather-related storms, flooding, droughts and wildfires. The Environmental Protection Agency (EPA) warns that water infrastructure may be vulnerable to sea level rise, saltwater intrusion and greater pollutant runoff, eroding confidence in system resilience at a time when asset hardening should be top of mind.

Black & Veatch's *2022 Water Report* survey of more than 300 stakeholders across the water, wastewater and stormwater industry illustrated that utilities are adopting a variety of strategies as they work to reposition themselves as more adaptable and resilient to climate change. That's even as they wrestle with how to plan for and secure funding, educate ratepayers and garner support in the face of a confoundingly unknown future.

A Seismic Shift

The water industry is making a substantial shift toward sorting out climate vulnerability and risks in concert with integrating such variables within their capital program, asset planning and operations. Across the industry, Black & Veatch has noted increased interest from water, wastewater and stormwater utilities when it comes to planning for climate change adaptation and mitigation, setting and meeting environmental, social and governance (ESG) goals, developing metrics and measuring sustainability and resilience.

When polled on what utilities see as their primary climate mitigation/adaptation strategies, most respondents pointed to water loss mitigation

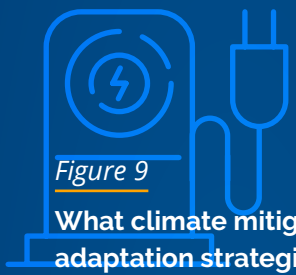


Figure 9

What climate mitigation/ adaptation strategies is your utility pursuing or planning to pursue? *(Select all that apply)*

Source: Black & Veatch

60.5%
Water loss mitigation and water conservation strategies

41.9%
Implementation of energy efficient strategies

29.1%
Conversion of fleet vehicle(s) to EVs

26.7%
Implementation of onsite renewable energy generation

14.0%
Green stormwater infrastructure

12.8%
Purchase of renewable energy from the grid

11.6%
Utilize Envision and/or LEED sustainability strategies

7.0%
Creation of a net zero road map

16.3%
None of the above

and water conservation, followed by strategies to improve energy efficiency and promote electrification and renewable energy *(Figure 9).*

The higher positioning of energy-efficient strategies, conversion of fleet vehicles to electric vehicles (EVs) and implementation of on-site renewable energy generation also reflect an industry focused on enhancing energy management efficiency. While some utilities in the past decade had started integrating energy management into their proactive planning, the war in Ukraine unfolding at the time of this report is further highlighting the need for energy resilience. The resulting sanctions against Russian gas and oil are throwing the global energy market into disarray, sending costs skyrocketing and spurring discussions about energy resilience and independence.

However, green stormwater infrastructure ranked fifth in the survey, which was surprising, given its importance in managing combined sewer overflows (CSOs), sanitary sewer overflows (SSOs) and flooding — all of which are impacted by climate change. Given that the majority of survey replies came from water and wastewater utilities (stormwater utilities comprised only 23 percent of respondents), it's likely that the results skewed toward water conservation — a big focus of drinking water utilities and energy-efficient, net-zero strategies (driven more by wastewater utilities).

Funding Resilience

Building climate change resilience and adaptation mechanisms also requires funding capacity. To date, water, wastewater and stormwater infrastructure has been notoriously underfunded in the United States. But federal funding through the American Rescue Plan Act of 2021 (ARPA) and the trillion-dollar Infrastructure Investment and Jobs Act (IIJA) now are offering utilities an unprecedented opportunity to plan and invest in aging infrastructure, address compliance mandates and enhance resilience driven assets and initiatives.

According to the survey, a combined 78 percent of respondents said they were "extremely likely" or "fairly likely" to pursue funding from these new mechanisms, tapping into resilience money through the new Building Resilient Infrastructure and Communities (BRIC) programs, pre-hazard mitigation funds and other multi-sector opportunities to drive greater climate resilience across their entire enterprise *(Figure 10).*

In a separate question, more than half — 51.3 percent — of respondents said they were "extremely" or "very" confident that they have the ability to use the funding, with an additional one-third expressing only moderate confidence. The relatively lower

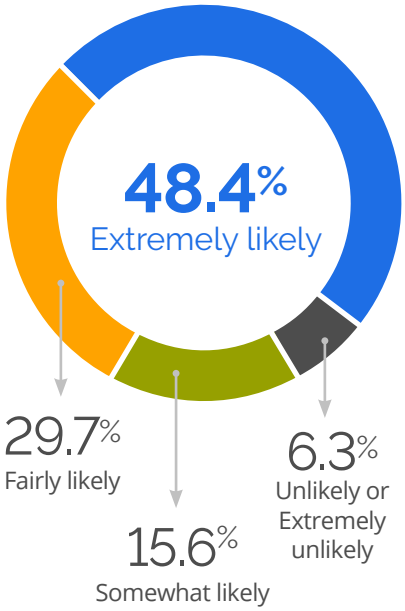
confidence could be due to various concerns, including competitive process to obtain funding, matching fund requirements, administrative reporting and other compliance requirements.

To leverage the federal, state and local funding opportunities, utilities should improve their internal funding resilience by investing in multi-year financial planning and financial best practices. They also should consider diversifying their funding streams so that utilities are not dependent upon one method of funding such as funding stormwater management through tax revenues but consider other more dedicated and stable sources of revenues such as stormwater user rates and charges, impact fees and other innovative monetization of services. By planning ahead and building out their internal funding resilience, utilities will be better equipped to leverage all the funding opportunities available to them.

Figure 10

As the federal response and spending towards infrastructure increases, what is the likelihood that your organization will pursue funding from these new mechanisms? *(Select one)*

Source: Black & Veatch



Planning for a Climate Future

For utilities to truly plan for climate adaptation, they must remember it's not only about investing in protecting assets but also optimizing operations and maintenance and enhancing the level of services, including effective management of green infrastructure.

Although respondents are focusing on water loss mitigation and conservation strategies, it is important to distinguish between the two types of mitigation. The first type, "real losses," are associated with the water infrastructure itself in the form of leaks, main breaks or other such losses resulting from physical infrastructure.

But the second type, "apparent loss," also plays a critical part and results from how a utility operates its billing, metering, pressure management and customer conservation programs, all of which fall under operations and planning. This also is true for energy-efficiency strategies; it's not only the infrastructure and technology that the utility places in service but also the type of operational protocols and policies that govern utility-wide energy management. This even extends to fleet operations in how water utilities operate their fleets, plan their routing, etc.

Climate adaptation will require planning, funding and the adoption of multiple yet integrated strategies to help ensure a more resilient future against climate-related extreme events. Continuous and consistent proactive planning and building the necessary technical, financial, infrastructural and organizational capacity can help utilities move forward on the continuum of climate adaptation and resilience.

Water Utilities Face Decarbonization Challenges, Opportunities

It's an evolving push with complexities of costs and deliberations, starting with how decarbonization can and should fit into a water utility's sustainability goals.

As the need for sustainability and resilience drives conversations in the industry more than ever, water and wastewater utility decision-makers are gaining awareness of the need to get greener — and the rewards that presents — in ways they hadn't considered just a decade or two ago.

It's an evolving push with complexities of costs and deliberations, starting with how decarbonization can and should fit into a water utility's sustainability goals. Should they continue to rely on passive gas-powered generators as backup power sources when active, more climate-conscious options exist? Are they fully recognizing the linkages between decarbonization and the energy-intensive requirements of the full cycle of water management: collection, treatment, distribution and storage? How does water conservation, water reuse and mitigating water loss factor in? What about the compounding effects of climate change?

Black & Veatch's *2022 Water Report* puts it all into focus, with results of a survey of more than 300 U.S. water sector stakeholders making clear that issues of sustainability are receiving a broader conversation and adoption. Decarbonization — essentially any approach that directly cuts greenhouse gas emissions and energy use — is helping pave the way.

