

2018
Black & Veatch
Strategic Directions

SMART CITIES & UTILITIES REPORT



About This Report

The Black & Veatch *2018 Strategic Directions: Smart Cities & Utilities Report* dives deeply into the current landscape of smart city efforts unfolding around the globe. With high-profile, ambitious projects in such cities as Kansas City, Seattle and San Diego, we see the evolution toward smarter infrastructure is possible and that obstacles — no matter how daunting — can be conquered.

This year's report shows that the large majority of respondents still see smart city projects as "transformational," with the ability to improve and redefine quality of life. Our data also show that individual efforts — from "Safe City" initiatives to the greater integration of distributed energy resources and the growing proliferation of electric vehicles — continue to advance. But are these individual efforts one-off projects, or are they part of larger, more integrated plans?

The *2018 Strategic Directions: Smart Cities & Utilities Report* details the obstacles that remain. Budget constraints are still a top hurdle; nearly two-thirds of municipalities point to funding issues as a major barrier to adopting smarter systems. Data collection systems are returning information en masse, but few cities and utilities truly understand how to manage, analyze and secure that data, leaving many feeling overwhelmed. Electric utilities — well-positioned to play a prime role in any in smart city initiative — are sometimes left playing support roles, or no role at all.

We are excited to bring you some new features in this year's report as well, from a guest opinion by Kate Garman, Smart City Coordinator for the city of Seattle, to a contributed article by Proterra, a rising leader in the design and manufacture of zero-emissions electric buses.

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

Sincerely,

JOHN CHEVRETTE | President, Management Consulting

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John Chevrette, President of Black & Veatch management consulting, 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 clients around the world in the electric utility, energy technology, gas pipeline, telecommunications and water industries.

Executive Summary

DATA AND PARTNERSHIPS SERVE AS THE FOUNDATION FOR TOMORROW'S SMARTER CITIES

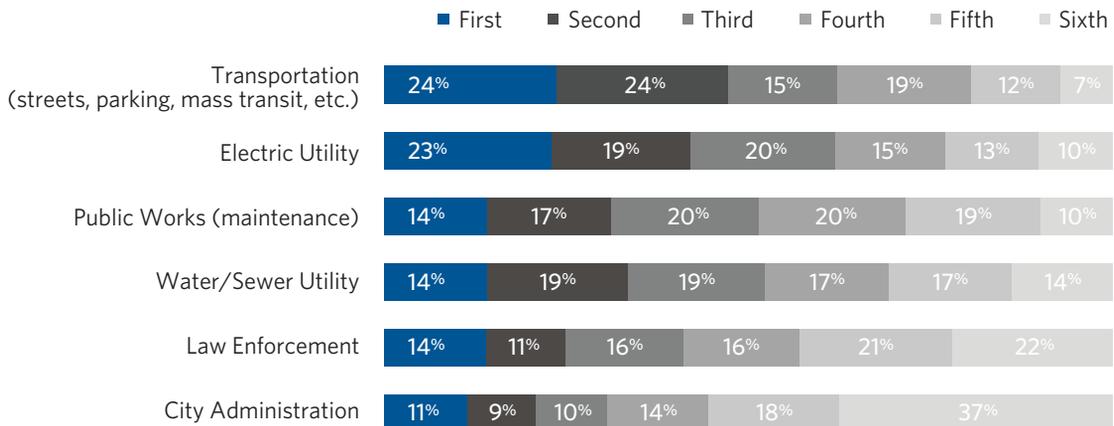
By [John Chevrette](#)

The insights uncovered in Black & Veatch's *2018 Strategic Directions: Smart Cities & Utilities Report* demonstrate a growing awareness among communities and utilities that modern, digital infrastructure such as data collection networks, infrastructure automation and advanced communication systems are the key components of today's smart city initiatives. It is only through these systems that cities and utilities can optimize operations to realize the promise of the smart city - and create a sustainable future.

This year's report explores the many specific aspects involved in planning and preparing for smart city efforts. We introduce a "Smart City To-Do List," which breaks an often-complicated, convoluted process into digestible tasks. We analyze the growing awareness of how smart cities can enable safer cities and, in an era of high-profile network intrusions, how utilities are working to ensure both physical security and cybersecurity.

FIGURE 1

Please rank the following city agencies in terms of which benefit MOST from a “smart city” initiative.



Source: Black & Veatch

The report also includes a series of articles that paint a comprehensive picture of today’s changing transportation landscape — one being shaped by increasing electrification and a growing acceptance of new technology such as autonomous vehicles. According to survey respondents, transportation agencies stand to gain the most from smart city initiatives, with electric utilities following a close second (Figure 1).

Electric utilities have a large stake in the game. As grid modernization efforts continue in an attempt to maintain, upgrade and improve aging infrastructure, utilities work to balance reliability and the increasing integration of distributed energy resources into the grid.

From new challenges — such as increasing load demands from electric vehicle (EV) charging stations — to hard fought battles that include ensuring safe, secure connections, utilities are working to stay on top of a rapidly evolving world.

Other key areas covered in this year's report include:

Build-Out of EV Network Infrastructure

This past year marked a turning point for the future of EVs, with sales rising and a number of automakers such as Volkswagen AG and Volvo announcing significant electrification plans. The environmental benefits of EVs are undeniable, and steadily improving technology and increasing affordability are encouraging Americans to buy electric. But what does this move away from the internal combustion engine mean for the future of energy management?

Autonomous Vehicles and Urban Mobility

Quickly moving past test and pilot phases, autonomous vehicles (AVs) are hitting the streets, promising benefits in reduced emissions and streamlined public transportation. But where do self-driving cars, most of which are electric, fit into the smart city puzzle? While half of municipalities and smart service providers believe that AVs will have a transformational impact on cities around the world, urban planners still are unsure how these projects will scale over time.

Electrifying Mass Transit

A movement is under way in mass transit: transportation providers increasingly are looking to electrify their buses. That shift is gaining momentum as zero-emissions technologies mature and concerns about climate change rise, fanning the desire to move people in more efficient ways. Even with federal taxpayer support, transit providers and other stakeholders need to engage now.

Smarter, Safer Cities

Communities are becoming more intelligent and connected, opening the door for integration with increasingly advanced public safety solutions. When people think of smart cities, they typically envision Wi-Fi kiosks and smart streetlights, not public safety technology like gunshot detection and facial recognition programs. Although admittedly in their infancy, Safe City pilots are gaining traction, and agencies are beginning to evaluate how these public safety investments fit into a larger smart city plan.

Outsourcing Distribution Modernization

The emergence of DER and the technologies collectively referred to as "smart grid" continue to upend traditional electric utility business models. Although today's utilities have access to a proverbial avalanche of system intelligence, few are comfortable managing that data or using it effectively; because of this, many utilities are enlisting outside assistance.

Investing in Distribution Modernization

More and more utilities are looking into comprehensive distribution modernization programs to increase resilience. Managing these efforts can be incredibly complicated, and survey results reflect an industry still figuring out how technology and networks will work together to modernize the grid. These large-scale changes are often driven by policy, with many local regulators pushing statewide efforts as they work to achieve environmental, cost-savings and fuel diversity goals.

With planning, support and understanding, combined with a hefty dose of vision and collaboration, cities and utilities can achieve their smart city initiatives and ensure a more resilient, sustainable future for us all.

Industrial Internet of Things

In constant pursuit of quality control, efficiency and supply-chain improvements, the Industrial Internet of Things (IIoT) is becoming increasingly attractive to the industrial and manufacturing sector. But even as sensors get cheaper and Big Data grows ever more ubiquitous, complexities emerge with the expanding scale. Businesses risk drowning in a sea of data, making it imperative that they develop and implement a strategy that will allow them to harness the data's value.

Physical Security and Cybersecurity

With the intent of safeguarding the nation's biggest electric grids from potential mayhem from sophisticated hackers, federal regulators have stepped up oversight of power utilities' security efforts. But threats linger, especially as information technology (IT) and operational technology (OT) systems converge. Although this integration promotes efficiencies, hackers may gain access via an IT route and use it to breach sensitive OT infrastructure.

Ongoing Grid Modernization

Historically, attention to the grid's distribution system focused on pole and wire maintenance and upkeep, but increasing connectivity and a

growing embrace of renewable energy are forcing a more holistic approach. Whether by regulatory mandate or stakeholder pressure, system upgrades are being made worldwide as security and distribution automation drive modernization efforts.

The Smart City To-Do List

Planning for a smarter city can be an imposing concept. From financing and partner ecosystems to advocacy and data governance, there is a lot to consider. But like any other complicated process, it can be managed by breaking it down into manageable tasks, effectively turning your smart city strategy into a logical progression through a series of steps that progressively build smart city capabilities and community benefits.

Conclusion

Moving smart city initiatives to the next level will not be easy, but cities and utilities appear to have a better grasp on building momentum as they work to engage stakeholders and educate an uncertain public. With planning, support and understanding, combined with a hefty dose of vision and collaboration, cities and utilities can achieve their smart city initiatives and ensure a more resilient, sustainable future for us all.

Jennifer James is the Smart City Solutions Lead for Atonix Digital, a Black & Veatch subsidiary that provides innovative analytics solutions to clients managing power, water and communications resources. James works with internal domain experts, clients and industry partners to advance smart infrastructure and analytics solutions.

Steph Stoppenhagen is the Smart Cities Business Development Director for Black & Veatch's Connected Communities business. She is widely recognized as a technology solutions expert, strategizing with clients to deliver value from smart infrastructure, networks and data.

Building Smart Cities

CHECK THE BOXES: YOUR SMART CITY TO-DO LIST

By Jennifer James and Steph Stoppenhagen

Building a smart city is easy to envision, but it can be challenging to implement. From questions about financing and stakeholder engagement to technology advocacy and information technology (IT) governance, there is a lot to consider after you've made the decision to enable data to make your community more livable, sustainable and connected. After the overarching vision and strategy are set, making smart cities real often starts by implementing a series of smaller changes that contribute to the overall transformation.

The path to the smart city is replete with obstacles: tight budgets, unaligned priorities, and a skeptical public. But from San Diego to San Antonio, examples of groundbreaking smart city initiatives are demonstrating how leadership, vision, collaboration and the engagement of a local champion can overcome doubts.

To help more cities move forward with their smart city visions, we've identified a set of common hallmarks of successful smart city plans. Each provides a specific action or milestone towards methodical and meaningful change.

- **Designate a Smart City Champion:** Many smart city initiatives have appointed executives charged with assessing the technology landscape and uniting stakeholders to implement projects. With titles such as “Chief Sustainability Officer” or “Chief Innovation Officer,” these leaders are a city’s high beams, scanning the landscape for ways their communities can take advantage of data and other technology to improve livability. They are the smart city initiative’s best advocate and work to build relationships, explore advantageous financing and engage citizens.
- **Think Big, Start Small:** Forward-looking smart city planners are big thinkers by nature, anticipating the interconnections between power, water and telecommunications, and considering programmatic approaches to improving their communities. While long-term blueprints are foundational to smart city successes, it’s important to consider the pragmatic, easy wins that can create momentum and enthusiasm among stakeholders. Less complex but high return-on-investment projects, such as smart streetlights or digital kiosks, create proof-of-concept successes that help coax support for deeper infrastructure improvements.
- **Form Strong Partnerships:** Much of the perceived complexity accompanying smart city plans relates to the large number of diverse stakeholder groups with different needs and priorities. Proactive cities are

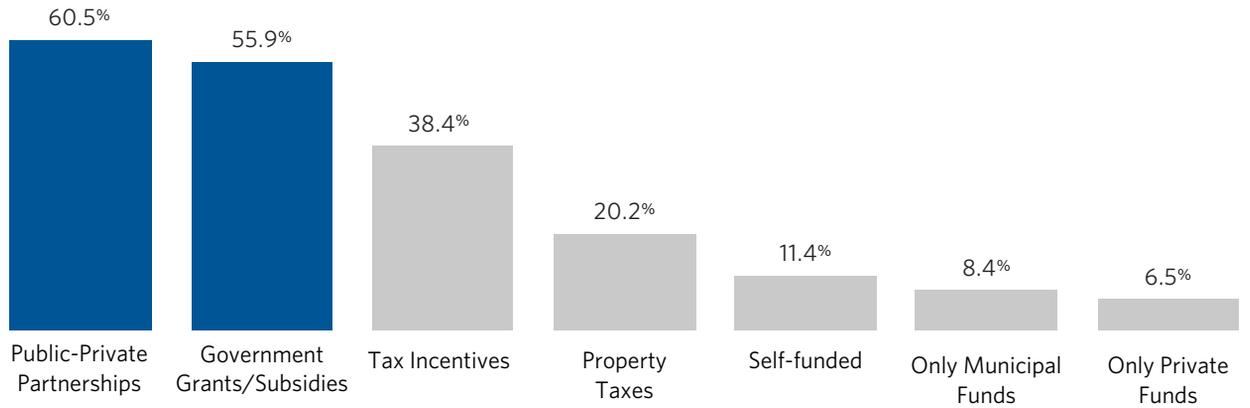
embracing this challenge as an opportunity for better engagement and alignment around a common vision.

The city of San Diego, for example, has formed partnerships with industry leaders, trade associations and educational institutions and, as one media outlet stated, is “rewriting the city’s DNA.” Smart city partners include San Diego Gas & Electric, General Electric, the University of California-San Diego, and trade association Cleantech San Diego. This level of collaboration across key stakeholder groups represents best practice and the model for other cities to follow.

Non-traditional partnerships can overcome historical problems. In Arizona, for example, the Arizona Commerce Authority, Deloitte and Black & Veatch are leading an initiative to employ technology-enabled infrastructure and streamlined processes, such as traffic optimization, to minimize the delays that slow commerce at the border. An estimated \$1.4 billion of commerce and 1 million people cross the U.S.-Mexico border each day, creating enormous economic development potential that will directly benefit from world-class border-region improvements. Other enhancements include boosting advanced educational opportunities and expanding broadband access for otherwise underserved communities on both sides of the border.

FIGURE 2

What would be (or is) the most effective financing model for “smart city” initiatives? (Select all that apply.)



Source: Black & Veatch

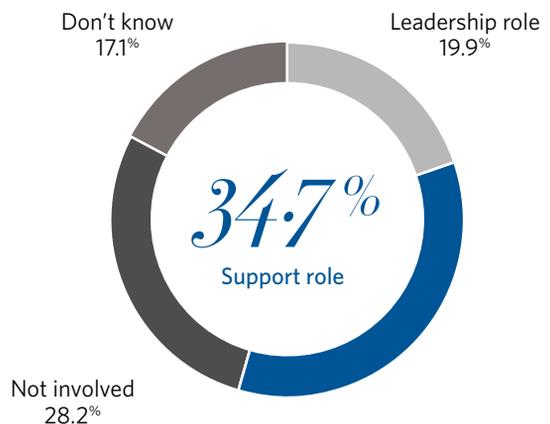
Explore All Financing Options: Perceptions that smart city initiatives — which may or may not align with traditional bond financing — are unaffordable continue to concern municipal planners. Responses to Black & Veatch’s *2018 Strategic Directions: Smart Cities & Utilities Report* suggest that public-private partnerships are an important tool for getting past the sticker shock of upfront costs (Figure 2). Since smart city initiatives are leading edge concepts, financing these initiatives also requires innovation. One example is revenue-generating smart digital kiosks, LED street lighting with controls, renewable energy installations and other improvements that can sharply reduce a city’s initial investment and/or ongoing operational costs.

Engage Utilities and Leadership: Energy innovation is at the heart of the smart city. Utilities are modernizing their grids, empowering customers and integrating new market participants, business models and technologies. That innovation begs the question: Why aren’t more utilities leading smart city projects? Responses to the Black & Veatch survey suggest that a significant number of smart city initiatives are not actively engaging their electric utility in leadership roles, or at all (Figure 3).

Utilities can facilitate connected cities by leveraging their grid technologies. In San Antonio, CPS Energy is a front-runner in this way: Through advanced metering infrastructure and other grid-modernization initiatives, CPS is connecting customers to energy efficiency technologies for greater control and savings. It also is embracing the distributed energy future by finding ways to integrate solar, electric vehicles and energy storage into a more flexible, responsive grid.

FIGURE 3

What role is your utility playing in your municipality’s “smart city” initiatives? (Select one choice.)



Source: Black & Veatch

□ **Weave Initiatives into the Social Fabric:**

A key challenge for smart city programs is leveraging technology to better enable people from all walks of life, empower them with what they find meaningful and include their inputs as part of the solution. This is starting to manifest in interactive streetscapes, digital kiosks that provide free Wi-Fi in low-to-moderate income communities, intuitive city apps that enable citizens to report issues and track progress, and community centers that bring people together through a smart intermingling of art, culture and technology.

