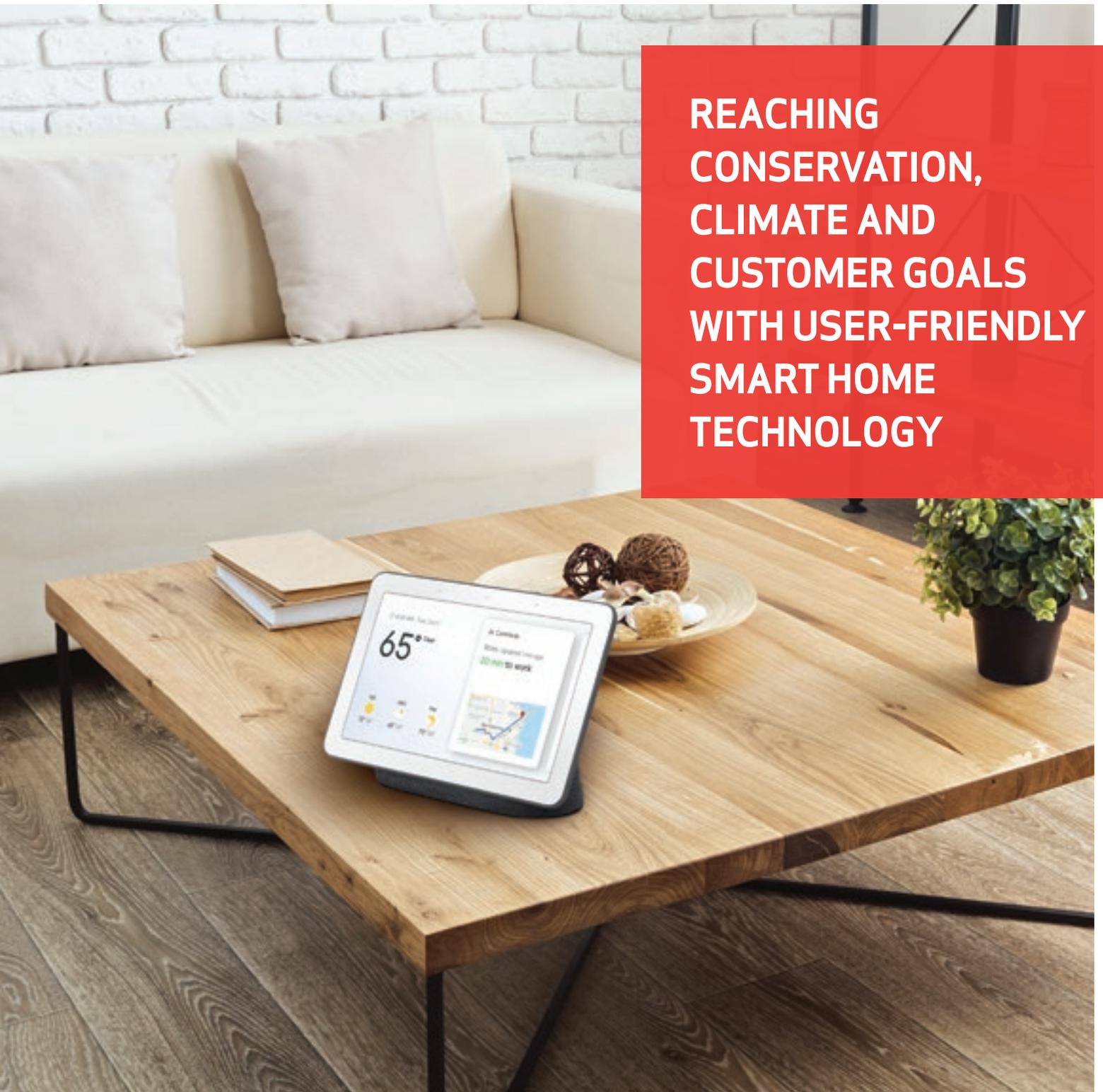


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PREPARING FOR WHAT'S AHEAD | Elisabeth Monaghan, Editor in Chief

The chatter may have died down about the top industry wins in 2018, but all of us will continue working to address the industry's most pressing issues. To ensure we are helping electric utilities and other industry partners respond to the greatest challenges they face in 2019, our contributors to this issue discuss the tactics and proven solutions that have worked for them and which just might help the rest of us prepare for what's ahead.

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Systems are only as good as their uptime. No one understands this more than utility managers, who told Black & Veatch in the company's 2018 Strategic Directions: Electric Industry Report that the long-time challenges of reliability, security and infrastructure are just as important today as they have been in years past.

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Electric utilities are required to operate and maintain the critical infrastructure that is vital to the overall health of an electrical network. In many cases, these systems or installations are un-manned, often located in places like distant substations or underground manholes. With these remote sites, engineers, operators and technician crews must be physically on-site to collect data manually, monitor conditions or perform maintenance.

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GUEST EDITORIAL

YOU CAN'T PREDICT THE FUTURE OF SMART GRID INTEGRATION, BUT YOU CAN MANAGE IT | Brad Harkavy

Today, there is an explosion of Distributed Energy Resources (DERs) such as wind, solar and storage being added to the grid daily. While Neils Bohr famously said, "Prediction is very difficult, especially if it's about the future," what is clear is the need for scalable technologies to manage an increasingly complex grid of devices, data and systems of systems from here forward.