Figure 11

What's included in your sustainability strategy?
(Select all that apply)

Source: Black & Veatch

67.3%
Water loss mitigation

56.9%
New/alternative water supplies

48.0%
Renewable energy

24.6%
Decarbonization goals

10.1%
Low carbon building materials

Sustainability: Focus, Blueprints are Essential

For purposes of this report, Black & Veatch defines the sizes of water utilities by two categories — those termed "larger" because they serve more than 500,000 customers, and those who serve less than that threshold.

Overall, nearly two-thirds of respondents consider sustainability to be a critical strategic focus in the water sector, with seven in 10 from the larger utilities viewing it that way compared with 58 percent of their smaller counterparts. One-third in general — and 40 percent of the smaller utilities — say sustainability "sounds good" but isn't a priority.

Breaking that down a bit further, some 72 percent said they have sustainability goals and associated performance metrics. That's impressive, up about 7 percentage points over 2021 and perhaps illustrating how water utility leaders are recognizing the role the sector can play in potentially influencing communities. The increase in severe weather events such as hurricanes, flooding, drought and wildfires merely sharpens the point.

Nearly nine in 10 — 87 percent — of the larger utilities say they have sustainability goals and the means to measure them, most noticeably in the West and Northeast. Some 63 percent of the smaller utilities report having sustainability goals and the related metrics.

In terms of what's in such sustainability strategies, water loss mitigation (67 percent), new or alternative water supplies (57 percent) and renewable energy (48 percent) lead the way. Decarbonization goals followed distantly at 25 percent, perhaps because utilities don't have a baseline about that topic, much less the clarity about how to set a goal for it *(Figure 11)*.

Slightly more than half — 52.3 percent — say they're feeling no pressure from their community or regulators to adopt sustainability practices. Roughly seven in 10 of the larger utilities say they've experienced such pressure, compared to some 40 percent of their smaller counterparts. That disparity makes sense, given that larger utilities have a more prominent place in their communities, and regulators see them as a regional leaders with an ability to influence area utilities.

Promisingly, utilities more than ever are mapping out their sustainability missions, with three-quarters of respondents saying their utility has some type of blueprint for it, even if it's just merely

Figure 12

Which of the following situations best describe sustainability planning for your municipality and the water utility? *(Select all that apply)*

Source: Black & Veatch

33.8%
The municipality and the water utility share the same sustainability plan

27.5%
The municipality and utility both have unrelated plans

22.5%
Neither the water utility nor the municipality have sustainability plans

7.5%
The water utility has a plan, but the municipality does not

6.3%
The municipality has a plan, and the water utility is included within it

5.0%
The municipality has a plan, but the water utility is not included within it

covered by the municipality's overall plan. Roughly one-third of respondents report that their municipality and water utility share a sustainability blueprint — a united vision that often proves most successful because both get the holistic synergies of being on the same page. Conversely, more than one-quarter — 28 percent — say their jurisdiction and utility have unrelated sustainability roadmaps, with an additional 23 percent acknowledging that neither entity has any such framework at all *(Figure 12)*.

Active vs. Passive: Backup Power

Even as activists, ratepayers and regulators press for water utilities to get cleaner and greener, carbon maintains its grip when it comes to the industry's backup power sources in a sector that consumes massive amounts of energy. Nine in 10 respondents still lean on generators powered by diesel fuel or gasoline as a localized, reliable option when unplanned outages strike, easily outpacing electricity (27 percent), natural gas (24 percent) and "new energy" standards such as battery (17 percent) and solar or other renewables (14 percent).

Virtually all respondents (95 percent) at the smaller water utilities prefer fuel-powered generators when needed, compared to 73 percent of their larger counterparts. Forty percent of those larger utilities also say they rely on renewable energy as a backup, dwarfing the 3 percent cited by their smaller peers, perhaps because larger utilities can better afford that option *(Figure 13)*. Less than 5 percent of respondents, regardless of their utility's size, have no backup power source.

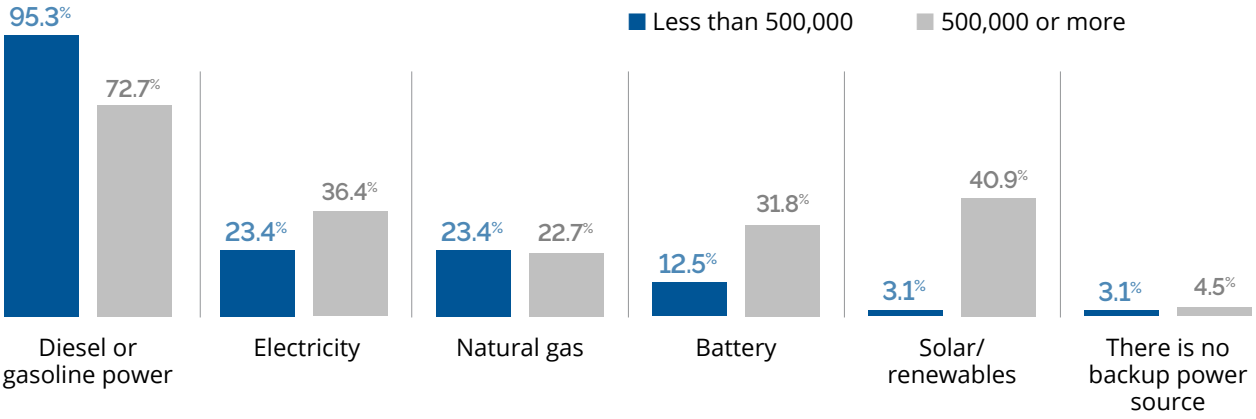
The reliance on generators may represent the perspective that switching to greener options is unnecessary, given the infrequency of unplanned outages or the relatively small carbon footprint the occasional use of a generator creates. As a result, the priority remains on the main source of energy for utility operations to drive a reduction in carbon emissions. It also could be the perspective that other decarbonizing technologies still are evolving, not fully proven and, for now, too pricy to justify to ratepayers.

Simply put, the timing may not be right for such investment among many utilities until they are certain of proven alternatives to a reliable generator. Yet as the global push for decarbonization intensifies amid growing climate change impacts, change is coming. Planning early to address these issues is key, especially knowing the pressures that electric utilities are facing to get greener eventually will apply to their water counterparts.

Figure 13

Which of the following backup power sources would your utility rely on in the event of an unplanned outage? *(By population served, select all that apply)*

Source: Black & Veatch



In many ways, it's a choice boiled down to active resiliency versus passive backup power. Because they're rarely used, generators amount to largely passive assets that still require monthly upkeep while deriving no economic value. Conversely, utilities would be best-served to map out their future by incorporating a blend of onsite generation — active power sources that couple renewable energy, including the biogas byproduct of wastewater treatment, with battery energy storage — that complement what the local power utility provides, embodying resilience and lowering carbon footprints through assets that deliver continuous value.

Looking ahead, one can envision a significant role for hydrogen as an energy carrier, particularly as the technology evolves to make better use of the heat and oxygen byproducts inside the utility's fence line.

Progress, But More Work Remains

With more than 50,000 water utilities and 16,000 wastewater utilities across the U.S., the sector is extremely fragmented. However, making a difference in decarbonizing the industry requires some uniformity in recognizing the need for a thoughtful pursuit of sustainability, from which decarbonization can blossom.

U.S. inflation pressures and other economic disruptions may distract water utility decision-makers from taking the necessary steps to making sustainability and decarbonization inherent parts of their identities, instead forcing them to retrench and focus merely on the basics of their services.

Against such headwinds, there's an overriding fact: The progress is clear and the value is indisputable in our global journey to reduce carbon emissions. As such, we must keep the focus of sustainability in our decision-making — it is the right thing to do.