□ **Promote Smart Multitasking:** Cities are using existing assets in new ways and sponsoring new levels of engagement. For instance, smart streetlights are much more than just streetlights. Cities are receiving up to 75-percent energy savings from retrofitting streetlights with LED bulbs, automated lighting and dimming capabilities, but they hold larger promise. Streetlights are becoming connected, multi-purpose city assets that contain digital signage, video cameras, internet connectivity, electric vehicle charging stations and smart sensors to help with everything from gunshot detection to air quality and traffic monitoring.

□ **Data Governance:** Data underpin the smart city and move across our systems in staggering amounts. For instance, a single autonomous vehicle has the potential to create more than 2 terabytes of data each day — roughly equivalent to two, Netflix-obsessed families' monthly data consumption. Multiplied across the sector, it is easy to see how huge investments in communications technology are critical. That much data will raise questions about who's managing that information, where it's stored,

how it's accessed and how cities are securing it. Cybersecurity is a crucial pressure point, and a smooth implementation of data-intensive upgrades will require cities and organizations to reconsider their approach to IT and operational technology issues and place new focus on data science and cybersecurity.

EVOLVE THE APPROACH

The top-down, government-led approach to sustainable cities is giving way to diverse partnerships, innovative financing and increased citizen engagement. As this shift happens, the smart city to-do list is a set of tasks that's bigger than any one leader can handle.

Fulfilling the smart city vision will demand teamwork across sectors, solution providers, citizen groups, technology companies and consultants, academic institutions, industry groups and financiers. The challenges that smart cities seek to solve are too complex to be left to a few players and too interdependent to be addressed in a piecemeal way.

The challenges that smart cities seek to solve are too complex to be left to a few players and too interdependent to be addressed in a piecemeal way.

Driving Electric Vehicles Forward

ELECTRIFICATION ON THE RISE: CAN ELECTRIC VEHICLE CHARGING NETWORKS KEEP UP?

By [Maryline Daviaud Lewett](#)

Maryline Daviaud Lewett is Director of Business Development for Black & Veatch's Transformative Technologies business. She is responsible for sales and partnerships in distributed infrastructure, sustainable and CleanTech transportation, and engineering, procurement and construction services of electric vehicle charging infrastructure networks, fuel cell vehicle filling infrastructure networks, and behind-the-meter energy storage.

Last year marked a monumental turning point for the future of electric vehicles (EVs), with several auto companies such as Volkswagen AG, General Motors and Volvo announcing significant electrification plans. Bolstered by improved battery technology, longer battery range, greater variety and lower prices, consumer confidence in EVs is at an all-time high. According to Forbes, light-duty EV sales in the United States rose 37 percent in 2016.

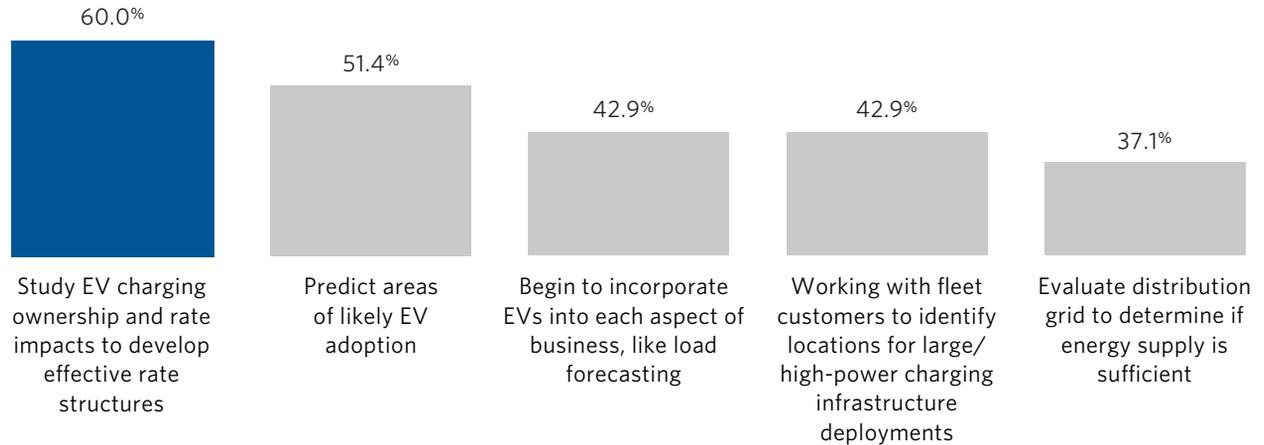
Utilities need to start thinking now about how they are going to scale up power infrastructure to meet the increased demand for commercial and personal vehicles. Although the benefits of electrification are undeniable, the move away from internal combustion engines is raising questions about energy management and grid stability.

ENERGY MANAGEMENT IS COMPLEX BUT NOT IMPOSSIBLE

Energy management is a complex issue that becomes even more complicated as EV adoption increases and charging infrastructure multiplies. High-powered charging infrastructure delivers up to 350 kilowatts (kW) per direct current charger, or seven times today's most common charging capacity (50 kW). Unmanaged growth could directly impact electric transformers in areas of high residential adoption. In addition, increased charging has the potential to alter an electric utility's overall load profile and stretch utility resources for grid planning, capital investment and operations.

FIGURE 4

To prepare for increased EV adoption and charging requirements, which activities do utilities consider MOST important? (Select up to three choices.)



Source: Black & Veatch

However, managed EV adoption and charging can help utilities and other stakeholders unlock significant new market revenue potential. Taking a structured approach to energy management can help utilities serve more load and increase revenue, balance grid demand and supply, and integrate renewable energy from wind and solar resources. It also helps utilities provide grid services in wholesale electricity markets and spur new grid and charging infrastructure, providing additional revenue.

PREPARING AND PLANNING FOR INCREASED EV ADOPTION

Utilities know that planning and preparation will be crucial to maintaining a reliable supply of electricity. According to this year's survey, 60 percent of utilities consider activities that would enable them to develop effective rate structures — such as studying EV charging ownership, behavior and rate impacts — to be the most important activity in preparing for increased EV adoption (Figure 4).

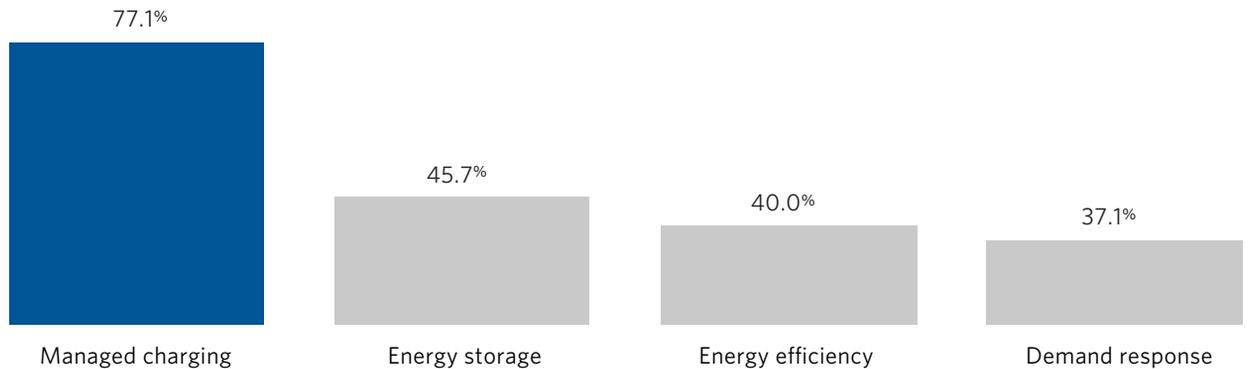
Standard utility rates can hamper EV growth, because fluctuations in demand allow rates to escalate throughout the day. For example, the midday surge sends rates skyward, making it expensive to charge vehicles midday, which dissuades fleet expansion and hampers growth. Allowing utilities to change their rate structure to parallel evolving technologies and fluctuating demand profiles will have a direct impact on shaping behavior and charging patterns and will help prepare the grid for widespread charging.

Predicting areas of likely adoption ranked second in importance (51 percent of respondents), reflecting a strong need for utilities to anticipate the number of EV adopters, the timing of charging sessions and the planning of charging hub locations.

The three remaining activities survey respondents ranked for importance — begin to incorporate EVs into each aspect of business (43 percent), work with stakeholders to identify locations for large and/or high-power charging infrastructure deployments (43 percent) and evaluate distribution grid to determine energy supply (37 percent) — all are imperative to the grid modernization effort.

FIGURE 5

Which grid management approaches will you most likely adopt to balance increased demand/loads related to EV charging? (Select all that apply.)



Source: Black & Veatch

LOOKING TOWARD A MANAGED CHARGING APPROACH

With increased adoption, EV charging will contribute greatly to the electric utility load. To help control energy distribution at the charging hub, more than three-quarters of utilities said that they will adopt a managed charging approach (Figure 5).

Managed charging — also called V1G, or intelligent or smart charging — relies on communication signals sent by the utility through the charging hub that allow the utility to remotely control charging levels by turning charging up, down or even preventing it altogether, if a high-load event is occurring on the grid.

Utilities can use this control to turn charging hubs into a flexible load source to gain capacity, for emergency load reduction, reserves or regulation, or to absorb excess energy from renewable energy resources such as solar and wind.

THE FUTURE OF WIDESPREAD ELECTRIFICATION

Stakeholders — including utilities, automakers, service providers, infrastructure builders and policymakers — will have to collaborate to develop new energy solutions to support EV adoption and charging. Although efforts will be far-ranging, it will be up to utilities to drive the infrastructure upgrades and managed approaches necessary to make widespread electrification a reality. As EV adoption rates continue to grow and high-power capacity is needed, the timing of this matter is none too soon.

That said, the EV market is full of potential, and through careful preparation and planning, utilities and other stakeholders can unlock significant new market revenue while helping shape the future of sustainable energy and clean transportation.



CASE STUDY - VOLTA EV CHARGING NETWORK

San Francisco-based Volta Charging, an industry-leading provider of EV charging, has been working to significantly expand its network of free public charging stations across the U.S. But rapid growth isn't easy, and Volta executives realized they needed help with engineering, design and permitting to reach their goals.

Black & Veatch delivers the pre-construction, design, engineering and permitting services Volta needs to bring many of its charging stations to life as quickly as possible. The work requires obtaining dozens of local government permits, meeting the needs of businesses where stations are located, and considering variable construction requirements at every physical location.

In some cases, Black & Veatch completed engineering and obtained permits that allowed Volta to bring units online in about a month.

Having nearly doubled its number of charging stations in 2017, Volta plans to continue expanding its network at a rapid rate in 2018. This includes launching at least two additional markets as Volta expands from the West and Midwest into key east coast markets including New York and Washington, D.C.

- In 2017, Volta charging stations provided 7.91 million free electric miles, displacing 174,000 gallons of gas.
- A 2017 Bloomberg New Energy Finance study estimates that EVs will account for 54 percent of all new light-duty vehicle sales globally by 2040, revised up from the 35 percent share previously forecast.
- Black & Veatch's vehicle-charging infrastructure portfolio includes more than 163 MW of capacity in North America.

Black & Veatch works alongside startups at a rapid pace, staging mass deployments over short periods of time. Our ability to engineer, implement and deploy networks of any complexity on a broad scale enables our clients to focus on growing their business. Volta is among a growing list of industry leaders leveraging Black & Veatch's ability to execute seamlessly on large-scale, geographically dispersed projects.

Paul Stith is Director of Strategy & Innovation for Black & Veatch's Transformative Technologies business. He specializes in sustainable transportation and distributed clean energy solutions. He works with vehicle OEMs, utilities, transit agencies, cities and emerging transportation service providers to plan and build infrastructure for electrification and automation of light, medium and heavy-duty vehicle fleets.

Driving Electric Vehicles Forward

ELECTRIFIED FLEET VEHICLES AND MASS TRANSIT GAINING MOMENTUM

By Paul Stith

Transportation accounts for more than one-quarter of the nation's greenhouse gas emissions, according to the U.S. Environmental Protection Agency. In a country with more than 70,000 transit vehicles — and with buses averaging roughly 34,000 miles of travel each year — electrification of the U.S. fleet and mass transportation spheres is becoming a top priority for city officials and utilities as they reimagine how people and goods move sustainably across urban landscapes. Removing fossil fuels from mass transit will go far in reducing that carbon footprint.

As battery and vehicle technologies advance the solution of efficient, environment-friendly transportation, the preference for electric vehicles — from passenger cars to metro buses and enterprise fleets — is the latest sign that electrified mass transit is growing. For example, orders already are mounting for Tesla's electric-powered semi-truck that can haul 80,000 pounds roughly 500 miles — at 20 percent less than the cost for diesel.

For transit providers and the communities they serve, what resembles exponential growth in adoption presents new challenges, requiring them to proactively and creatively engage now.

For transit providers and the communities they serve, what resembles exponential growth in adoption presents new challenges, requiring them to proactively and creatively engage now. Such a transition — from acquiring the buses to upgrading the distribution grid and charging infrastructure, along with developing financing models to pay for it all — doesn't happen overnight.

Roughly 5,000 public transit buses are purchased each year in the U.S. With more than 60 agencies demonstrating or deploying electric buses — 850 already are on order, with active requests for proposals for hundreds more — the number of fossil-fueled vehicles is about to shrink dramatically.

Given the technological strides of recent years in battery storage and electric drive, a community or transit provider that once passively viewed electric buses as novelties is now considering how they can move people in cleaner, greener ways as these options increasingly become the obvious choice. Dozens of additional agencies each year are putting electric buses into play, either by testing the waters or jumping straight to large deployments of vehicles that already are proven in the most demanding duty cycles.

Many agencies are committing to completely electric fleets. Earlier this decade, Los Angeles County's transit authority, the nation's second-largest, retired the last of its fleet's diesel buses and turned fully to alternative fuels, including cleaner-burning compressed natural gas (CNG), to cut air pollution in one of the country's smoggiest regions. The region's governing transportation authority recently agreed to invest more than \$138 million for 95 electric buses — the first step toward replacing its entire CNG fleet and eliminating emissions from its more than 2,300 buses by 2030. China has led the way in output of electric buses, having sold 115,700 of them in 2016 and 94,260 the year before that. In 2013, Chinese manufacturers sold just 1,672.

The U.S. government is doing its part to support the drive to zero-emissions transit. Each year, the competitive "No/Low-Emission" grants provide tens of millions in funding for vehicles and supporting infrastructure. In September 2017, \$55 million in federal awards were announced for four dozen projects to replace aging internal-combustion buses with efficient, cleaner transportation. Those funds help transit providers launch or accelerate their vehicle and infrastructure programs even in the face of budget constraints or competing interests.

Market growth in zero-emissions technologies is fueled by growing public awareness of new options that include electric- and hydrogen-powered buses, which provide cleaner air, a better experience for passengers and drivers alike, and increasingly support the imperative to cut greenhouse gas emissions. Federal and numerous state-backed programs acknowledge that electrification is primed to move beyond the combustion vehicles that contribute heavily to transportation pollution in cities.

Key to the equation, electric buses have lower maintenance costs than their diesel or hybrid counterparts. Much of this is due to the benefits of electric drive’s regenerative braking that virtually eliminates replacing brakes and electric motors that don’t require costly rebuilds of their diesel counterparts. Not so long ago electric buses that were priced at about \$1 million apiece have declined to around \$750,000, with upfront cost parity just a few years away through economies of scale as demand and production volume increases.

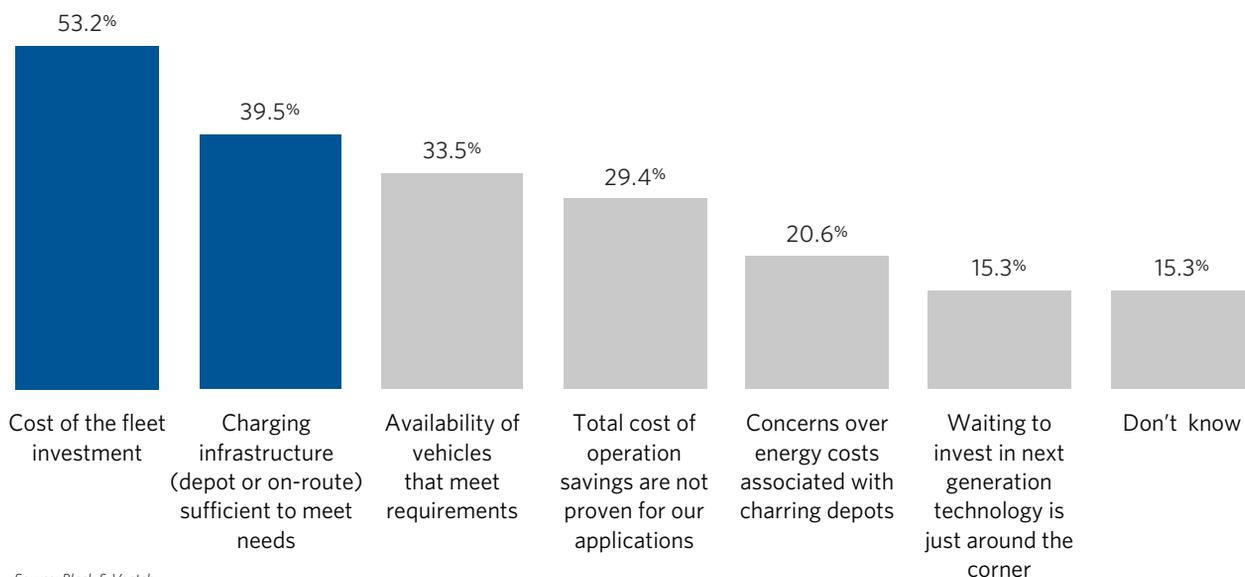
Still, cost considerations weigh on broader growth in the electric busing sector. More than half of survey respondents in the *2018 Strategic Directions: Smart Cities & Utilities Report* listed the investment price as the biggest obstacle to adopting an electric fleet. Four in 10 respondents cited the sufficiency of a charging infrastructure, while one-third pointed to concerns about the availability of vehicles that meet requirements as an obstacle to electrifying a fleet (Figure 6).

When asked what is most important when considering electric fleets, 51 percent of respondents cited the total cost of operation and the return on investment from similar fleet applications, followed closely (48 percent) by the charging infrastructure needed.

Electrified transit has broad applications well beyond metro busing. Shuttles at everything from airports to national and amusement parks and other tourist sites are poised for greater acceptance. Over-the-road coaches that can run 300 miles between charges are on the horizon.

FIGURE 6

What are the barriers to adopting an electric fleet? (Select up to three choices.)



Source: Black & Veatch



Electric-powered school buses are picking up the pace, with a Daimler subsidiary, Blue Bird, and other manufacturers planning rollouts of new or enhanced all-electric models in 2018 or the following year.

Trucking isn't being left out of the mix. Daimler is marketing its emissions-less eCanter, an all-electric, light-duty box truck designed, at least for now, just for around-town traffic, given battery limitations. In November, Tesla announced plans to hit the market in 2019 with an electrified, futuristic-looking truck tractor that can get 500 miles on each charge, even with an 80,000-pound payload. Tesla hasn't yet revealed the sticker price.

Electrified mass transit has significant charging demands, and cities must determine how to scale charging infrastructure and manage increased electric loads. Enabling a robust EV charging

infrastructure for vehicles requires industry, municipal and utility partnerships.

Public transit agencies and utilities must develop infrastructure roadmaps to guide pilot studies and mass deployment for on-route and depot charging scenarios. The battery charging demands of large buses — and fleets of those buses — will create substantial loads for the grid that could necessitate distribution grid upgrades.

These capital-intensive upgrades require careful coordination with the host utility and have long lead times for engineering, permitting and construction. Utilities and cities should begin preparations now to design, finance and manage this new infrastructure.

Paul Stith is Director of Strategy & Innovation for Black & Veatch's Transformative Technologies business. He specializes in sustainable transportation and distributed clean energy solutions. He works with vehicle OEMs, utilities, transit agencies, cities and emerging transportation service providers to plan and build infrastructure for electrification and automation of light, medium and heavy-duty vehicle fleets.

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Driving Electric Vehicles Forward

AUTONOMOUS CARS POISED TO TRANSFORM, CONNECT SMART COMMUNITIES

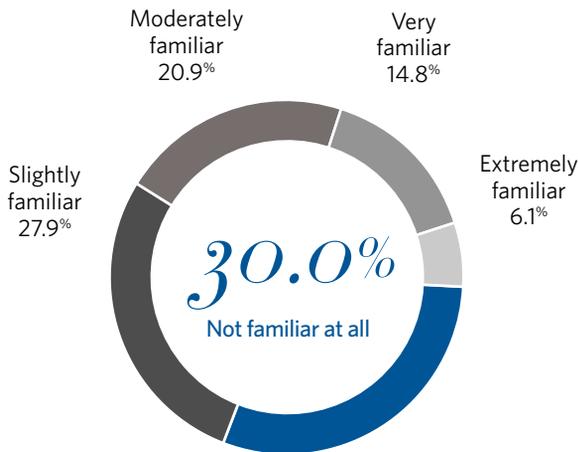
By Paul Stith and Jennifer James

A future where driverless cars are roaming city streets may be closer than you think. Quickly moving past test and pilot phases, autonomous vehicles are now hitting the road in business parks and on limited fixed routes, bringing the promise of increased safety, reduced emissions and the potential for streamlined public transportation.

Many hurdles must be overcome before this new mode of transport can deliver real efficiencies in the movement of people and goods, and like other smart city initiatives, must be fully integrated with other city systems. Self-driving cars, most of which are EVs, also will require charging infrastructure and coordination with utilities.

FIGURE 7

How familiar is your organization with autonomous vehicles? (Select one option.)



Source: Black & Veatch

Findings from the *2018 Strategic Directions: Smart Cities & Utilities Report* survey reveal that while half of municipalities and smart service providers believe that autonomous vehicles will have a transformational impact on cities around the world, they still are widely unsure of how these projects will scale. In fact, 30 percent of survey respondents indicated that they are not yet familiar with autonomous vehicles (Figure 7).

This could mean that despite the buzz around this new transportation option, many city officials and constituents alike are unsure about the requirements needed to reap the benefits of this burgeoning technology.

EARLY DRIVERLESS APPLICATIONS

There are several applications in which autonomous vehicles can be deployed. Some of the initial uses being tested include:

Self-Driving, On-Demand Ride Services:

Popular ride-hailing services such as Uber and Lyft already are incorporating autonomous vehicles into their fleets in select cities such as Boston and Pittsburgh. This service is poised to expand with Uber's recent order of 24,000 autonomous vehicles from Volvo and Lyft's partnership with self-driving technology leader, Waymo. Lyft co-founder John Zimmer has even predicted that most of its fleet would be self-driving within five years. Meanwhile, General Motors' \$500 million investment in Cruise Automation and dozens of other technology partnerships and investments around the world convey that this application may be the most competitive area to watch.



Streamlined Public Transit: Autonomous buses and trains that utilize remote sensors and automation could augment or replace current transit systems for safer and more efficient operations. Autonomous public transit systems can help take more personal vehicles off the road, and reduce emissions and traffic accidents.

Expanded First Mile/Last Mile Options: Shared, autonomous shuttles may offer a convenient, efficient and cost-effective way to transport people between public transit stops and their ultimate destinations. Solving this vexing first mile/last mile challenge would increase public transit usage, reduce traffic congestion and emissions, and alleviate the need for additional transit station parking.

Increased Transportation Access for Senior Citizens: According to the Insurance Institute for Highway Safety, nearly 16 million citizens who are 65 or older live in communities where public transportation is poor or nonexistent. For those typically using taxi services on a regular basis, autonomous vehicles could provide more economical and reliable mobility services for an aging population.

Increased Transportation for Disabled Individuals: A report titled “Self-Driving Cars: The Impact on People with Disabilities,” conducted by the Ruderman Family Foundation and Securing America’s Future Energy (SAFE), found that increased use of driverless vehicles could save up to \$19 billion annually in healthcare costs. Public transportation options cannot always accommodate disabled riders, and dedicated para-transit systems can be costly.

Optimized Movement of Goods: The impact of autonomous vehicles on the long-haul shipment of goods also is making headlines. Tesla recently unveiled its electric semi-truck with autonomous features and DHL has announced plans to start testing autonomous delivery vehicles this year. Regardless of the application, deploying autonomous vehicles en masse will require end-to-end planning. Collaboration with public transportation agencies, utilities and regulatory bodies will be critical.

When it comes to the true logistics behind deploying these programs, state and federal policies will dictate what each city and community can put on the road.

STATE POLICIES ENABLE BUT ALSO CREATE BARRIERS FOR AVs

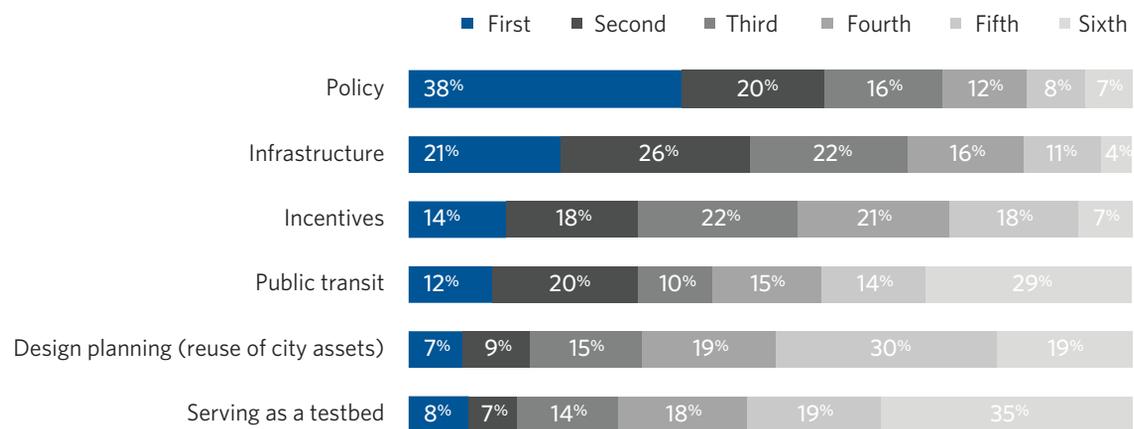
When it comes to the true logistics behind deploying these programs, state and federal policies will dictate what each city and community can put on the road. State and federal politics were a huge factor in the early boom in renewable energy five to seven years ago. Municipalities are aware of this, with 38 percent responding that policy was the most influential factor in pursuing autonomous vehicle initiatives (Figure 8).

Policies also are directly linked to funding, and year after year budget constraints are cited as the top hurdle in the Black & Veatch survey to implementing smart city initiatives. To help garner funding, states are publicizing their intent to welcome technology vendors looking for driverless car test sites. Arizona, California and Michigan are among states partnering with automakers, vying to be the first to successfully roll out an autonomous vehicle program. These high-visibility test programs can sometimes attract additional funding through federal grants and private investments.

In winning the U.S. Department of Transportation’s Smart City Challenge, Columbus, Ohio, received \$40 million to advance their smart city initiatives. The city also received an additional \$10 million from Vulcan Inc., specifically dedicated to electric vehicle charging infrastructure. Following Vulcan’s lead, other private-sector companies also seeing the potential long-term economic growth impacts of such initiatives have helped expand the pool of funds to nearly \$500 million.

FIGURE 8

Rank the following factors that will influence your organization’s pursuit of autonomous vehicle initiatives.



Source: Black & Veatch

ENHANCED SAFETY

According to a recent study by RAND Corp., more than 90 percent of car accidents are caused by human error. The RAND study found that introducing autonomous vehicles sooner, rather than later when the technology is more proven, could already start reducing accident-related fatalities. Researchers found that “introducing autonomous vehicles when they are just better than human drivers — as opposed to nearly perfect — could save hundreds of thousands of lives over 30 years.”

While reducing car accidents is one of the leading catalysts for implementing programs, policymakers at the state and federal levels remain uncertain about how safe it is to operate autonomous vehicles.

DRIVERLESS PROGRAM LEADERS

Deploying autonomous vehicles within a community could look different depending on chosen applications, citizens’ needs and available or developing infrastructure. Some states are leading the charge, and how they plan, test and begin implementation should be closely watched to capture early lessons.

In Michigan, driverless cars are being tested at Mcity, a 32-acre portion of the University of Michigan where “industry, government, and academia come together to improve transportation safety, sustainability, and accessibility for the benefit of society.” Gov. Rick Snyder enacted a number of regulations in December 2016 that accommodate testing, use and sales of driverless cars at sites like Mcity. These laws have propelled the state to be one of the most welcoming for testing self-driving vehicles.

A new service on the Mcity campus transports students, faculty and staff in two fully automated, 15 passenger, all-electric shuttles manufactured by the French company NAVYA. The shuttles operate on a nonstop two-mile route between the Lurie Engineering Center and the university’s North Campus Research Complex. The service will augment the current campus bus system and will test mapping technology, driving accuracy and citizen interactions.

In Arizona, Waymo, Uber, General Motors, Ford and Intel all are testing autonomous technology, and Gov. Doug Ducey has been attracting these companies with favorable policies as part of the state’s economic development strategy. In California, the City of Chula Vista is committed to opening all of its streets as an autonomous vehicle proving ground.

An aggressive crackdown on vehicles that emit toxic fumes is driving EV deployment on a large scale in London. In an effort to improve air quality and public safety, drivers of older, polluting vehicles now have to pay a daily “T-charge” to drive in central London. Mayor Sadiq Khan has been a strong proponent of lowering emissions and is preparing to launch an “ultra-low emissions zone” by April 2019.

London cab company Addison Lee is leading a government-backed effort into driverless car research, with partners such as Ford, to explore the potential for unmanned vehicles and ride-sharing services. Use of autonomous vehicles could considerably reduce traffic in the densely populated city, further reducing air pollution.

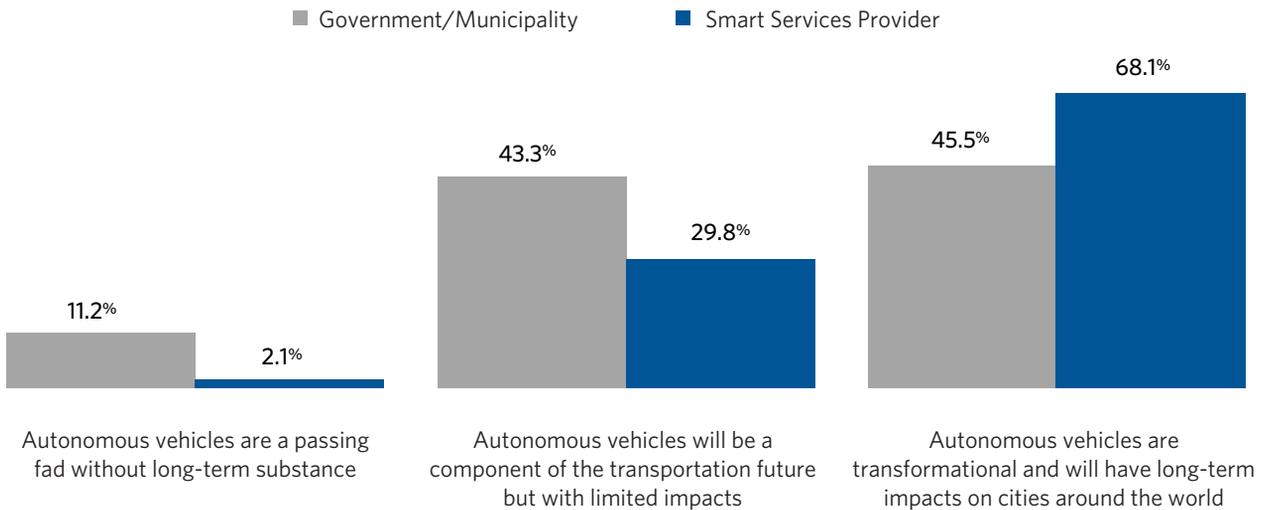
IS THE DRIVERLESS FUTURE NIGH?

So what will a city with fewer human drivers on the road actually look like? Generally speaking, many believe that autonomous vehicles will drastically change transportation, but public officials and technology vendors do not seem to agree about when. Government and municipality respondents are evenly split in their views of the future impacts of driverless programs. Conversely, smart service providers appear to be more certain, with 68 percent believing that these new transportation options will have long-term impacts around the world (Figure 9). This means there is still much work to be done to integrate autonomous vehicles into the smart city landscape.

If and when autonomous vehicles are deployed at scale, ramifications could include a complete reworking of streets and public transit routes and uses; evolving energy demands; and conversions of parking lots and garages that may no longer be needed. Developers will need to think about the future to enable sustainable growth and meet emissions reduction, public health and clean energy goals. Best practices from pilot projects are already showcasing how collaboration with regulators, utilities and citizens is critical to successfully deploying the unmanned transportation that could transform how we move the people and goods and help communities thrive.

FIGURE 9

In regard to the future of autonomous vehicles, which of the following statements do you agree with most? (Select one option.)