Technology

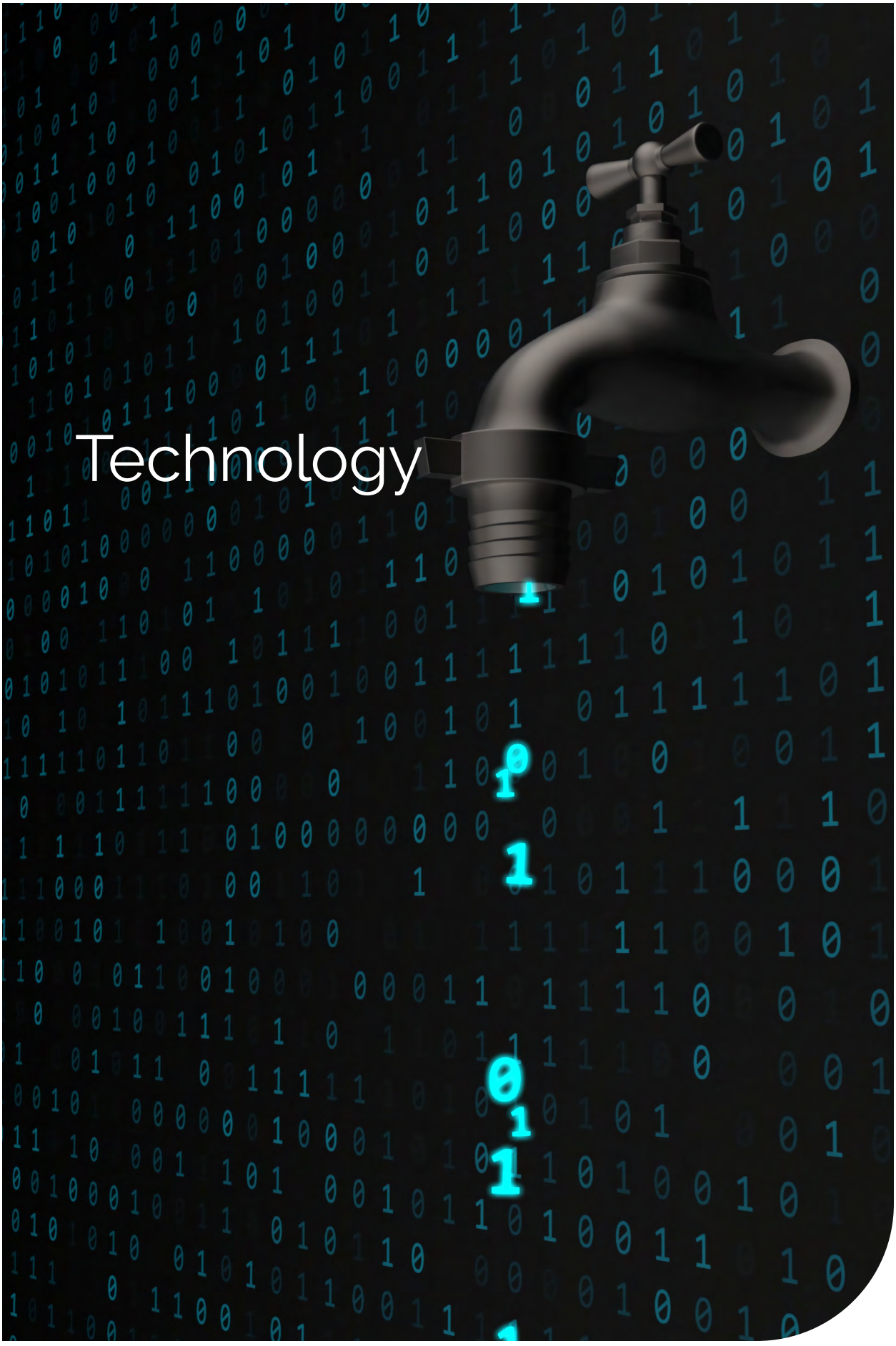
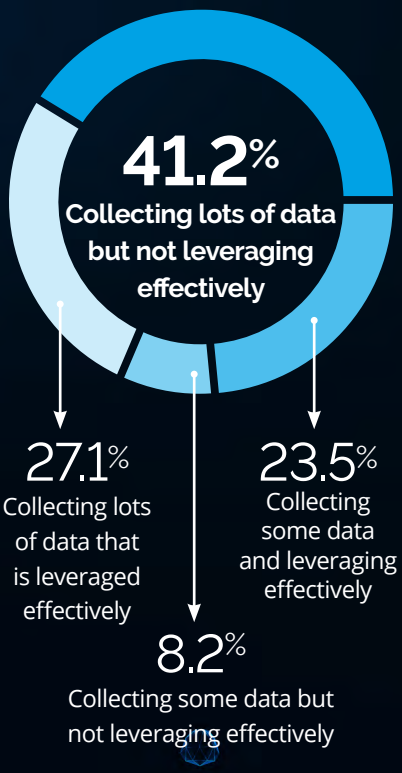
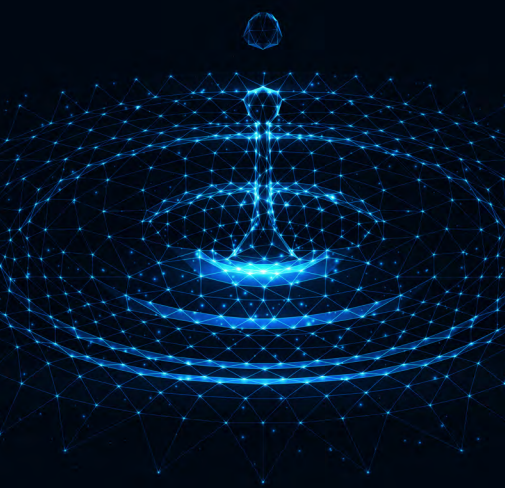


Figure 14

Which of the following statements best describe the current data management practice at your organization?

Source: Black & Veatch





Water Data in the Digital Age

With a wealth of digital technologies at their fingertips, utilities can gather telling information on just about any metric imaginable. Putting that data to the best use to optimize their assets and operations is another story.

Many utilities struggle to unlock value or actionable items from their data — a blind spot that becomes increasingly threatening as workforce exoduses and calls for greater efficiency create even more need for the solutions that data analytics can offer.

As utilities work out how to turn raw numbers into valuable insights, they also must work to harmonize the need for widely accessible data management systems with the more robust cybersecurity measures demanded by the digital age.

Data Rich, Information Poor

It appears that a significant segment of utilities are data rich but remain information poor. In a survey of more than 300 water industry sector stakeholders for Black & Veatch's *2022 Water Report*, 68 percent of respondents claimed they were collecting "lots of data," but only 27 percent believed they were leveraging that data effectively *(Figure 14).*

This may be because data collection has become business as usual for many operations — they collect the information and file it away but have yet to create a process for data analysis. For others, it could be due to a lack of a qualified workforce to interpret data — or that the data is so voluminous they're daunted by it, uncertain where to begin.

For many utilities, current data analysis begins and ends with single-point considerations, including the condition of an asset at any given time. But the true value of comprehensive data collection lies in the ability to analyze trends and risks over an extended period, such as how an asset is holding up against an increasing number of storms or how it is performing relative to its expected life cycle.

Figure 15

How would you describe your current data strategy within your organization?

Source: Black & Veatch

45.2%
Data is organized and you are using it to inform actions

39.3%
Data is being organized

6.0%
Data is not available, not organized, or paper/legacy processes still used by most stakeholders

8.3%
Data is not organized and is not accessible by most stakeholders

1.2%
Data is organized and easily accessible by stakeholders across the business

Such metrics can serve various purposes, ranging from tracking long-term efficiency to determining weaknesses, demonstrating priority areas of investment to stakeholders and even deciding when an asset needs rehabilitation or replacement based on deterioration over time.

Democratizing Data

While data informs decisions and empowers better asset and operations management, it has little ability to do so if it is not accessible or easy to locate. This presents another challenge for many utilities, which often collect data but fail to store it within a system that makes it available or interpretable to those who can find value in it.