Source: Black & Veatch

Kent Leacock is Director of Government Relations and Public Policy at Proterra Inc., the leading U.S. manufacturer of zero-emission commercial transit solutions. Leacock is responsible for developing and implementing the company's state and regional government/regulatory affairs and public policy strategy to advance business objectives in the Western portion of the U.S.

Perspectives:

UTILITIES KEY TO POWERING THE FUTURE OF MASS TRANSIT EV'S

By Kent Leacock, Director of Government Relations and Public Policy, Proterra

What will mass transit look like in the future? Earlier this year, **California announced an ambitious plan** to reduce emissions by 40 percent below 1990 levels by 2030, setting the state on a path to achieving 80-percent reduction by 2050. Although satisfying these goals will require contributions from all sectors of the economy, the transition to zero- and near-zero emission vehicles will play an outsized role — particularly when it comes to mass transit.

It's not that far afield to assume that by 2030, transit agencies will be moving right along with removing diesel buses from our streets and replacing them with electric buses. And by 2050, we might even see the last fossil-fueled bus put firmly to bed. Renewable energy will be in its heyday, with utilities generating power from solar, wind and hydroelectric sources. Bus yards would derive energy from solar parking canopies, storing energy in batteries and recharging during peak utility hours, while drawing from the power grid during the off-peak. Excess power could even be sold back to the utility for community use.

But how we do get there? Delivering on the promise of cleaner, more sustainable transit means bringing together stakeholders across the spectrum of transportation — automakers, local and municipal governments and public transit agencies. But the most important stakeholder will be each community's local utility company.

UTILITIES, PUBLIC TRANSIT MUST COLLABORATE

According to the *2018 Strategic Directions: Smart Cities & Utilities Report* survey, more than half of smart services providers (57 percent) point to the need for charging infrastructure — both depot and on-route — as the most prohibitive barrier to large-scale electric fleet adoption. The issue ranked second for government and municipality respondents, who named the cost of fleet investment as their No. 1 concern.

Public transit agencies must work with utility companies to develop the charging infrastructure necessary to bring this plan to life. Proterra, a leader in the design and manufacture of zero-emission heavy-duty vehicles, can play an important role in fostering this collaboration by partnering with transit agencies to develop an efficient energy plan. For example, a transit agency may be considering the purchase of 25 electric buses with a plan to charge the vehicles at night, when they are off-duty.

The agency would provide Proterra with the duty cycle — the number of miles, hours and days each bus runs its routes — for each individual bus. Proterra would determine the fleet's power needs and build a load profile to share with the transit agency's utility company. Armed with this information, the utility would be able to assess its current infrastructure to determine its ability to support the added load and, if necessary, develop additional infrastructure.

Because the utility was brought on board as a partner early in the process, they are aware of potential infrastructure needs — not just for today's 25 buses, but for future growth.

Delivering on the promise of cleaner, more sustainable transit means bringing together stakeholders across the spectrum of transportation. But the most important stakeholder will be each community's local utility company.



Photo: Proterra Catalyst*

COMMITTED TO THE VISION

Although the utopia of fully electrified transportation might sound far-fetched, increasing electrification isn't a fad but rather a reflection of deep market change around the globe. And utilities appear to be on board: To date, three major California utilities — Southern California Edison, San Diego Gas & Electric, and Pacific Gas and Electric — have submitted more than \$1 billion in proposals to electrify the state's transportation sector.

These proposals are multifaceted and involve a number of programs – from working with automakers to introduce heavy-duty EVs to broadening existing EV charging networks with a call for more than 10,000 new charging stations across the state. They are taking action now, with 69 percent of utilities planning, researching or considering EV managed charging programs, to plan for future growth and infrastructure needs over the next 10 to 20 years.

As electric buses continue to gain traction, we have the opportunity to begin working towards this shared vision of the future: to create a healthy, self-sustaining system; to promote a safer, cleaner environment and to keep our people and goods moving safely and efficiently across the landscape.

But this future can only become reality if all stakeholders — utilities in particular — step up to help drive and support the widespread adoption of EVs in mass transit.

About Proterra

Proterra is a leader in the design and manufacture of zero-emission heavy-duty vehicles, enabling bus fleet operators to significantly reduce operating costs while delivering clean, quiet transportation to local communities across North America. With more than 490 vehicles sold to 62 different municipal, university, airport, federal and commercial transit agencies across the continent, Proterra is committed to providing state of the art, high-performance vehicles to meet today's growing market demand. The company's configurable Catalyst platform is capable of serving the full daily mileage needs of nearly every transit route on a single charge. With unmatched durability and energy efficiency based on rigorous U.S. certification testing, Proterra products are proudly designed, engineered and manufactured in America, with offices in Silicon Valley, South Carolina, and Los Angeles. For more information, visit: <http://www.proterra.com> and follow us on Twitter @Proterra_Inc.

Jeff Buxton is an Executive Consultant with Black & Veatch. He has more than 30 years of industry experience, with particular expertise in strategic business planning, technology roadmapping, deployment and organization planning, and regulatory support.

David Hulinsky is a Utility Telecom & Automation Director at Black & Veatch, where he provides integrated grid modernization solutions for utilities. Hulinsky focuses on advanced automation and telecommunication systems to improve the scalability, reliability and efficiency of the electric grid. He has led some of Black & Veatch's largest turnkey grid modernization projects for leading utilities such as SDG&E, Hydro One, CPS Energy, United Illuminating and NV Energy.

Data Powers Next-Gen Applications

GRID MODERNIZATION: INCREASING CAPITAL INVESTMENTS TO DECREASE RISK

By [Jeff Buxton](#) and [David Hulinsky](#)

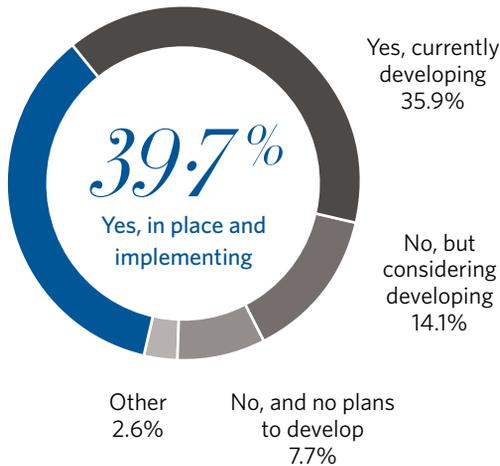
Growing commitment to distributed energy resources (DER) is forcing continued modernization of the grid — and the effort shows no signs of letting up. Whether by regulatory mandate or stakeholder pressure, system upgrades are being made worldwide to support the increase in renewable energy, while making infrastructure smarter and more resilient.

Historically, attention to the grid's distribution system focused on poles and wire maintenance and upkeep, but growing connectivity between assets is requiring a more holistic approach. Modernizing grid management using connected technology is becoming more important — both to the distributed utility and the digital utility — as more sensors and controls are installed throughout the networks. Today, system reliability and efficiency remain the top priorities, but these priorities are now being reimaged in a much more distributed paradigm with augmented third-party involvement.

Results from the *2018 Strategic Directions: Smart Cities & Utilities Report* survey show that this new grid management paradigm is causing more utility managers in the United States to plan accordingly and maintain the new systems they've put in place.

FIGURE 10

Is your utility developing or does it already have a Grid Modernization strategy/plan for electric distribution? (Select one choice.)



Source: Black & Veatch

The majority of utility respondents (76 percent) are busy developing grid modernization plans or already have a strategy for electric distribution in place. Of these, 40 percent already have a grid modernization plan in place and are implementing it, while 36 percent are in the process of putting theirs together. Of the 24 percent not currently engaged in grid modernization, more than half are considering it (Figure 10).

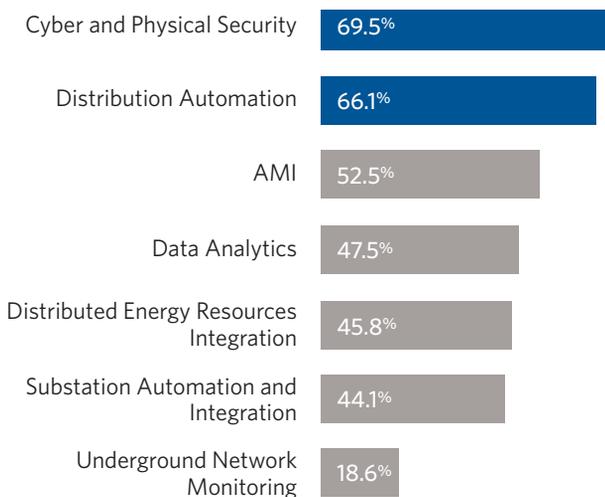
SECURITY, DISTRIBUTION AUTOMATION DRIVE MODERNIZATION EFFORTS

What are the driving elements in today’s modernization efforts? According to survey results, 70 percent of utilities point to cybersecurity and physical security — a growing “must have” in protecting the influx of wireless technology and other communication devices.

Once efforts to protect the grid are in place, respondents are interested in improving grid reliability and efficiency through the use of automation and providing deeper understanding of grid operations. Thus, distribution automation (66 percent), advanced metering infrastructure (53 percent), data analytics (48 percent), DER integration (46 percent) and substation automation (44 percent) all were reported as strong motivators (Figure 11).

FIGURE 11

What are the primary use cases of your grid modernization strategy/plan? (Select all that apply.)



Source: Black & Veatch

PUTTING STRATEGY INTO PRACTICE

Both federal and state-based drivers have served to accelerate the transition to the digital utility over the past decade through subsidization of grid modernization projects and growing regulatory support. Starting with the Department of Energy's Smart Grid Investment Grants, which poured billions of dollars into grid upgrades and fostered partnerships to make them more manageable, many state legislatures and regulators have provided new mandates and regulatory constructs to facilitate recoverable investments in grid modernization technologies.

Many of these projects have focused on multiyear smart grid initiatives, including advanced metering, distribution automation, substation automation, ubiquitous communications networks, microgrids and DER integration. More often, these projects are integrating with third parties such as universities, cities and municipalities, and third-party resource aggregators become key partners in developing the grid of the future.

Leveraging many first-generation grid automation technologies, these projects now combine second-generation communications networks, automated grid controls, demand response, renewable generation resources and energy storage.

ADDRESSING CHALLENGES: AGING SYSTEMS, FUNDING, STABILITY

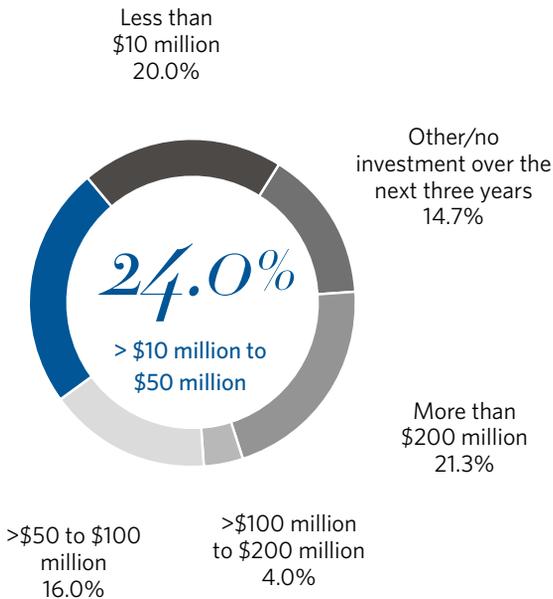
In many cases, the move to more advanced grid technologies is hampered by the capacity and capabilities of current communications networks supporting the grid. The equipment has aged and systems may be outdated, making renewable integration, distribution automation or network convergence difficult to implement without more reliable and robust communications. Further, the transformation from serial communications to internet protocol (IP) has demanded a network that not only distributes better but also contains enough bandwidth to support the monitoring of itself with the proper transparency and control.

More than 58 percent of utilities believe their current communications network is not adequate; 4.5 percent of that group admitted not knowing where to start.

When looking to upgrade, utilities appear to be poised to invest the needed capital and report much higher investment levels than last year. While most utilities say they plan to invest less than \$50 million in their electric distribution systems over the next three years, a quarter of respondents will spend more than \$100 million (Figure 12). Some larger utilities in that reporting segment plan to spend over a billion dollars. In stark contrast, 70 percent of the previous year's respondents reported they were planning to invest less than \$20 million.

FIGURE 12

How much capital do you plan to invest in the electric distribution system over the next three years? (Select one choice.)

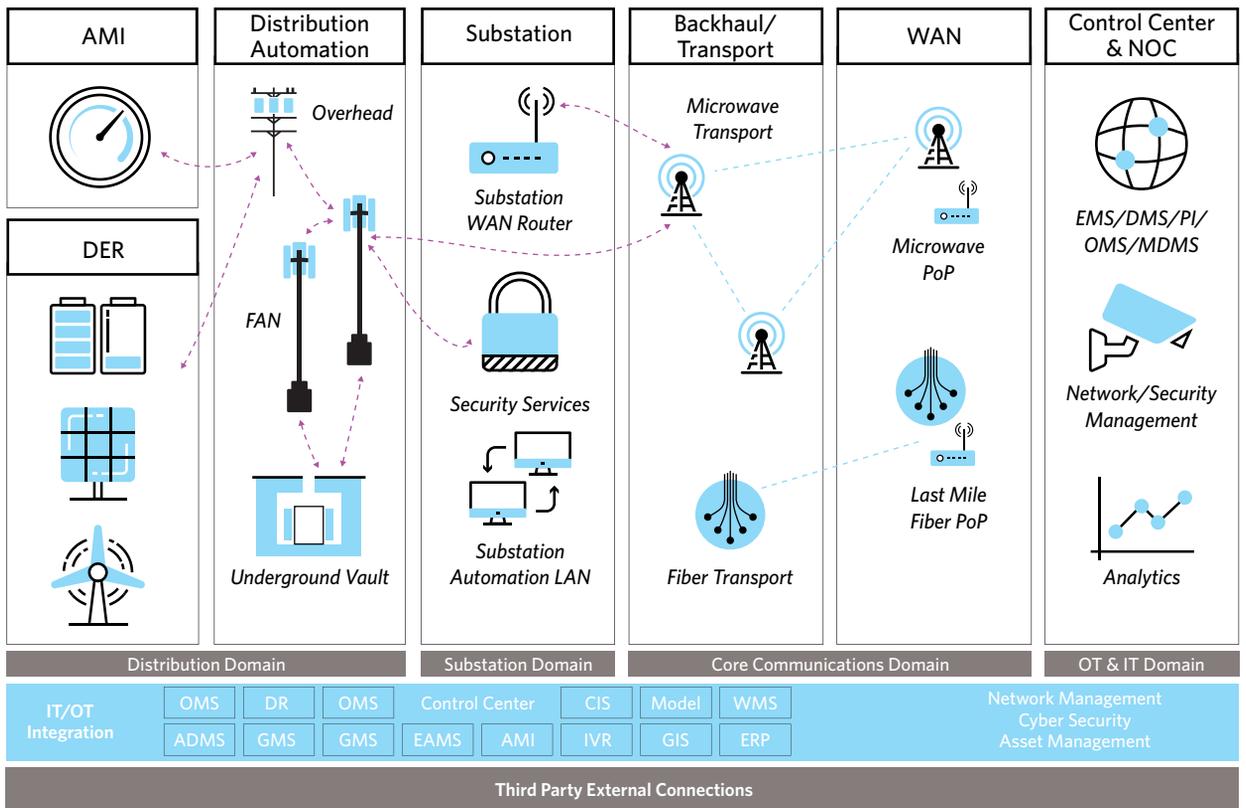


Source: Black & Veatch

The path to grid modernization can be challenging. The ability to support a high penetration of ubiquitous sensors, automated controls and DER within the current distribution system requires focus on many levels. Nearly half (49 percent) of respondents report system stability as the biggest obstacle, while troubles with analyzing DER load flows, business modeling and standardizing interconnections were called out.

How utilities tackle these upgrades also seems to make a difference. The active networks that constitute many segments of a “smart” distribution system are best served with a more holistic approach rather than focusing on the separate pieces of the generation and distribution process. Responses to the report survey indicate utilities that view their systems holistically and use an integrated systems approach (i.e., one integrated contractor to install the system) — rather than a segmented, uncoordinated approach perhaps involving separate contractors designing and installing equipment — can potentially reduce costs by between 75 and 150 percent.

SMART DISTRIBUTION SYSTEM: ACTIVE NETWORK



Rick Azer is Associate Vice President for Black & Veatch and a founding member of the company's Growth Accelerator. Azer commercializes new technologies and service offerings that extend the company's position as a leader in critical human infrastructure. His project portfolio includes a nationwide network of high-power electric vehicle charging stations, hydrogen fuel filling stations, stationary storage and smart city infrastructure.

David Price is a Senior Managing Director for Asset Management in Black & Veatch management consulting. He has more than 25 years of management, strategy, product development, delivery and operational experience in the utility consulting, systems integration and software industry, specializing in the creation and delivery of large-scale, complex business solutions.

Data Powers Next-Gen Applications

INDUSTRIAL INTERNET OF THINGS AND BIG DATA: THE (R)EVOLUTION CONTINUES

By Rick Azer, David Price, Matt Kirchner and Robin Winslett

The industrial ecosystem increasingly is turning to the Industrial Internet of Things (IIoT) in pursuit of quality control, efficiency and supply-chain improvements. But as sensors get cheaper, Big Data grabs a bigger footprint, and the technology gets ever more ubiquitous, complexities emerge with the broadening scale. With all this ability to measure and monitor, businesses risk drowning in a sea of data during the digital transformation. This challenge demands a strategy for structuring information, applying analytics and extracting knowledge to harness data's value.

If you think of an industrial machine as a living organism, IIoT is the central nervous system that enables feedback and intelligence, allowing that organism to prosper. Thriving through instrumentation and analytics is no longer a cost-prohibitive proposition. And it's only going to get cheaper and more practical for more discreet elements of information to be collected, analyzed and used.

IIoT has fostered the massive proliferation of low-cost sensors that — while occasionally susceptible to giving incomplete or false readings — collect richer amounts of information, gracing operators with a far wider understanding of their systems, chunks of information to create actionable insights, and better opportunities to optimize against broader domains and to make quicker decisions. Operators

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Robin Winslett is an Associate Vice President and Client Director for Black & Veatch. Winslett has over 20 years' experience working with clients in the heavy industrial, light industrial and commercial marketplaces covering a broad range of industries including steel, oil and gas, chemical, power, automotive, hospitals, universities and commercial office buildings.

of wind turbines, for instance, have been able to leverage data from those towering devices to prevent component failures and make minor design tweaks that make them more efficient, often at no additional expense.

While the fact that IIoT drives efficiencies and optimizes processes isn't necessarily new, the scale is. With the transformational ability to capture numbing blasts of data through sensors, structuring and finding ways to distill something usable from the collected information becomes a significant, even daunting proposition. That's increasingly the case as advancing technology — evidenced by things such as smartphones, drones and self-driving cars — grabs an ever-expanding foothold in the industrial workplace. Businesses are spurred to digitize with more analytic platforms involving such things as sensors, machine learning and artificial intelligence, increasing the opportunity for intelligent operations and planning.

Such departures from traditional business applications hold the promise of paring operational costs and furthering sustainability by using data analytics to better understand your environment and drive greater decisions about costs, materials and the amount of energy used — or more importantly, wasted — in creating something.

The increasing affordability of technology is fueling the revolution, with no shortage of examples: Drones, once costing consumers thousands of dollars to build from scratch not many years ago, now fetch just a few hundred dollars in retailers' electronics sections. More new automobiles these days come equipped with rear-mounted backup cameras. Cloud computing technology also allows massive amounts of data to be processed quickly and made available to more people than just programmers or analysts. Wireless is the pervasive norm, not the exception.



As industries strive for cost-cutting efficiencies and rightsizing workforces through gadgetry, downsides of the disruptive technologies are drawing scrutiny, most visibly when it comes to the societal fallout on staffing levels and the resulting blurring of where any new jobs will come from in such workplaces.

In the IIoT sphere, businesses are taking their energy destiny into their own hands, turning to renewables and microgrids rather than relying on power utilities. This move from centralized to distributed reinforces the need for data collection and analysis to ensure proper operation and maintenance of these often unmanned assets.

In addition, businesses are exploiting technology well beyond sensors, turning to such analytics platforms as Black & Veatch's cloud-based ASSET360®, which gathers, integrates and crunches data from infrastructure systems, assets and devices to help users make more informed, quicker decisions. That technology also offers modeling capabilities and predictive analytics, identifying issues well before a human's situational awareness could discern that something is wrong.

With the marrying of IIoT efforts and data-structuring analytics picking up steam, businesses that master that union and nimbly collect and process vast amounts of data hold the edge.

Preethi Pillaipakkam is the Business Director of Connected Communities for Black & Veatch, where she leads capture strategy for large statewide and/or multi-jurisdictional projects. Pillaipakkam also manages financial performance for the Connected Communities engineering, procurement and construction (EPC) business.

Data Powers Next-Gen Applications

SMARTER, SAFER CITIES: IMPROVING PUBLIC SAFETY

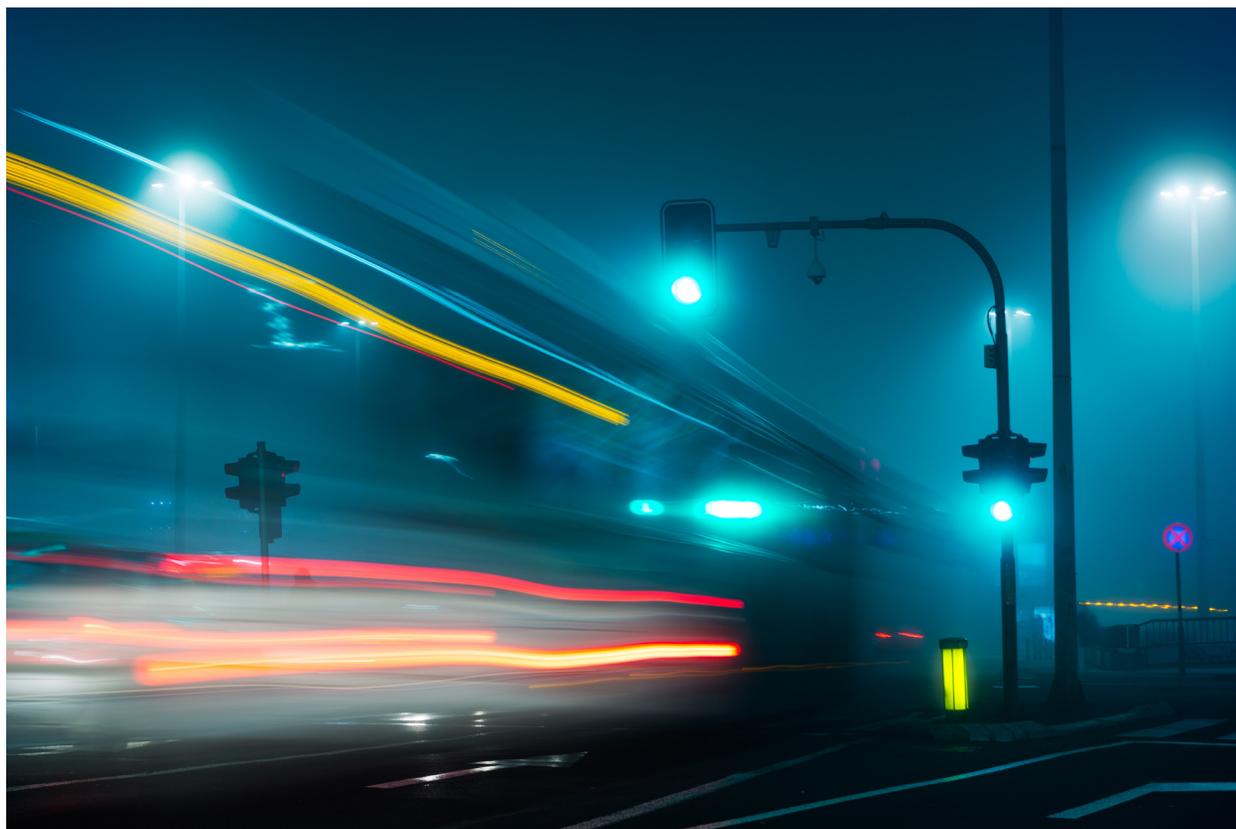
By [Preethi Pillaipakkam](#)

Smart cities also can be “Safe Cities” through the integration of smart city and public safety initiatives. An estimated 20 Safe City pilot programs are underway across the United States, in addition to programs on nearly every continent, in cities such as Dubai, Singapore and London.

SMART CITY ELEMENTS ENABLE THE FUTURE OF SAFE CITIES

Imagine this scenario: A gunshot rings out in a high-crime section of a large city. A car speeds away. A victim lies on the sidewalk.

An audio sensor embedded in a nearby streetlamp detects the sound of gunfire, identifies where it came from and, through a high-speed backhaul to the nearest real-time crime center, alerts dispatchers to the situation. As police and emergency medical technicians race to the scene, the streetlight brightens to its full capacity, making it easier for first responders to see what’s going on.



Behind the scenes, the feeds collected by the surveillance cameras automatically are run through databases housing fingerprint, DNA and mugshot information. Real-time license plate and facial recognition technologies are applied, and a data analytics engine kicks in to correlate the data and provide actionable intelligence. The result? The perpetrators can be more quickly captured by law enforcement.

That's the future.

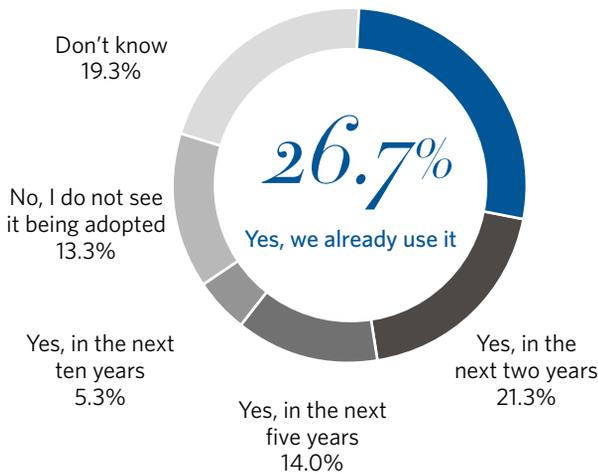
When people think of smart cities, they typically envision smart parking meters, smart electric meters, smart streetlights and smart transportation systems, while public safety typically takes a back seat. However, the benefits of Safe City programs include not only improved crime-fighting but also safer conditions for first responders. For example, the public safety system could alert a police officer responding to a call that a dangerous individual lives at that address or that drug activity previously has occurred there.

From a firefighting perspective, Safe City technologies could include the use of drones that can enter a burning building to investigate, sparing humans that risky task. Armed with multiple capabilities, such as the ability to enter confined spaces and transmit video, drones can be a valuable tool in any Safe City initiative. Drones can be equipped to detect the presence of chemical substances, such as a gas leak, or can provide aerial surveillance in dangerous or remote areas, in situations ranging from brush fires to lost or injured people.

Social media, which continues to command a growing presence in our lives, fits into Safe City initiatives as well. Online and social media applications, such as Twitter, provide an opportunity for citizens to quickly post information and for government and public safety agencies, such as police and fire departments, to spread the word to the community about a situation, such as a crime scene, fire or accident.

FIGURE 13

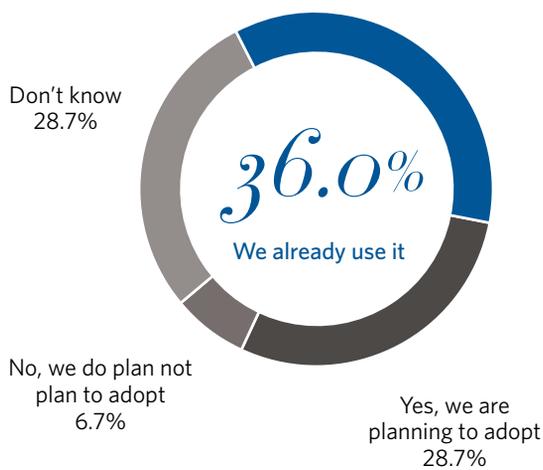
Do you see data analytics (predictive and video analytics) playing a role in your organization's crime prevention/resolution? (Select one option.)



Source: Black & Veatch

FIGURE 14

Does your organization plan to adopt integrated voice, data and video as elements of public safety communications systems? (Select one option.)



Source: Black & Veatch

FIGURING OUT THE SAFE CITY PUZZLE

Cities, counties and communities eager to implement smart city solutions should include public safety initiatives within their planning process. Responses to Black & Veatch's *2018 Smart Cities & Utilities Report* survey show that although stakeholders are deploying individual Safe City initiatives, there is clearly an opportunity for a system integrator to deliver a bundled solution.

For example, 27 percent of respondents said that they already use data analytics in their organization's crime prevention and resolution activities, while another 21 percent plan to use data analytics in the next two years (Figure 13).

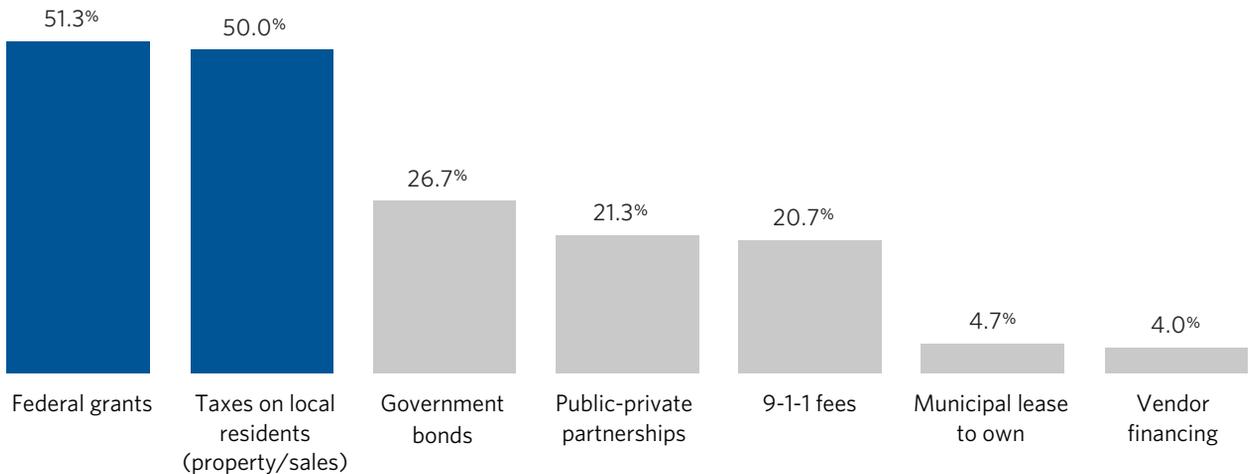
Although data analytics are often used to identify high-crime locations, the next step could be to deploy video cameras at these locations to deter — and hopefully prevent — crimes from occurring. A surveillance video itself can then serve as an invaluable tool in solving crimes.

According to the survey results, data, social media integration and video feeds are the most popular technologies currently in use at real-time crime centers. Over a third (36 percent) of survey respondents have already adopted integrated voice, data and video as elements of a public safety communications system, with 29 percent planning to adopt elements (Figure 14). More than half (54 percent) said they foresee adoption within the next two years.

When asked what additional technologies were needed, respondents listed data analytics as No. 1, followed by video surveillance and long-haul connectivity.

FIGURE 15

**How do you obtain funding for the build out and operation of your Public Safety Command and Control Centers?
(Select all that apply.)**



Source: Black & Veatch

FUNDING SAFE CITY INITIATIVES

Funding is a key issue when it comes to Safe Cities. Today, the largest cities armed with the largest budgets, namely New York and Los Angeles, are leading the way in public safety. These metropolises already have substantial video surveillance programs, along with sophisticated, state-of-the-art crime centers and/or emergency operations centers that coordinate first responder operations.

When it comes to funding, half of municipalities surveyed state that they rely on federal grants as their primary source of money, followed closely by local taxes. Only 21 percent said they obtain funding through public-private partnerships (Figure 15).

THE FUTURE OF SAFE CITIES

The current situation with respect to Safe Cities is a bit chaotic, with small, startup companies pitching individual products and services to large

government entities — from facial recognition to gunshot detection and license plate recognition to last-mile backhaul. Buying cycles can be lengthy, and many municipalities end up self-performing the integration services. Many communities struggle to obtain the buy-in of their residents, as questions persist over privacy and surveillance.

Although challenges exist, there are opportunities for system integrators or consultants to work with cities to put together a comprehensive Safe City roadmap. As part of this effort, a key component should be to educate the community and encourage community involvement, especially in regard to the social media aspect of the program.

If implemented properly, a Safe City program can be important, not only in preventing and solving crime but also in working quietly behind the scenes to make people feel safe, universally improving quality of life.

Joey Friend is a Client Director for Black & Veatch Public Telecom Networks business. She is responsible for sales, client relationships and project execution of telecommunications wireless infrastructure to support Carriers and Neutral Host networks.