When asked about how they would describe their organization's current data strategy, 45 percent of respondents said it is organized and used to inform decisions, with an additional 39 percent saying it's merely organized. Yet just 1 percent said their data is easily accessible by stakeholders across the business *(Figure 15).*

To ensure that data can be used to its highest potential, it is imperative that utilities consider their data organization and management tools, removing silos and "democratizing data" by making the information readily retrievable across the organization, including by frontline staff.

Technologies such as data dashboards and business intelligence — which display meaningful statistics in an interactive format that easily can be manipulated for various metrics and results — offer digestible methods for data organization that can bring value to workers across an enterprise. So can digital twins — virtual models of assets that can run simulations of various potential scenarios to determine outcomes and mitigation strategies

As businesses invest in these technologies, recognizing the value of data-driven insights, digital twins are poised to revolutionize the way they access and utilize digital content by providing actionable insights and connecting datasets and systems while generating unique opportunities for visual exploration of data.

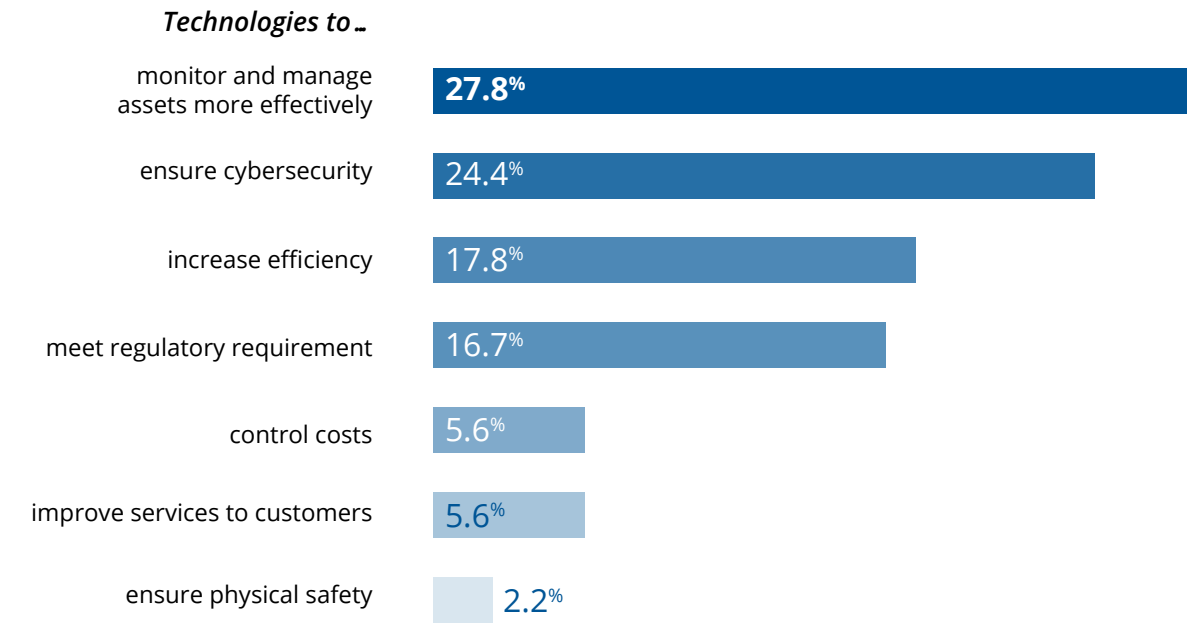
Creating the Digital Safety Mindset

Usually, the top consideration in creating a data strategy is ascertaining how to build in resilience against digital threats, but this becomes complicated when coupled with the need for knowledge sharing.

Figure 16

Which type of new technology should water utilities emphasize most?

Source: Black & Veatch



When asked which new technologies water utilities should prioritize, respondents most pointed to those that monitor and manage assets effectively and those that ensure cybersecurity *(Figure 16)*. But reconciling effective asset management technologies — often reliant on digital systems and data implementation — with cybersecurity means making data-focused tools available across organizations while still keeping those digital systems secure.

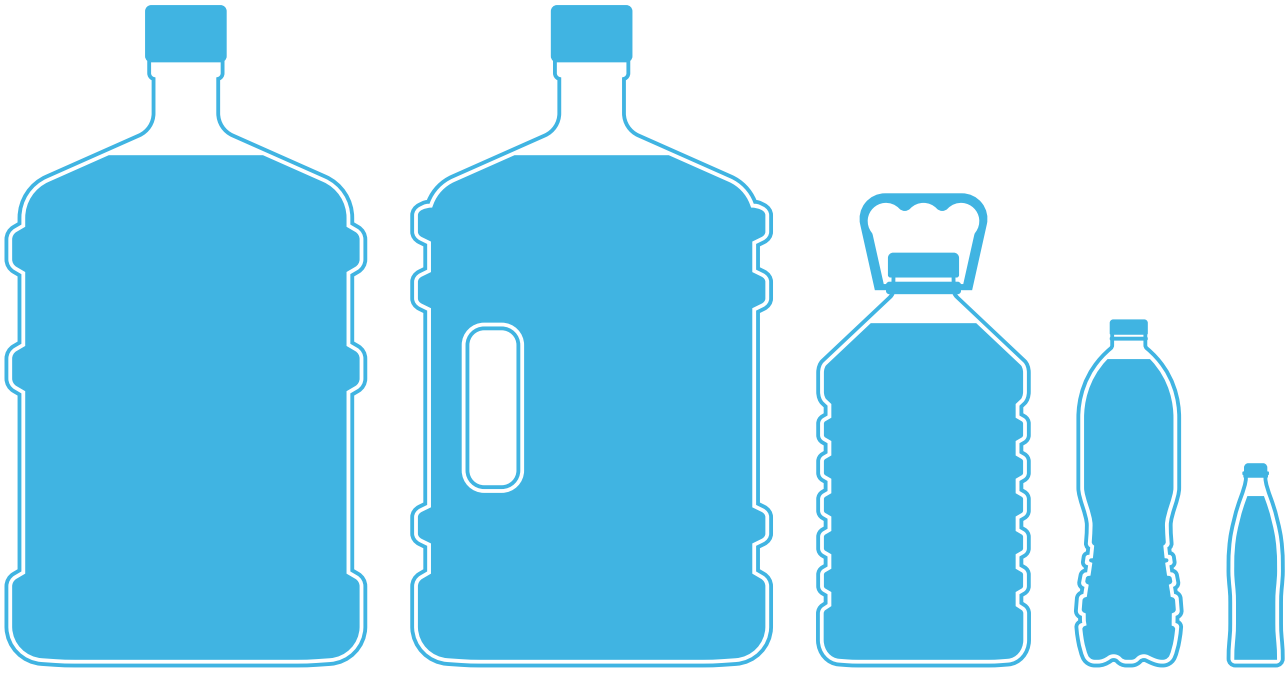
In a classic information technology mindset, digital assets may be heavily gated; but in the new mindset of knowledge sharing and data utilization, this approach to cybersecurity may be limiting.

Instead, utilities should apply a safety mindset to digital assets, much like that which is applied on physical worksites. Instead of guarding data in a way that risks limiting its actionable value, data protection should focus on training employees on digital safety, teaching them to responsibly access and utilize digital systems.

Data Management for the New Age

In this rapidly evolving digitalization landscape, the needs and possibilities for data management are in flux. To keep up, utilities must develop plans and tools for data analysis and usage. As they do this, they must prioritize knowledge sharing and cybersecurity education within their organizations to promote success through a culture of productive yet safe use of digital solutions.

Perhaps most importantly, utilities will find the most value in the information they already have in their grasps.



Advanced Drinking Water, Clean Water Technologies

Fifty years have passed since sweeping amendments to the Federal Water Pollution Control Act of 1948 carried water pollution control to the next level through the Clean Water Act (CWA) of 1972. "The objective of this Act is to restore and maintain the chemical, physical and biological integrity of the nation's waters," read the opening of the CWA, which laid the foundation and structure for regulating pollutant discharges into U.S. waters.