Data Powers Next-Gen Applications

5G ON THE HORIZON: THE FIFTH GENERATION OF WIRELESS BROADBAND WILL ENABLE SMART CITIES APPLICATIONS

By Joey Friend

Once just an industry buzzword, 5G is now truly on the horizon, promising faster communication speeds and ultra-low latency. As Internet of Things (IoT) connections scale from millions to billions, carriers have begun to hone in on this next generation of wireless technology by launching 5G trials and test beds in various markets throughout the United States. Consequently, they're finding that the establishment of 5G is less of a single, enchanted event and more like clicking thousands of LEGO® pieces into place.

As part of this evolution, carriers are tackling capacity requirements by creating dense zones of small cells and distributed antenna systems (DAS) to help form the 5G network that will support our leaps-and-bounds technology advances. Accordingly, densification programs will be the biggest market driver for outdoor small cells growth, and installation of nonresidential small cells will **leap 36 percent by 2022**.

Also serving as a key piece of the 5G puzzle, carriers are deploying fiber to provide wireless backhaul from small cell sites and pushing fiber closer to the user to meet their growing capacity needs. A **Deloitte Consulting LLP analysis estimates** that the United States requires between \$130 billion and \$150 billion over the next five-to-seven years to adequately support broadband competition, rural coverage and wireless densification.

While its full range of capabilities has yet to be defined, 5G is sure to build upon the progress of its predecessors. The GSMA, a trade body that represents the interests of mobile network operators worldwide, expects that we will not see the full scale of 5G network deployments until the post-2020 period — the 5G era. This era will usher in limitless connectivity and intelligent automation, transforming the way we live, work and communicate.

ENABLING THE “SMART” IN SMART CITIES

Despite a growing cache of innovative smart city applications, smart is not a sure thing. The uptick of mobile data services, escalating subscriptions, and IoT connections sends data traffic soaring, which reduces network capacity.

Total mobile data usage in the United States and Canada will grow by 35 percent annually through 2021, with North America predicted to lead the world in mobile data traffic at 22 gigabytes per smartphone. Alongside wireless data growth, Ericsson’s North America Mobility Report (2016) estimates that 3 billion IoT connected devices such as activity trackers and connected thermostats will link into the network by 2021.

The 2018 *Strategic Directions: Smart Cities & Utilities Report* survey indicates that funding priorities in cities mirror these regional data trends. Survey results reveal that 34 percent of municipalities rated high-speed data networks as one of their top three priorities. (Figure 16).

FIGURE 16

What are the TOP THREE most important systems a “smart city” program should invest in first? (Select three choices.)

	By Organization Type	
	Government/Municipality	Smart Services Provider
High-speed data network	33.6%	25.9%
Smart transportation	25.6%	37.0%
Smart water systems	32.7%	25.9%
Smart electric grid, including smart metering	35.5%	38.9%
Renewable/distributed generation/microgrids	13.3%	29.6%
Smart street lighting	18.5%	16.7%
Smart buildings	32.2%	51.9%
Smart sensors	15.6%	7.4%

Source: Black & Veatch

This prioritization is not without reason because communities are already seeing the benefits of smart applications that leverage today's wireless networks. Industries such as health care, transportation, energy and manufacturing can expect to see positive impacts from the advent of 5G, and this effect will drive investment in wireless technologies in 2018.

According to a Harris Poll commissioned by wireless trade association CTIA, 80 percent of business leaders in these industries believe their businesses will benefit from 5G, and 62 percent intend to spend more on wireless advancements this year. For the utility sector, 5G technology will help unleash the next wave of smart grid features and efficiency through low-cost connections, improved monitoring capabilities and better forecasting of energy needs.

In transportation, 5G will help drive revolutionary advancements such as the autonomous vehicle (AV) market. Many industry leaders think that cellular systems, specifically 5G, will be best suited to support AV. With greater capacity and faster broadband connection, 5G will allow AV technology to scale more quickly.

In addition, 5G will help AV integrate with smart city functions — such as real-time traffic information and ride-hailing applications — and other advanced technologies. Similarly, smart city innovations in public safety are a hot topic for the telecommunications industry, and wireless technology is the driving force. 5G LTE for public safety communications will offer mission-critical services for voice, video and data that exceed 4G capabilities, which can lead to improvements in emergency response.

SEAMLESS INTEGRATION: THE RIGHT APPROACH TO 5G DEPLOYMENT

Deploying thousands of small cell and DAS sites, along with backhaul fiber, takes time. While the Federal Communications Commission recently moved forward with plans to simplify small cell deployments in municipalities across the country, carriers are also streamlining their deployment approaches. Many are trading a multivendor approach for the self-perform approach. Carriers who use the self-perform approach engage one team to conduct uniform deployment of all phases and entrust one team representative to coordinate with city offices, such as utilities and permitting, on their behalf. This approach helps foster a mutually beneficial alliance between carriers and municipalities that is instrumental to smart city success.

In addition to streamlined deployment processes, carriers are seeing the benefits of multi-technology networks and how these once-siloed worlds are converging. The future is not wireless or wireline, but a seamless integration of both. Service providers are faced with the challenge of delivering advanced services with higher bandwidth requirements, and in many instances, their existing infrastructure is not meeting capacity demands. Adding capacity to these disparate networks comes with challenges, including disruption to cities and customers.



A better approach is to engineer for future needs and develop a holistic plan for network infrastructure that does more than simply add capacity to existing systems. A **Converged Intelligent Network** is one that has been engineered and deployed to anticipate long-term capacity requirements for high bandwidth services, provide low latency instantaneous connectivity and facilitate cross-platform machine to machine data sharing in the cloud for **smart city** applications. Delivering a converged network also reduces the permitting complexity, resulting in improved operational costs and better relationships with municipalities and utilities.

MUNICIPALITIES IN SUPPORT OF 5G

It's clear that 5G is coming, but what role can and should municipalities play in this evolution? With large wireless network investments forecasted by telecommunications operators in the next decade, municipal leaders can bolster

the success of their smart city programs by taking steps to encourage telecommunications companies to invest in deploying next-generation infrastructure in their cities.

The shift from traditional macro towers to small cell sites, which often use city and utility infrastructure, will require more streamlined permitting processes and modifications to existing regulations. Municipal leaders should strive to improve process efficiency and reduce regulatory hurdles to support new deployment models required for this next generation.

The reality is that, despite fever pitch interest, smart cities cannot fully emerge without expansive network capacity and coverage. With the right approach and advocacy, 5G technology can be the cardinal game-changer by transforming smart city imaginings into real-time innovation.

Kate Garman is the Smart City Coordinator for the city of Seattle, where she is responsible for running the City's Smart City program, which leverages technology to improve the lives of Seattle residents.

Perspectives:

DATA AS THE NEW INFRASTRUCTURE

By [Kate Garman](#)

For decades, the definition of “infrastructure” has remained unchanged and was used to define roads, bridges, electricity and water delivery systems, among other examples. But as cities continue to build upon smart city efforts, the concept and very definition of infrastructure is changing.

As the former Innovation Policy Analyst for the city of Kansas City, Missouri, and now the current Smart Cities Coordinator for Seattle, my personal journey has been exciting and challenging. What began as a simple conversation about city right-of-way when deploying sensors is now a much larger conversation on a wide range of issues, including digital inclusion, autonomous vehicles, city performance management and small attachment regulatory schemes for the coming of 5G.

Cities are now looking at both the internet and data as basic forms of infrastructure. For example, San Francisco city leaders recently announced the kickoff of a \$2 million study to build municipal broadband, which carries a potential price tag of \$1.5 billion.

Another leading city, Chattanooga, Tennessee, is paving the way as a city offering a similar service, which has resulted in significant dividends in economic development and digital equity for its residents. In addition, Kansas City, Missouri, now has 52 square blocks of free public Wi-Fi. These efforts reflect cities’ progress in building the foundation to connect residents to city data.

As these connectivity efforts grow, stakeholders in smart city projects need to continue to collaborate. Smart city projects must have a direct correlation to city performance, which means vendors need to think like a city. However, gaps exist, particularly when it comes to what cities need and what vendors can provide.

A great example of a “lost in translation” service is the data for pedestrian counts. Vendors will sell pedestrian counts to a city as a way to enhance economic development and commerce; however, this information is not always that helpful. Cities generally know which blocks are economically vibrant and which are not.

Pedestrian data can, however, help with real-time intersection behavior. If we could change the functionality of an intersection and count people like we count cars, then we would be giving multimodal options a real chance to operate together. For example, if there are 25 people on the sidewalk, but just two cars going in the same direction, a real-time adaptive signal will shorten the green light based only on the car count, missing any accommodation for pedestrians. There is great opportunity for improvement here.

Cities cannot do this alone, as evidenced by responses to Black & Veatch’s *2018 Smart Cities & Utilities Report* survey. This overarching sense of collaboration is evident, as cities and municipalities are clearly interested in pursuing partnerships across traditional and nontraditional lines to see these efforts through. According to survey results, nearly half (43 percent) of municipalities/administrations polled reported

collaborating with utilities to help determine their smart city initiatives (Figure 17).

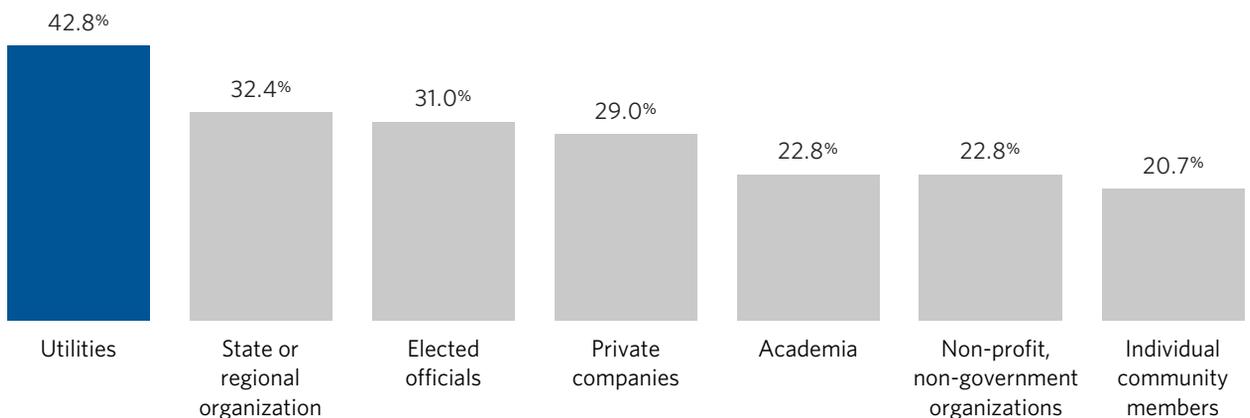
Working with subject matter experts and technology leaders continues to be a priority; but at the same time, we have a lot of work to do internally. For example, the private sector may offer a sensor that gathers a vast amount of data to help a city better perform. But if said city isn’t ready to ingest, manage and analyze that data, the actual results will be delayed. The easier vendors make it for cities to process the data and incorporate it into status quo operational habit, the more successful the smart city project will be.

The easier vendors make it for cities to process the data and incorporate it into status quo operational habit, the more successful the smart city project will be.

I have nothing but optimism for this industry as it charges ahead. More cities than ever are engaging with smart city efforts, and we’ll keep moving forward. It all comes down to one word: data. Data may or may not be the “new oil,” but it is certainly the new form of infrastructure.

FIGURE 17

Which of the following did your municipality/administration collaborate with to help determine the focus of your “smart city” initiatives? (Select top two choices.)



Source: Black & Veatch

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Roadmap to Reliability

CYBER THREATS TO PHYSICAL ASSETS DEMAND A PROACTIVE APPROACH

By Scott Dicus, Dave Mayers, David Price and Nathan Ives

Intent on safeguarding the nation's largest electric grids from potential mayhem, federal regulators have stepped up their oversight of the security of power utilities in an attempt to protect it from threats and incidents such as widespread, long-duration blackouts caused by digital saboteurs.

Cyber threats linger, however, with operational technology (OT), including water systems that are far less centralized and, thus, more vulnerable. As efficiency efforts drive IT and OT systems to converge, hackers can gain access to the OT infrastructure via an IT route, fueling a need for utility leaders to assess, plan and implement OT protection strategies for critical assets. This position represents a fundamental shift in approach whereas security, once set up under IT only or as a separate shop, is being integrated into a broader IT/OT function.

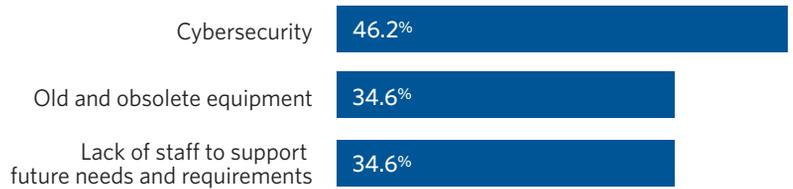
The U.S. Department of Homeland Security has labeled cyber attacks on critical infrastructure among the nation's most serious security challenges. Not unexpectedly, government and utility leaders clearly understand the importance of maintaining security across IT and OT networks.

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Nathan Ives is Managing Director of Business and Technology Architecture for Black & Veatch management consulting. With 25 years of international experience in the power, oil and gas, and mining industries, Ives has led utility operations, online and outage work management, and maintenance teams.

FIGURE 18

What are the top three major challenges your team is facing with your current distribution system automation and communication capabilities? (Select top three choices.)



Source: Black & Veatch

When asked to select the top three major challenges with their current distribution system automation and communication capabilities, nearly half of survey respondents cited cybersecurity; old and obsolete equipment and a lack of staff to support future needs and requirements tied for second, each with 35 percent (Figure 18).

When asked separately where cybersecurity measures will be implemented in their networks within the next three years, 64 percent of respondents cited addressing any shortcomings in their core assets as their top priority. Edge assets such as switches, regulators and capacitor banks were ranked second (43 percent) and backhaul third (34 percent).

However, addressing core vulnerabilities may be the quickest, easiest response and can more easily leverage in-house resource capabilities because of its relatively small scale. Focusing on physical assets may prove to be more complex, given the larger scale and the fact that many infrastructure assets were designed and built years ago without security in mind and at a time when the prevalence of analog systems brought security through technological obscurity.

In recent years, sophisticated rogue actors have brought the need for upgraded system defenses to the fore, making the threat more than simply theoretical. In 2011, the Stuxnet computer virus reportedly destroyed centrifuges involved in Iran’s nuclear program. In 2013, Iranian hackers breached the command-and-control system of a dam near Rye Brook, New York, managing to gain access to the floodgates — a breach Sen. Charles Schumer of New York called “a shot across our bow.” In September of last year, according to The Associated Press, cybersecurity firm FireEye warned that a group of hackers suspected of working for the Iranian government was targeting the aviation and petrochemical industries in the United States, Saudi Arabia and South Korea.

Across the digital landscape, threats are limited only by the imagination and deviousness of those carrying out cyber mayhem. Video surveillance cameras and wireless routers also may be vulnerable to online intruders, cybersecurity experts have warned.

Cyber threats are gaining the attention of U.S. industry leaders. According to the *2018 Strategic Directions: Smart Cities & Utilities Report* survey,

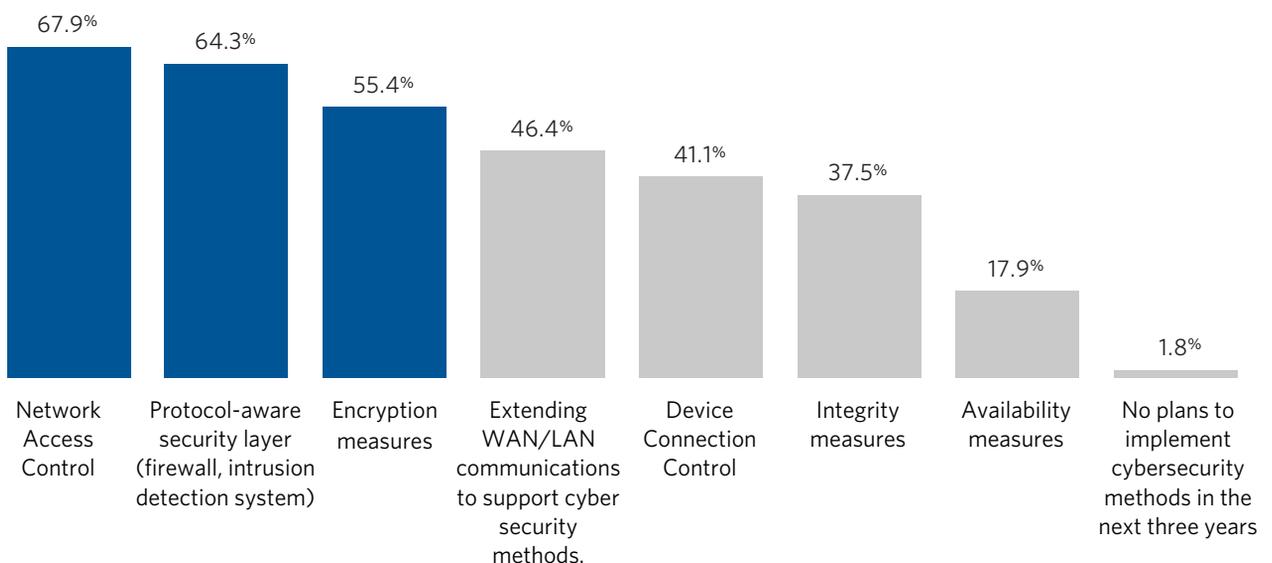
more than 60 percent of respondents cited upgrades in network access control and in firewalls and intrusion-detection systems — all relatively simplistic doors to close — as cybersecurity methods they plan to adopt within the next three years. More than half said they expect to deploy encryption techniques (Figure 19).

Rapid evolution of electric grids and communications networks can make it difficult to plan safeguards, but asset managers must assess their risks and adopt responsible security measures that are flexible and scalable, shunning dismissive attitudes that such investments simply become outdated within a few years.

A truism of cybersecurity is that the risk level is never zero. The quest for brawnier security begins with a deep-dive assessment of critical infrastructure to understand the networks, cyber asset inventories and existing risks, then deciding what risks are acceptable and which to remediate. By quantifying risk, stakeholders can prioritize and justify investments in cyber protection to maintain an acceptable level of risk and a sustainable security posture.

FIGURE 19

What cybersecurity methods does your organization plan on implementing in the next three years? (Select all that apply.)



Source: Black & Veatch

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Roadmap to Reliability

HOLISTIC DISTRIBUTION MODERNIZATION PROGRAMS REQUIRE MORE THAN IT UPGRADES

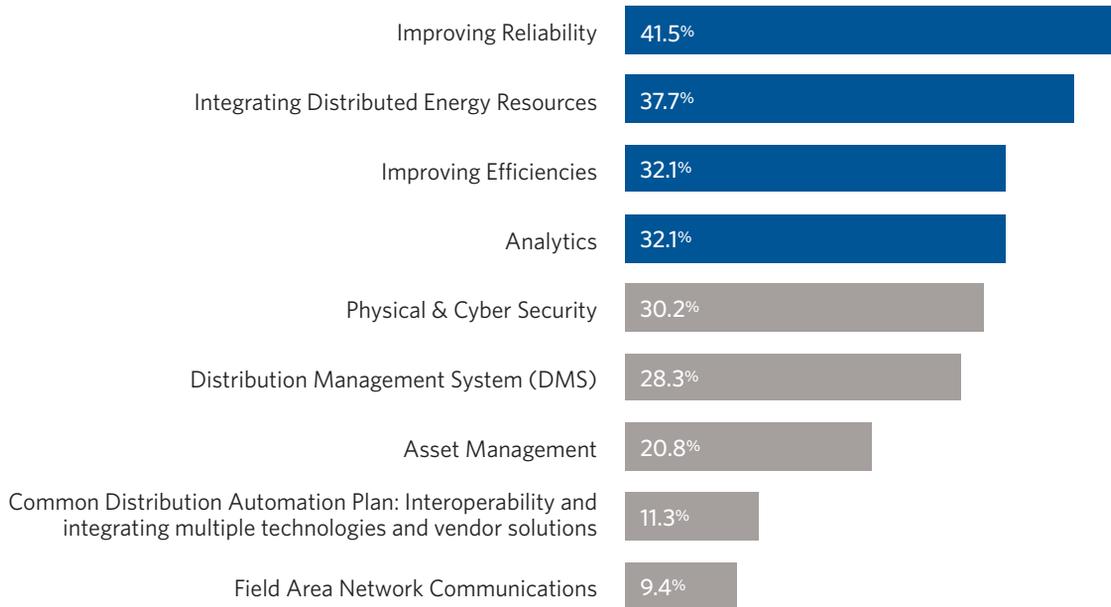
By Scott Dicus and Forrest Small

Electric utilities are realizing that distribution modernization programs, also referred to as grid modernization, can no longer be put off. Overhauling the electric distribution system will require upgrades to OT, as well as to the networks that allow IT and OT components to communicate to improve reliability. The benefits are clear: Grid operators need advanced sensors, communications and automation so they can see what's happening in real time, which will lessen disruption while enhancing efficiency, reliability, security and safety.

More and more utilities also are looking into comprehensive programs that include efforts to deploy underground transmission lines and rehabilitate substations to further increase resilience. Managing distribution modernization efforts can be incredibly complicated, and survey results from the *2018 Strategic Directions: Smart Cities & Utilities Report* reflect an industry still figuring out how technology and networks will work together in the modern grid.

FIGURE 20

What are the TOP THREE major challenges your team is facing with your current electric distribution system? (Select top three choices.)



Source: Black & Veatch

WHAT'S DRIVING DISTRIBUTION MODERNIZATION INVESTMENTS?

Today's electric utilities are still focused on reliability, but nearly as important as maintaining a reliable grid will be integrating the growing number of DER being deployed. Improving reliability, integrating DER, improving efficiencies and analytics are the top four challenges facing distribution systems according to utilities, reinforcing the need for upgrades that will address those issues and more (Figure 20).

These large-scale changes, because of their reach and complexity, are often driven by policy, with many local regulators pushing statewide efforts. Regulators are becoming increasingly more involved in distribution modernization initiatives, while also wanting to accomplish more strategic environmental, cost-savings and fuel diversity goals.

With investments in the range of \$100 million and up, state officials are working to better understand grid modernization dimensions and work more closely with utilities on planning. Black & Veatch has worked with several clients to host workshops where technology integrators, local authorities and utilities can discuss and collaborate about what is entailed in proposed or ongoing grid modernization programs.

INTELLIGENT DER INTEGRATION REQUIRES REGULATORY SUPPORT

Many utilities see distribution modernization as built on a platform that can offer capabilities to improve customer experience and integrate DER. To meet DER deployment goals, organizations are adapting integrated system plans to identify ideal DER locations. Twenty-four percent of utilities

forecast expected DER participation on a system-wide basis, while 19 percent integrate large-scale DER participation only into their ISP, and 11 percent forecast expected DER participation on a circuit basis.

The largest pool of respondents indicated that they are not adapting plans at this time. This surprisingly high percentage could point to utilities' apprehension to collaborate with regulators until they have well-developed DER plans in place.

The need for increased regulatory support, however, was highlighted in survey results as a key to standardizing DER implementation. For example, some utilities must first determine the expected customer support level. Some utilities do not have a lot of headroom to raise rates, so they will need to explore cost recovery mechanisms that have to be approved by local government.

Many organizations require changes in the regulatory structure to encourage DER implementation; 61 percent indicated the need to de-link energy consumption from distribution rates. This change would likely be the easiest way to fund distribution modernization efforts. Updated connection charges (26 percent) and increases in fixed rate elements (26 percent) were other leading amendments suggested by survey respondents.

The focus on regulatory involvement signals a shift in the industry. Utilities are beginning to move past initial technology concerns and are realizing that technology, infrastructure, business models and regulations must all be taken into consideration for a holistic distribution modernization program.

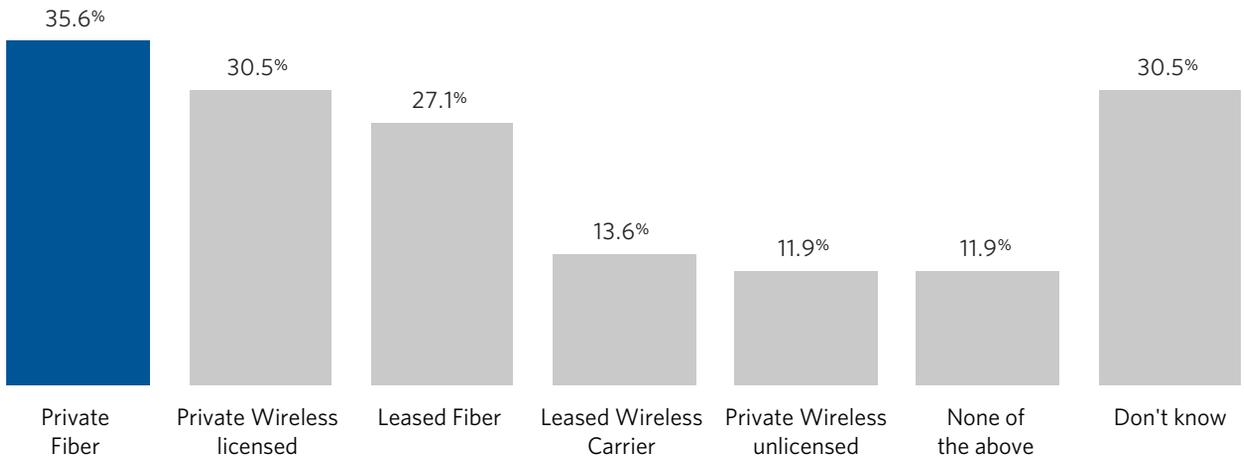
ENHANCED MONITORING TO ADVANCE CAPITAL PLANNING

Many survey respondents still seem unsure of how all the elements will play together. For example, many utilities already have enhanced monitoring in place but are not using it to its full potential. When OT systems are fully integrated with business systems, data from enhanced monitoring can be used to make informed business decisions. However, only 39 percent of survey respondents are currently using smart monitoring to provide input into assessments of asset condition and their likelihood of failure.

For distribution modernization programs to be successful and scale, capital planning approaches need to evolve. Leading utilities are implementing integrated resource planning for their smart grid investments. Integrated resource planning takes into account how a utility and/or state is looking to the future using conventional resources, DER, energy efficiency goals, electric vehicle programs and more to meet the needs of its customers for the long term. Program management expertise in both smart metering and telecommunications networks can help leverage existing assets and optimize capital for infrastructure upgrades.

FIGURE 21

Which of these communication solutions do you anticipate deploying in the next three years to support distribution automation? (Select all that apply.)



Source: Black & Veatch

ASSESSING DISTRIBUTION AUTOMATION COMMUNICATIONS OPTIONS

Utilities are widely adopting advanced metering infrastructure in earnest, but the next step in distribution modernization is in automation. Automation will enable DER to support the grid without jeopardizing reliability. Regardless of DER deployment goals, distribution automation (DA) will be a foundational technology, but the electric industry may be underestimating costs.

Just over a third of survey respondents (34 percent) are only planning to invest less than \$10 million over the next three years in DA, which will rely heavily on suitable communication solutions. Private fiber is currently the most popular network option, chosen by 36 percent of utilities (Figure 21). This is unsurprising because one of the main drivers for DA is higher bandwidth, and private fiber-optic networks can accommodate the most capacity.

This is a point of contention in the telecommunications space because adequate broadband private wireless solutions are limited. Without a clear industry standard, Black & Veatch is investigating private long-term evolution options for utility clients that will allow those organizations to utilize licensed spectrum for optimal operations.

Most telecommunications networks require updates to support DA and enhanced transmission substation operations. While funding will continue to be a challenge, end-to-end planning, design and implementation expertise can play a critical role in selecting optimal technology and network solutions on the basis of system requirements. Collaborating with engineers, equipment vendors, regulators and utilities can ensure that technology solutions and advanced communications networks are configured to deliver a return on investment.

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Bob Welch is a Vice President of Black & Veatch, and Chief Operations Officer of Black & Veatch Management Consulting, LLC. He is responsible for the development and deployment of client offerings, delivery of client engagements and the overall Sales Operations process for the Unit.

Roadmap to Reliability

DISTRIBUTION MODERNIZATION PRESENTS CHALLENGES AMID EVOLVING BUSINESS MODELS AND PRACTICES

By Forrest Small and Bob Welch

The emergence of distributed energy resources and the technologies collectively referred to as the “smart grid” are upending traditional business models, operations and processes for electric utilities. Power providers increasingly need to incorporate DER into the grid, which means having to store, deliver and manage power from independent sources – a major departure from their traditional role of one-way delivery of energy to consumers.

Utilities also will have to make extensive use of automated control and intelligence — evaluating, correlating and analyzing data from smart meters, supervisory control and data acquisition (SCADA) and many other systems to provide operational value for the utility and ratepayer. The result should be a new environment that differs from what most utilities may be accustomed to. It also is extremely dynamic, with new applications and use cases constantly emerging.

Distribution modernization programs are in full swing in virtually every state. The value drivers are compelling, namely, to improve reliability, operational efficiency and outage performance, support DER — including microgrids such as the one at Marine Corps Air Station Miramar in San Diego and rooftop solar — and provide a richer customer experience and new forms of engagement.

Perhaps most importantly, utilities are positioned for a new power ecosystem that is far different from when their grids were laid out decades ago, long before technology such as the internet and DER were conceived.

A COMPLEX TRANSITION

Achieving the desired outcomes, however, involves technologies with which utilities often have limited experience, including new communications and power distribution networks, data collection and analysis, and sophisticated automation to support new workflows. As utilities get started with these initiatives, they also recognize that distribution modernization involves more than operational technology. Two other elements play a crucial role:

- New Business Models:** DER and increased consumer control of energy consumption mean that people will use the power network in new and different ways. Utilities must look beyond their traditional business model of one-way power flow because their consumers may also be DER providers who expect compensation for the power they supply to the grid. Utilities will have to create new business models to ensure that all stakeholders can participate and sustain investments.
- A New Regulatory Construct:** Utility companies are moving from a protected position where their revenue was ensured to a competitive or quasi-competitive environment that requires them to open the grid to other entities that want to make money from it. At the same time, they are under pressure to increase their reliability, resilience and efficiency, both to meet regulator expectations and, ultimately, to ensure their survival in this new environment.

As utilities strive to navigate these different layers to achieve business objectives, they will likely find themselves in new and different territory. For example, a major question is how to get started with DER. Utilities often have little idea of the required initial analysis and planning, how to value DER, how to integrate and manage them in the network and/or how to manage the number of applications from everyone who wants to put solar on their roof.

Leveraging the large quantity of data from the smart grid also is problematic. In general, utilities are uncertain how to structure that data, manage it, ensure accuracy and use it effectively. They are unlikely to have data scientists on staff who understand how to evaluate, correlate and analyze data to achieve desired value drivers, whether to determine when a meter needs replacing, predict the impact of DER in a particular region or provide management with strategic intelligence previously out of reach.

Utilities generally prefer a partner that can manage the full life cycle of investment, from initial analysis through planning and implementation.

WHERE WILL ASSISTANCE COME FROM?

Most utilities lack the resources and knowledge to handle all this activity on their own. In fact, more than half of U.S. utilities (55 percent) have communications and telecommunications teams with fewer than 10 employees, according to results from the Black & Veatch *2018 Strategic Directions: Smart Cities & Utilities Report* survey, suggesting that in the near term at least, significant outside assistance will be needed (Figure 22).

In their search for outside assistance, utilities generally prefer a partner that can manage the full lifecycle of investment, from initial analysis through planning and implementation, and then serve as an ongoing resource to ensure that the utility achieves the value it was seeking. In addition to effective project management at scale and appropriate cost structures, one of the most crucial partner attributes in these initiatives is the ability to successfully navigate the requirements of regulators, DER providers and internal stakeholders.

EVOLVING PARTNER ARRANGEMENTS

A variety of partner arrangements are possible as distribution modernization initiatives continue to take shape. These arrangements may include engagements to manage the modernization (or a specific segment of it) to completion on a project basis to provide insights on an advisory basis that help utility executives make key decisions, or to supplement in-house staff with specialized expertise. Transitional engagements provide a way

to get a new process off the ground and gradually turn it over to utility staff as their knowledge and comfort level rises.

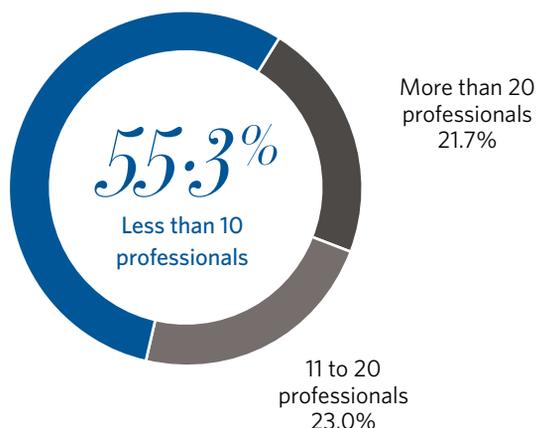
This includes the deployment of new or upgraded networks to handle the increase in data traffic to and from fixed “smart” devices in the revamped distribution network and mobile devices deployed in the field for work scheduling, asset maintenance and customer support.