In the following decades, publicly owned treatment works and privately owned industrial wastewater treatment facilities used associated construction funding for upgrades to meet enforceable limits and other new requirements established by the U.S. Environmental Protection Agency (EPA). In the 1970s, utilities focused largely on removing solids and biodegradable organic pollutants. Beginning in the 1980s, the focus shifted to achieving nutrient removal targets — a shift particularly motivated by large, impaired bays such as the Long Island Sound and Chesapeake Bay.

After the initial flurry of activity, investments in treatment plant upgrades slowed. But regulatory pressures and asset condition still largely drive infrastructure and technology investments. More than two-thirds of the Black & Veatch *2022 Water Report* survey respondents foresee the need for their organizations to add technology to treatment plants to improve water quality over the next 10 years, and half expect to do so within the next five years. These responses likely reflect optimism about funding and public support as well as uncertainty about the regulatory landscape.

Figure 17

For what reasons do you expect to add a new technology? *(Select all that apply)*

Source: Black & Veatch

54.2%
New regulation

37.3%
Nutrient removal

35.6%
Enhance resiliency

32.2%
Newly detected contaminant

30.5%
Improvement of distribution water quality

28.8%
Change in source water quality

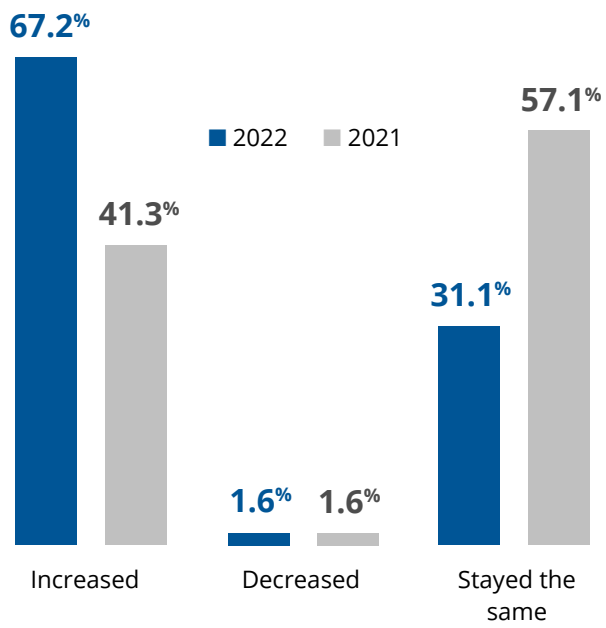
13.6%
Energy or carbon footprint reduction

6.8%
At the request of customers

Figure 18

Compared to previous years, would you say the value of wastewater has increased, decreased or stayed the same in your community? *(Select one)*

Source: Black & Veatch



Trended results are among wastewater utilities only

New regulation — including more stringent nutrient removal requirements and the need to address new contaminants — will largely drive such investment, according to survey participants. But a sizable percentage expect to add new technology to enhance resiliency and reduce their energy and carbon footprints *(Figure 17).*

Growing interest in enhanced water supply resiliency and sustainability — along with increased implementation of asset management and smart water programs — can spur investment in new infrastructure and technology to improve water quality. Process intensification — applied to biological processes, solids management and other processes — exemplifies a shift in focus from new to enhanced technology and from adoption to adaptation when it comes to technology innovation. "Infrastretching" through intensification can help utilities reduce facility-site footprints, energy requirements, operating costs and carbon emissions.

As the overall value of water increases, demand continues to outpace supply in many regions of the country, and climate change only exacerbates concerns about the future. According to survey participants who represent wastewater utilities, two-thirds believe the value of wastewater has increased, up from 41 percent in 2021 *(Figure 18).* Many utility leaders have championed holistic water management and rebranding of wastewater, and this year's survey results perhaps suggest that the public perception of value and utility of wastewater may be changing.

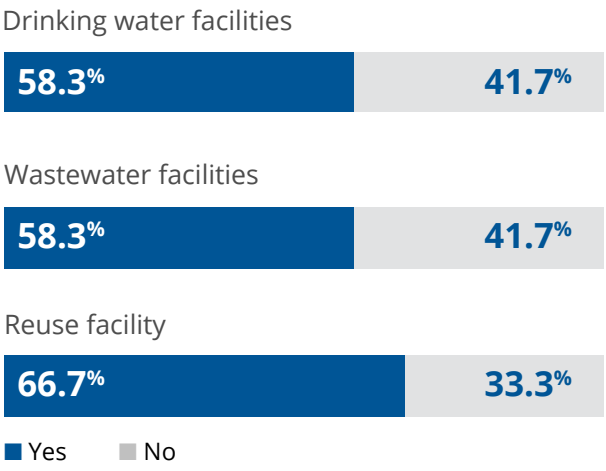
The CWA was passed to remove water pollution, but investment in technology to improve the water quality today tends to be tied to reuse of water and recovery of embedded resources such as energy and phosphorus. The majority of respondents expect to add new treatment processes to increase water-supply resilience for wastewater and reuse facilities *(Figure 19).* Some of these expectations could be linked to rising interest in reuse to address new or more stringent discharge limits, water-supply gaps and enhanced treatment as potable reuse becomes more important in California, Texas, Florida and other states.

Figure 19

Do you expect that new treatment processes will be added to your facility or facilities to increase resilience of the water supply?

(Select one per row)

Source: Black & Veatch



Chronic concerns about aging infrastructure and maintaining a qualified workforce — combined with the continued emergence of sustainability goals (72 percent have sustainability goals) — could make it challenging for utilities to financially address future regulatory and other requirements *(Figure 20).* These challenges will nudge utilities to carefully implement intensification technologies that will maximize and extend the value of existing assets. Innovation in data management also will help address workforce challenges. The continued and heightening importance of enhancing sustainability will elevate the importance of resource recovery as a strategy for utilities to chart the future.

For many years, wastewater utilities focused on the treatment of liquids. Solids management picked up speed along the way as recovered resources became more important for fertilizer and fuel. In California, the Irvine Ranch Water District enhanced resource-recycling capabilities by adding a new biosolids and energy recovery facility at its well-established Michelson Water Recycling Plant. Designed by Black & Veatch, the award-winning new facility produces a Class A (pathogen-free) product that is usable as fertilizer and e-fuel and generates energy and heat to meet the facility's needs.

In North Carolina, the city of Raleigh is progressing with a bioenergy recovery program. The city will convert biosolids primarily generated at the Neuse River Resource Recovery Facility into a Class A product for beneficial use through land application and produce vehicle fuel from biogas generated in anaerobic digestion.

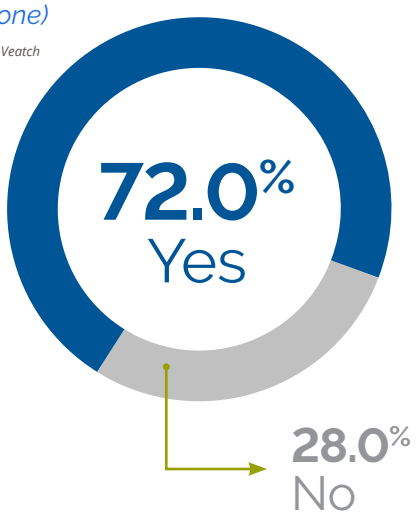
Regulation is here to stay, but it's taking new forms and approaches, even as the water sector is approaching plans and solutions from a different mindset a half century after cleaner water became a national priority. Integrated resource recovery, greener solutions that include green energy and green infrastructure to reduce overflows, watershed and holistic water planning, and the prioritization of technologies that will help utilities enhance water quality through diverse portfolios have bumped the CWA from center stage. Nevertheless, the beneficial impact of that law and the lingering need to raise the water quality of still-impaired U.S. waters still are in the spotlight.