Utilities are also exploring new types of partner arrangements and taking advantage of the transition to solve traditional problems in more innovative and effective ways. For example, rather than each utility allocating staff to handle similar functions, in some cases, a collective engagement with an experienced third party that handles it for all of them could be more productive and cost-effective.

Distribution modernization can be transformative for power utilities by affecting their operations, their customer relationships and their bottom line. With the right partner, the right skills and insights can be provided and delivered at the right time.

FIGURE 22

How large are your communications network/telecommunications operations teams today?



Source: Black & Veatch

Fred Ellermeier is a Vice President and the Managing Director of Black & Veatch's Connected Communities business, which deploys distributed smart city and public safety infrastructure and leverages data analytics to address asset management, operational efficiency, reliability and sustainability. With more than 20 years of experience, Ellermeier is an expert in energy management, energy optimization and sustainable design practices.

Closing Commentary

ARE SMART CITIES REAL?

By [Fred Ellermeier](#)

Is the smart city hype cycle over? Have concerns about cost, security and public skepticism finally won out over the benefits of efficiency, sustainability and public safety?

It is fair to consider whether the futuristic visions of hyper-connectivity and advanced livability, enabled by accessibility to vast streams of data, can withstand the very real concerns that municipalities cannot afford the technologies behind smart city projects. A close look at survey responses contained within the Black & Veatch *2018 Smart Cities & Utilities Report* reveals some unsettling retrenchment tied to cost and stakeholder engagement:

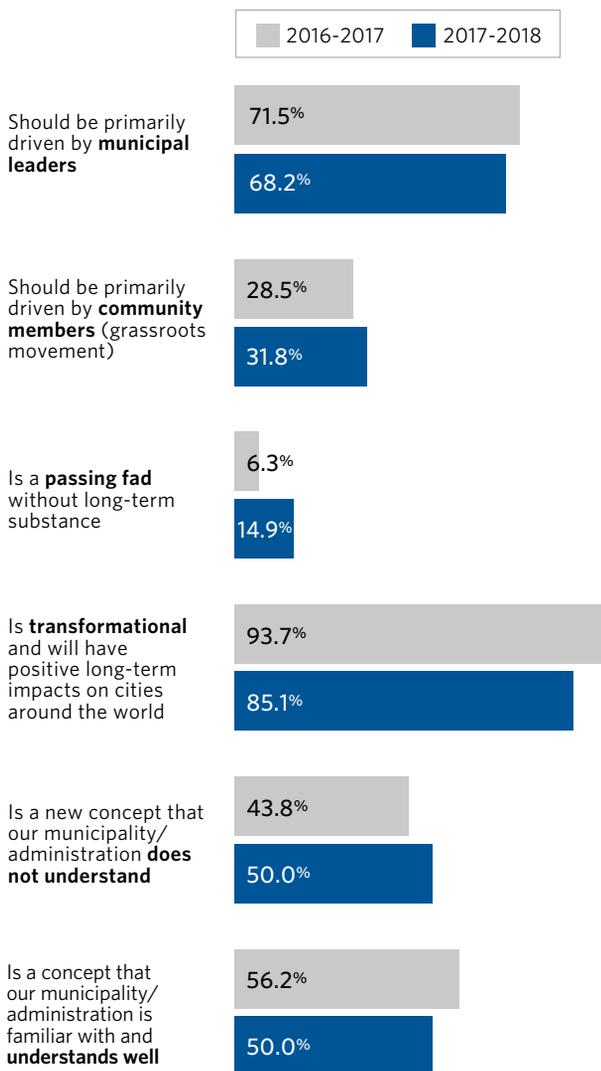
- Rising numbers of respondents say smart cities are a passing fad, and if they happen at all, they are likely far off in the future.
- Perhaps the most influential of smart city stakeholders — the electric utility — are sometimes being left out of new initiatives, or taking support roles instead of leadership.
- Possibly the biggest worry of all is cost. City leaders continue to cite affordability and tight budgets as a critical inhibitor to smart city initiatives.

Some very high-profile smart city projects in places like San Diego, Seattle and Kansas City prove that each of these obstacles can be overcome; however, it is also true that leaders of successful projects faced these questions before making the hard choice to push forward.

What do they see that others may miss?

FIGURE 23

Listed below are several opposing statements related to “smart city” initiatives. Please select the statement you agree with most.



Source: Black & Veatch

SMART CITY STAYING POWER

Among the most interesting findings from this year’s survey is the rising sentiment among those who view smart cities as lacking substance. While it’s true that an overwhelming 85 percent of respondents say smart city projects are transformational with long-lasting impacts on cities, the number of respondents who see the trend as a fad more than doubled from the previous year (Figure 23).

Smart city advocates might too quickly attribute those doubts to a lack of understanding. There is a genuine debate over just how smart even the smartest cities — ones that have projects on the books — really are. As Kendra L. Smith, associate director of community engagement in the Center for Population Health Sciences at Stanford University, bluntly assessed in a recent column for Scientific American, “The current reality of smart cities is that there aren’t any. At the end of the day, most so-called smart cities are just cities with a few or several standout smart projects.”

Moves are afoot to make the case for the important step of large-scale planning. For example, interactive dashboards, powered by Black & Veatch’s ASSET360® data analytics platform, enable city leaders and community members to review and productively engage with program priorities, plans and progress.

Cities are confronted with two options: the simple pilot project that shows quick results or the comprehensive master plan that scales the smart city up over years and decades. It is understandable that pilot projects can show results and gain momentum, but the long-term benefits of a master plan that can account for how all systems — power, water, communications, transportation and public safety — can work together are undeniable. Smaller, single-point initiatives have great value, but in isolation, they may fuel skepticism that smart cities are little more than one-off projects with little long-term benefit.

FIGURE 24

What are the top three hurdles that your city/utility has had to address to enable utility, city/community or campus systems to be managed in a smarter, more integrated way? (Select three choices.)

	By Organization Type	
	Government/Municipality	Smart Services Provider
Policy hurdles	28.1%	29.6%
Lack of resources or expertise	35.2%	53.7%
Technology availability	20.0%	40.7%
Budget constraints	63.3%	55.6%
Gaining stakeholder support	23.3%	31.5%
Ownership across departments	24.8%	24.1%
Time constraints/other priorities	29.0%	31.5%
Short-term mindset	27.1%	27.8%
Other	2.4%	1.9%
Don't know	11.0%	0.0%

Source: Black & Veatch

COST DRIVES THE CONVERSATION

Budget impacts carry the most primacy in any smart city project discussion. Nearly two-thirds of survey respondents (from governmental or municipal circles) cited budget constraints as their top hurdle to implementing smarter systems. There were also interesting increases in the numbers of respondents who cited time constraints and short-term mindsets as barriers within their organizations (Figure 24).

Fortunately, new models are challenging old notions about prohibitive upfront costs. For example, the city of Sacramento, California, is teaming with Verizon in a public-private partnership designed to increase public safety, support economic development, create jobs, bolster educational opportunities for Sacramento’s youth, and advance digital equality by offering free Wi-Fi access in many of the city’s public parks. The proposed program will deliver a safer,

more mobile and more sustainable city providing private-sector small cell infrastructure investment, technology and implementation expertise.

Public-private partnerships help in two crucial ways. They pair the value brought by city assets with private capital to raise levels of service unattainable by going it alone. They also tap the experience of a technology provider when bandwidth and expertise among city staff is constrained.

There is the larger, long-term growth to consider. Just as light rail and new mass transit are known for attracting new businesses and population, businesses are drawn to locations that are “smart.” It means they will have the best in network connectivity, information and data processing, which in turn will lure talent, foot traffic, quality of life, amenities and entertainment.

ELECTRIC UTILITY BLACKOUT

With power being one of the fundamental elements of any city, lessons learned in the generation and delivery sectors have put electric utilities in a prime position to lead successful smart city projects. Their experience in innovating on the grid, adopting new business models and deploying technology to drive efficiency meshes well with the smart city movement.

Yet, responses in this year's survey showed nearly 35 percent of utilities are playing support roles in smart city initiatives, with more than 28 percent playing no role. These utilities are too frequently left to supporting roles, or no part at all, when projects get underway.

Electric utilities are facing a need and opportunity to transform their business because of the bidirectional nature of distributed generation and energy storage. We see a time, perhaps in the next five to 10 years, when distributed generation will outgrow conventional utility plant generation in certain regions. The amount of data and information needed from these systems is only going to become more and more relevant. Connectivity between systems will be critical in harmonizing how electric vehicles, distributed generation, energy storage and conventional generation all work together to match energy supply to demand, and provide needed system resiliency.

Energy innovation is at the heart of the smart city. Utilities are modernizing their grids, empowering customers and integrating new market participants, business models and technologies. It is imperative that utilities have a seat at the table, driving the smart city forward.

THE QUESTIONS ARE REAL, BUT SO ARE THE ANSWERS

The future of connected communities relies on strategic urban infrastructure that arises from the critical smart city layers of infrastructure, data and telecommunications. But how can we help cities, utilities and telecommunications providers better understand and take advantage of these critical components?

Perhaps we should start by moving away from the hype when validating the real cost concerns for cities. We can then begin the dialogue to develop an understanding of the broad benefits data and connected systems bring to citizens. From that understanding, visionary leaders will lead the way to make the benefits come to life.

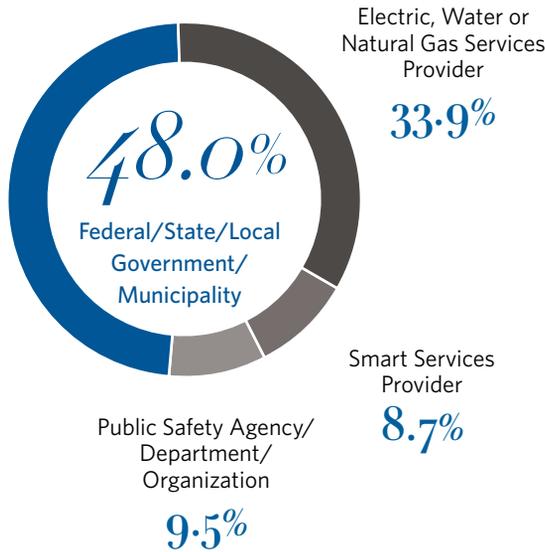
2018 Report Background

The Black & Veatch *2018 Strategic Directions: Smart Cities & Utilities Report* is a compilation of data and analysis from an industrywide survey. This year's survey was conducted online from 2 October 2017 through 31 October 2017. A total of 644 qualified utility, municipal, commercial and community stakeholders completed a majority of the survey.

Because the survey was administered online, the amount of self-selection bias is unknown; therefore, no estimates of sampling error have been calculated. The following figures provide additional details on the participants in this year's survey.

FIGURE 25

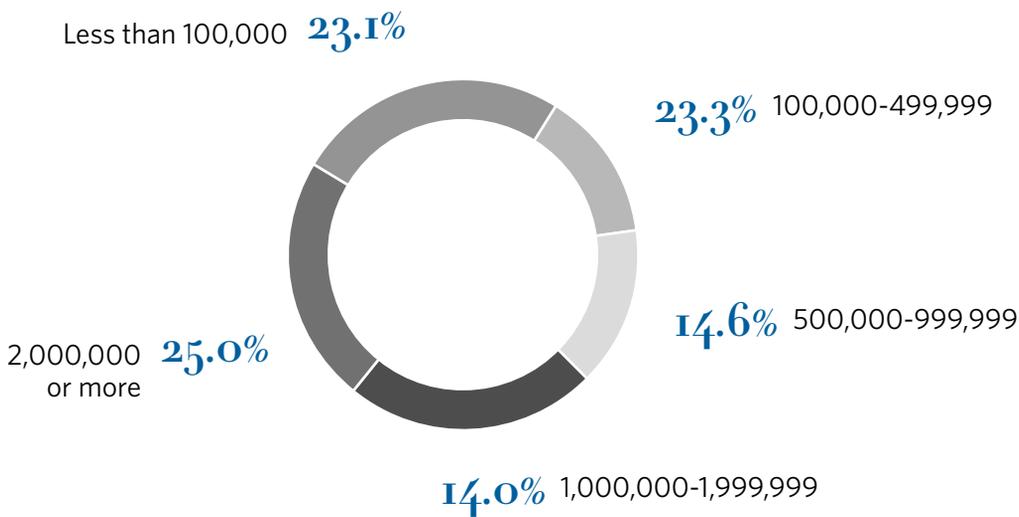
Which of the following best describes your organization?



Source: Black & Veatch

FIGURE 26

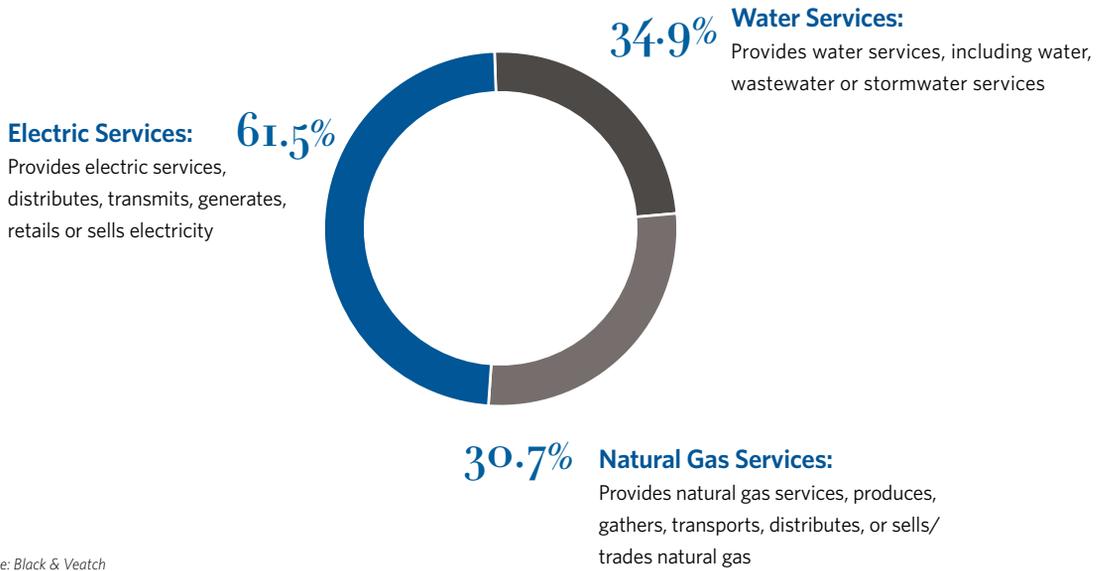
What is the estimated population served by your organization? (Select one choice)



Source: Black & Veatch

FIGURE 27

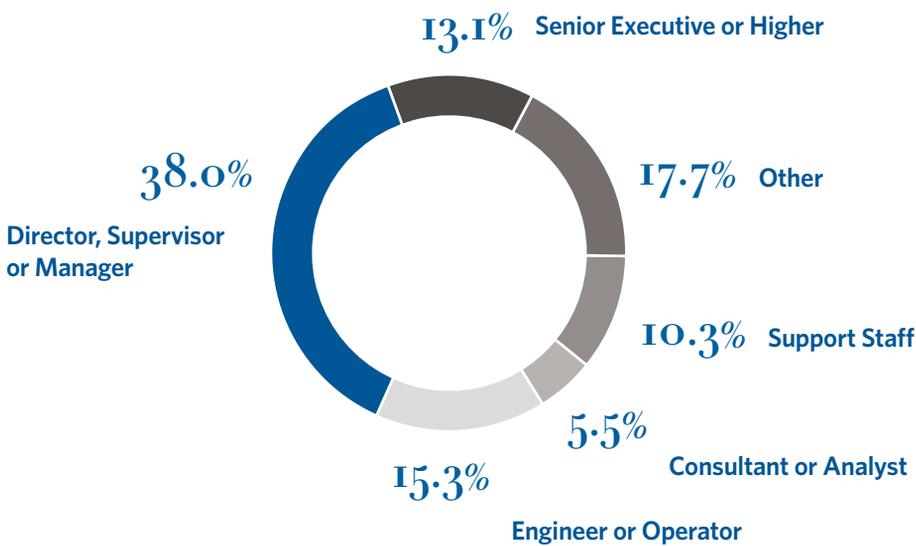
Which utility services does your organization provide? (Select all that apply)



Source: Black & Veatch

FIGURE 28

What job function do you currently hold within your company? (Select one choice)



Source: Black & Veatch

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