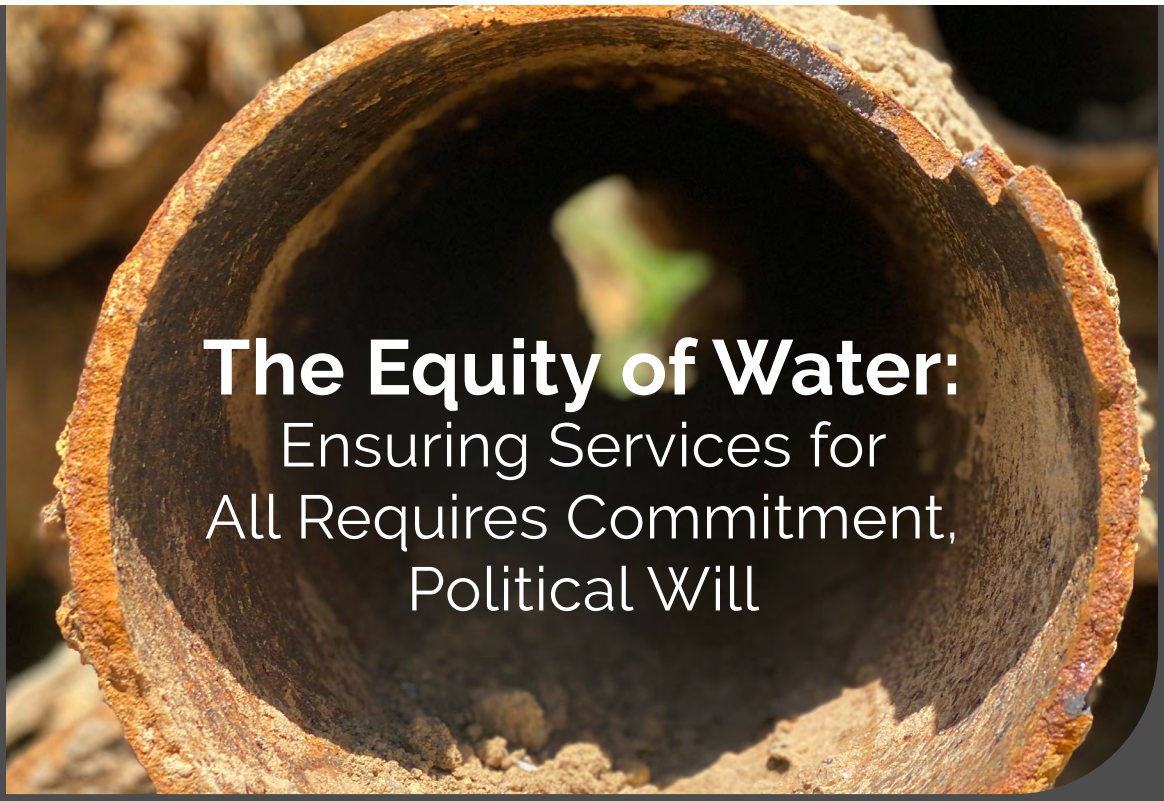
Figure 20

Does your organization have sustainability goals and associated performance metrics?

(Select one)

Source: Black & Veatch





The Equity of Water: Ensuring Services for All Requires Commitment, Political Will

When it comes to understanding water equity, the easy part may be defining it as merely equal access to clean, safe and affordable drinking water — and effective wastewater services — in urban and rural settings alike.

Ensuring its reality is the challenge.

More than ever, U.S. water and wastewater utilities are under pressure to deliver socioeconomic parity in terms of water, if anything, because it's the right thing to do. But the question lingers: Are those sectors doing enough in the face of the megatrend that is climate change — and its effects, including hurricanes, fires, floods and droughts — that continues to threaten water assets across the American landscape?

The answer may be purely subjective, with publicized failings in the pursuit of water equity drowning out the countless stories about where it's worked.

The poster child of water infrastructure shortcomings is Flint, Michigan, where residents unwittingly consumed lead-tainted water in parts of 2014 and 2015 during a stretch in which the city opted to switch to the Flint River as its water source. Experts have shown the river water's chemistry proved corrosive to feed pipes and home plumbing, elevating lead levels in water in a community already struggling with severe socioeconomic challenges. The case proves how one decision can snowball into something tragic.

More recently, there's the plight of Haynesville, Alabama, and Lowndes County's failing sewage system that leaves raw sewage flowing into yards — what NBC News reported as "a daily reminder of the poverty and lack of infrastructure enveloping residents."

Such anecdotes offer reminders that while many municipalities and utilities believe they're socially conscious when it comes to

providing effective water and wastewater services to all, we sometimes still miss the mark, resulting in failures that should not be occurring in a nation as technologically advanced as the United States.

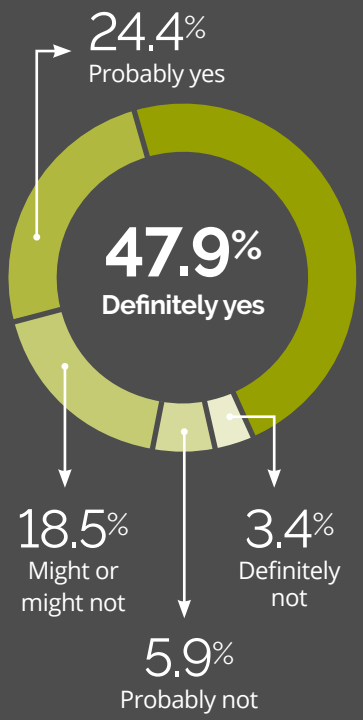
Social justice is a rising theme in today's conversations about environmental, social and governance (ESG) objectives among many locales and their utilities. That's helping keep and drive the focus on water equity and the need for everyone to share in the economic, social and environmental benefits of water systems.

But a survey of more than 300 U.S. water industry stakeholders for Black & Veatch's *2022 Water Report* shows the challenge of making water equity more universal. When asked whether their water organizations seek to improve infrastructures across high- and low-income communities equitably, nearly half — 48 percent — replied "definitely yes," with an additional one-quarter responding "probably yes." Sadly, 9 percent said probably or definitely not *(Figure 21).*

Figure 21

Does your organization seek to improve infrastructure across high-and low-income communities equitably? *(Select one)*

Source: Black & Veatch



In the end, decision-makers must ask the difficult questions: How are we helping communities, especially those that are economically disadvantaged or historically underserved, namely those of color? The Center for Economic and Policy Research notes that Illinois, for example, has more lead pipes than any other state, with Black and Latino residents there twice as likely as their white counterparts to live in neighborhoods with the most lead service pipes. Aiming to remedy some historical inequities in water sector investment, the Infrastructure Investment and Jobs Act devotes $1.7 billion to Illinois over five years to modernize its water infrastructure, helping ensure that everyone in that state has access to clean, safe drinking water.

True progress comes only when stakeholders and the public become more focused on and engaged in ESG-type issues, casting a critical eye on what water utilities are doing to ensure that service quality applies to everyone.

Recognition of the domestic issue is crucial, knowing that pockets of the United States lack even basic water and wastewater service levels. That understanding should fuel the need — and governmental commitment at local, regional and state levels — to ensure that people in America's often-overlooked, even forgotten, neighborhoods receive all the necessities the nation can offer.

Even in the water sector that constantly grapples with budget constraints, change happens when political will is coupled with creativity and commitment.

With Threats on the Rise, Utilities Must Be Aggressive in Bolstering Cybersecurity

In January 2022, ***The Washington Post*** **guest column** was ominous but left no confusion: "The cybersecurity risk to our water supply is real. We need to prepare."

Sounding the alarm, the opinion piece explained, was an October 2021 **joint advisory** by the FBI, National Security Agency and two other federal agencies, warning that U.S. water and wastewater systems are being targeted by "known and unknown" malicious actors.

"This activity — which includes attempts to compromise system integrity via unauthorized access — threatens the ability of (utilities) to provide clean, potable water to — and effectively manage the wastewater of — their communities," read the advisory, coming eight months after one U.S. breach offered a stark warning.

In that case, hackers exploited a security vulnerability in a Florida water treatment plant's control system and tried to taint the local water supply. Thankfully, a plant supervisor, through his computer interface, noticed the hack in progress and intervened before any real damage was done.

Now, in the face of geopolitical tensions, the continued rise of ransomware and publicized cases of recent cyber breaches, are water utilities doing enough to heed and address the warnings? A survey of more than 300 U.S. water industry stakeholders for the Black & Veatch *2022 Water Report* offers a mixed bag in the cybersecurity arena that the American Water Works Association, a leading trade group, considers to be a mission-critical function for the water sector.

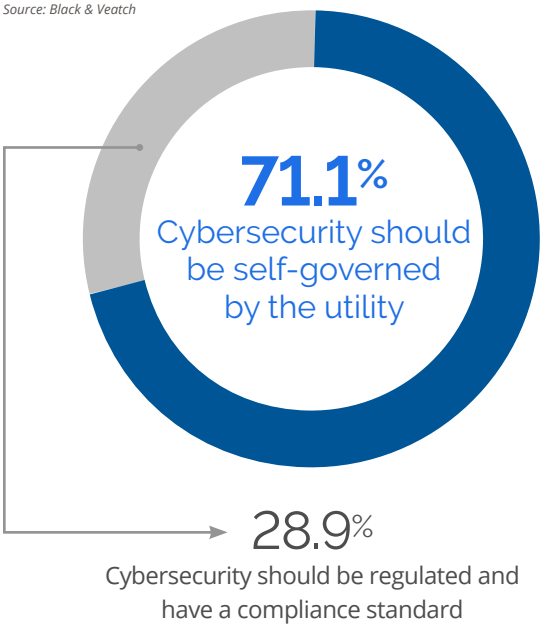
Promisingly, awareness of the threat appears to be growing, with more than 90 percent of respondents prioritizing investments in cybersecurity as important — three-quarters of them even viewing it as "very important." Ten years ago, when Black & Veatch first launched the yearly report, just 43 percent saw it as "very important." The perceived value of spending on physical assets also has risen significantly over the past decade, though the disparity is smaller.

Bolstering cyber defense requires knowledge and awareness of cybersecurity, coupled with technology to monitor and assess cybersecurity posture. When asked what new technologies

Figure 22

Would you prefer cybersecurity to be regulated and have a compliance standard, or prefer it to be self-governed by the utility? *(Select one)*

Source: Black & Veatch



water utilities should emphasize most, roughly one-quarter cited those that ensure cybersecurity — second only to the 28 percent who pointed to anything that better monitors and manages assets.

Cyber, By the Numbers

Along the way, roughly six in 10 respondents report having a formal, robust cybersecurity program to safeguard their IT systems and networks, mirroring 2021's results but raising the question of whether that reflects overconfidence in their interpretations of "robust."

Also in line with last year's findings, roughly 40 percent say they have cybersecurity protocols established but recognize there may be gaps with field devices and hosted solutions. The takeaway: Those utilities smartly view cybersecurity as a moving target, and rolling it out throughout their entire system takes time and a lot of effort. It's progress, but a work in progress, nonetheless.

Just 1 percent rely on antivirus software with no formal cybersecurity protocols. While that response may reflect an honest acceptance of their weakness in safeguards, such an approach carries its own perils of increased vulnerability.

Unsurprisingly, two-thirds of water utilities with more than 500,000 customers report having formal, robust cybersecurity programs — 9 percentage points more than their counterparts below that population threshold. The possible reasons: Bigger utilities tend to have more financial resources to fund their healthy cyber programs and may recognize that hackers intent on sabotage, including ransomware attacks, tend to go for headlines by hitting the industry's largest players.

That's not to say smaller utilities don't face risk. With less robust cybersecurity programs, known vulnerabilities in software and hardware may go unmitigated or unpatched, making attacks easier in allowing one hacking group to attack multiple smaller targets instead of spending more time on one large target.

Compliance Mandates May Loom

When asked whether water utilities would like their cybersecurity to be self-regulated or dictated by a compliance standard, seven in 10 respondents said they'd like to keep it in-house *(Figure 22).* Cost considerations may explain that go-it-alone mindset, given that significant investment needed to be compliant could be viewed as better spent on nagging, visible headaches such as continuously aging infrastructure or improving their data systems.

Compliance mandates, at least minimum ones, may be on the horizon. In April, Kevin Morley — the American Water Works Association's federal relations manager — pressed during a House Committee on Homeland Security hearing on cybersecurity that baseline cyber standards for the gamut of U.S. water systems may be needed.

According to the AWWA, Morley testified that the water industry could model a regulatory approach similar to the electric sector, with

Figure 23

When was the last cybersecurity assessment performed by your utility? *(Select one)*

Source: Black & Veatch

2022, or currently conducting	33.3%
2021	**43.5%**
2020	8.7%
2019	2.9%
2018	5.8%
Before 2018	2.9%
Have never performed	2.9%

a tiered risk- and performance-based set of requirements. Federal oversight and approval of requirements would be provided by the U.S. Environmental Protection Agency, given its existing statutory role in the water sector.

"The current threat situation illustrates both the necessity and strength of continuous two-way engagement and the value of partnership that is necessary to jointly manage cyber threats facing our nation," Morley said. The "AWWA stands ready to work with Congress, the sector and federal partners to implement a strategy that supports sustainable cybersecurity protection that recognizes the variability of water systems across the nation."

The Bioterrorism Act of 2002 required utilities to perform vulnerability assessments. The requirements changed nearly three years ago with the passage of America's Water Infrastructure Act (AWIA), which shifted assessments from vulnerability-based to risk and resiliency assessments (RRA), adding cyberattacks to the list of threats that already included natural disasters and physical sabotage.

Those RRAs and the remedy-outlining emergency response plans must be updated, with those self-certified action plans reported to the U.S. Environmental Protection Agency every five years.

While the AWIA was meant to bring about some conformity in cyber defenses, the follow-through on it by utilities is questionable. In the immediate wake of that AWIA mandate, Black & Veatch's survey finds, just 3 percent of respondents reporting having a cyber assessment performed in 2019 — 9 percent did it the following year — either internally or by experts such as Black & Veatch.

Perhaps awakened or alarmed by recent publicized cyber breaches, utilities are picking up the pace — 44 percent completed an assessment in 2021, and one-third say they've done one this year *(Figure 23).*

Perhaps because utility operators are focused on keeping assets running and aren't proficient in cyber defenses, roughly six in 10 respondents reported separately that they've consulted about that topic with outside experts or information security engineers versed in the trends and solutions. Thirty percent say they've gone an extra step, adding such expertise to their full-time staff — a more common occurrence at larger utilities, given their greater ability to afford it.

Affirming the crucial importance of vigilance, two-thirds of respondents cited ongoing monitoring and assessments — actions such as actively reading firewall logs to see who's logging in and out — as their top choice of efforts needed most to mitigate cybersecurity risks. IT modernization was a distant second at 43 percent, followed by internal assessments (33 percent) *(Figure 24).*

Figure 24

Which of the following efforts are needed most for your utility to mitigate cybersecurity risks?
(Select all that apply)

Source: Black & Veatch

66.3%
Ongoing monitoring/ assessments

43.0%
IT modernization

32.6%
Internal assessment

17.4%
External/Supply chain assessment

15.1%
OT modernization

9.3%
Remediation plan

5.8%
Other

8.1%
None of the above

Cyber Hygiene: Trends, Outside Help Offer Solutions

When it comes to the most common attacks, a hacker's modus operandi isn't a secret: inject malware into a computer system by exploiting employee trust or vulnerabilities in the technology.

Enter the need for cyber hygiene — the every-day routine practice of keeping your network safe from the most common cyberattacks.

Experts such as Black & Veatch can help water utilities develop internal cyber hygiene by performing an initial assessment to identify gaps and determine cybersecurity posture, followed up by suggested mitigations. Those steps may include minor procedure changes, cyber awareness training, network architecture redesigns or the development of cybersecurity policies and procedures that guide a utility's cybersecurity program, tailored to each utility's size and unique operating conditions.

To guard against the worst cyberattacks — cyber sabotage with the backing of nation states — Black & Veatch has partnered with Idaho National Labs to offer "Consequence-driven, Cyber-informed Engineering" (CCE).

CCE is an engineering methodology to prevent or mitigate the impacts of cyber-enabled sabotage. As a four-step process, CCE first determines the highest-consequence events for a particular utility, then analyzes the utility's people, processes and technologies before mapping out how a cyber attacker would perpetrate high-consequence events. Non-cyber solutions then would be designed to prevent or mitigate the designated high-consequence events.

For utilities lacking in-house resources to address cybersecurity needs that perhaps weren't a point of emphasis a decade ago as opposed to today, baby steps and collaboration with outside consultants on the topic can make the difference.

The choice is clear: Be proactive now or face the prospect of paying dearly later.

Contaminant Regulation: Lacking Clarity, Proactive Approaches Take Center Stage

When it comes to ridding drinking water of contaminants such as per- or polyfluoroalkyl substances (PFAS) — so-called "forever chemicals" — along with lead that can leach out of pipes and plumbing materials, water utilities face a preeminent challenge: uncertainty in the timing and content of future federal or state rules.

Although the U.S. Environmental Protection Agency (EPA) has proposed several new PFAS regulations and recently published an aggressive strategy — the **PFAS Strategic Roadmap** — to address widespread PFAS contamination, the federal government has not yet been able to promulgate primary drinking water regulations.

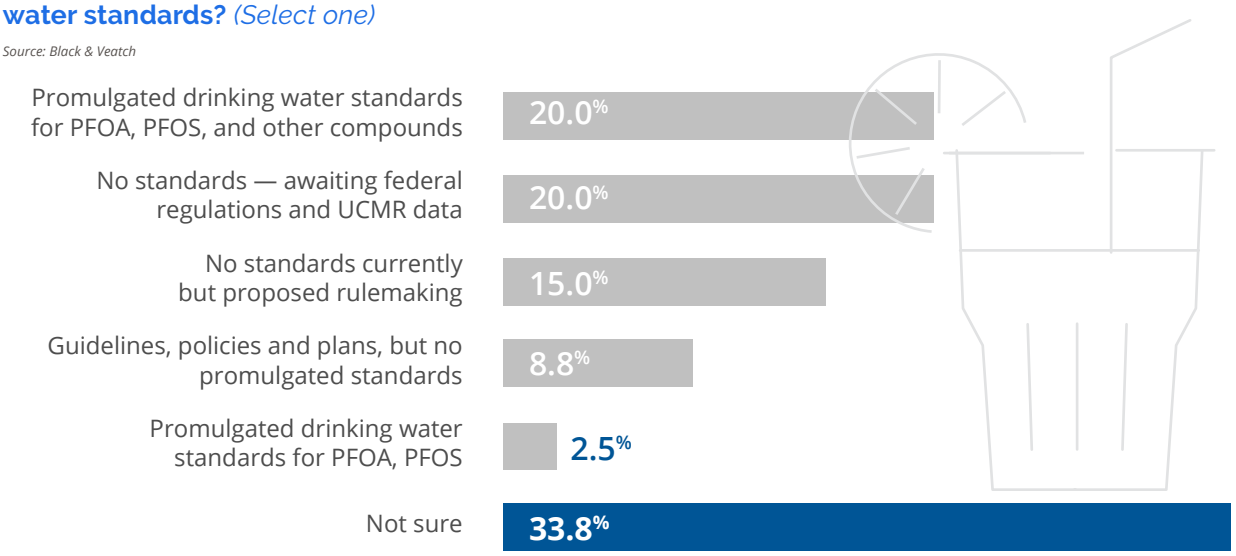
State legislatures, however, are not waiting for federal regulations; more than half already have promulgated drinking water standards below proposed federal limits. Public, media and litigation attention (more than $4 billion in settled cases), as well as new funding for addressing PFAS contamination, also are adding to the pressure municipal water suppliers are feeling to test for and address, if necessary, PFAS in water supplies.

Important changes are looming at both federal and state levels. In December 2021, the EPA published the fifth Unregulated Contaminant Monitoring Rule (UCMR 5), which will require utilities to sample for 29 PFAS contaminants between 2023 and 2025. The results of this study will provide much-needed data on the understanding of the frequency of PFAS in the nation's drinking water, ultimately leading to the development of better regulations. Meanwhile, states are pushing regulatory boundaries

Figure 25

What is the status of your state with respect to PFAS drinking water standards? *(Select one)*

Source: Black & Veatch



through a variety of measures such as regulating groups of PFAS chemicals — using a hazard quotient approach — and by regulating PFAS compounds not considered at this time for regulation by the EPA.

The takeaway: municipal water suppliers proactively are testing for and addressing PFAS contaminants where appropriate, but longer-term courses of action, and the pursuit of funding sources to pay for it, will take time to sort out. Perhaps most importantly, compliance requirements are likely to be controlled at the state level rather than the federal level for years to come.

A Survey's Telling Findings

In a survey of more than 300 water industry sector stakeholders for Black & Veatch's *2022 Water Report*, 34 percent of respondents expressed uncertainty about the status of PFAS drinking water standards in their states.

Twenty percent said they don't have standards but are awaiting guidance from the federal government. With the UCMR 5 on the horizon, these percentages likely should decrease over the next several years *(Figure 25).*

Other than the UCMR 5, there are more positive PFAS changes ahead. The Infrastructure Investment and Jobs Act (IIJA) has committed $10 billion to addressing PFAS contaminants, but even then, uncertainty about that funding remains. When asked if they were eligible to pursue IIJA funding for assistance with PFAS — a potentially huge opportunity for water utilities — 77 percent of the respondents said they lack clarity about their eligibility and await state guidance.

Changing Old Routines

On the other side of the coin, significant changes recently have been made to the Lead and Copper Rule (LCR) for the first time

Figure 26

What are your biggest challenges related to lead/copper rule compliance? *(Select all that apply)*

Source: Black & Veatch

56.7%
Homeowner response to communications

51.7%
Service line inventory mapping

46.7%
Approval to access private property

45.0%
Staffing availability

38.3%
Public education

25.0%
Funding

23.3%
Legal restrictions

20.0%
Data management

in three decades, titled the Lead and Copper Rule Revisions (LCRR). Some of the new revisions include required testing in schools and childcare facilities, development of an inventory for service line materials, creation of a lead trigger level to facilitate more frequent lead service line (LSL) replacement and requiring systems to make the locations of LSLs available to the public.

In terms of challenges tied to complying with the LCRR, nearly six in 10 respondents — 57 percent — cited homeowner response to communications. That topped the list, illustrating the need for utilities to bolster their communications with home ratepayers, who fully or partially own most service lines *(Figure 26).*

This data is surprising, notably in that roughly three-quarters of respondents said they did not have programs in place to assist customers with paying for an LSL replacement. But funding varies on a utility-by-utility basis; some utilities expect the homeowner to pay for their half of the LSL replacement, tamping down the utility's concerns about funding.

When asked who owns the service lines in their territory, 61 percent said such lines are jointly owned by the utility and homeowner, while about one in five — 21 percent — are owned entirely by the homeowner and 18 percent belong completely to the utility.

Contaminants: An Evolving Topic

Regarding contaminants in drinking water, the operative word may be "evolving" — the evolving regulatory landscape, evolving knowledge about chemical compounds and evolving information on how utilities should respond.

But one thing is certain: While progress is being made in the world of drinking water, Black & Veatch — a global leader in critical human infrastructure solutions — stands poised to partner with utilities as they cut through the clutter of the uncertain contaminants landscape and the pursue the opportunities presented by available federal funding.

About the Authors

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