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THE BIGGER PICTURE

PEEKING INTO UTILITIES FUTURE: RELEVANCE, RISK AND RESILIENCE | Roberta Bigliani

Offering combining distributed generation and energy storage at home is just one among the several examples of how utilities are changing the way to accomplish their mission. Digital disruptors are circumventing industry entry barriers, and utilities are being reborn in 3D: decentralized, divergent and digital.

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SECURITY SESSIONS

CREATING A MORE SECURE ELECTRICAL GRID FIVE CRITICAL CONSIDERATIONS FOR NETWORKED EQUIPMENT AND DEVICES | Max Wandera

As utilities implement innovative connected technologies, they're challenging suppliers to provide substantial cybersecurity assurance against emerging cyber threats. Although both the utility and manufacturer share responsibility when it comes to creating a secure grid, product cybersecurity should be an integral consideration much like product quality, with strict protocols placed on the people, processes and technologies at every phase of product creation.



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POWERFUL FORCES

KATHY NELSON – ONDAS NETWORKS

| Elisabeth Monaghan, Editor in Chief

For this issue of EET&D, we are pleased to spotlight Kathy Nelson, a "powerful force," who leads industry relations and product marketing for Ondas Networks. With 25 years of experience as a telecommunications engineer in the electric utility space, Nelson has both witnessed - and participated in creating - the myriad changes the industry has undergone - especially over the past decade.

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AMEREN ILLINOIS REMOVES JUNK FROM RIGHT-OF-WAYS AND ALLEYS IN TINY ILLINOIS COMMUNITY

By Brian Bretsch

Years of illegal dumping in alleys in the tiny Village of Washington Park, Illinois, has choked off automotive traffic and made it virtually impossible for Ameren Illinois trucks to gain access to its natural gas and electric facilities.

The massive amount of debris – mattresses, tires, roofing shingles, even TVs – has created a huge headache for the Village. For Ameren Illinois, the presence of the trash in its right-of-ways has slowed crews responding to natural gas calls or repairing downed power lines after a storm. The company has even resorted to using its own heavy equipment to push the debris out of the way.

With Washington Park scheduled for routine tree trimming, Ameren Illinois Vegetation Manager Rick Johnson and his team knew they needed to do more than just trim and remove invasive plants in the community. They needed to take matters into their own hands to solve the debris problem.



Many of the alleys and right-of-ways were chock-full of debris such as doors, awning, tires, clothes and shoes.

With the help of Paula Nixon, community relations liaison for Ameren Illinois, the company partnered with the Village of Washington Park and one of Ameren's diverse suppliers, Bill Mason Landscaping. Under a pilot program, funded by Ameren Illinois, Bill Mason Landscaping removed the debris from the alleys and right-of-ways and placed it in a designated area. Once or twice a week, public works employees for Washington Park properly disposed of the materials at a nearby landfill.

Overall, approximately 200 dump truck loads of debris were removed. Now that the right-of-way are accessible, tree trimmers are safely clearing paths to the company's natural gas and electric equipment.

"In the long run, this saves Ameren Illinois money and resources because we now have ready access to our facilities," Johnson said. "I'm proud of the partnership we have with the Village of Washington Park and the community has really shown us their appreciation for removing this debris."

The results of this pilot program have been quite the site to see for local residents. What was once an eyesore has become a line of sight for all to look from one end of an alley to the other. It has given many in the community access to their property from the alleys for the first time in years.

"There is a great sense of pride in this neighborhood now," said Washington Park Mayor Rickie Thomas. "Everyone is so happy. When the workers are out here, citizens are bringing them water, asking them if they need anything to eat. The community wants the right-of-ways clean. But we have a lot of outsiders coming in, dirtying up the community, dumping. The citizens are grateful that the Village of Washington Park and Ameren Illinois joined together to get this trash removed."

"What may have once taken us weeks to trim can now be completed in a matter of a day or two because all of that debris has been removed," said Richard J. Mark, chairman and president of Ameren Illinois. "Even more importantly, we will be able to get to our gas and electric equipment much more quickly and safely."



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STATNETT SPEEDS UP THE DIGITAL TRANSFORMATION

January 2019

Statnett has signed an R&D agreement with Cognite to gain momentum in the creation of the digital foundation that is fundamental for us to achieve a digital transformation.

"Cognite has the expertise and working methods in place, and can therefore contribute significantly to the digitization of Statnett's processes" says Peer Olav Østli, Senior Vice President ICT in Statnett.

Initially, Cognite will contribute to digitize the asset management in Statnett.

Cognite has worked closely with the oil and gas sector, and is familiar with complex processes that are also found in the power sector. Statnett and Cognite will work closely together during the contract period, and an expected outcome is that Statnett will be positioned to take more data driven decisions.

"We own and manage more than 11,000 km of power lines, multiple cables and 150 transformer stations with many critical components, and by digitizing the management of these, we will be able to streamline operation and also contribute to securing the power supply," explains Østli.

Cognite will also help to digitize the processes around connection applications.

"We are experiencing a strong increase in the number of requests for connection to the grid across the country, a large number of stakeholders consider connection of new consumption in several areas, and each of these require analyses," says Østli. "If we can have a more streamlined and digitized process related to these requests, will we save time and resources both at Statnett and with the stakeholders."

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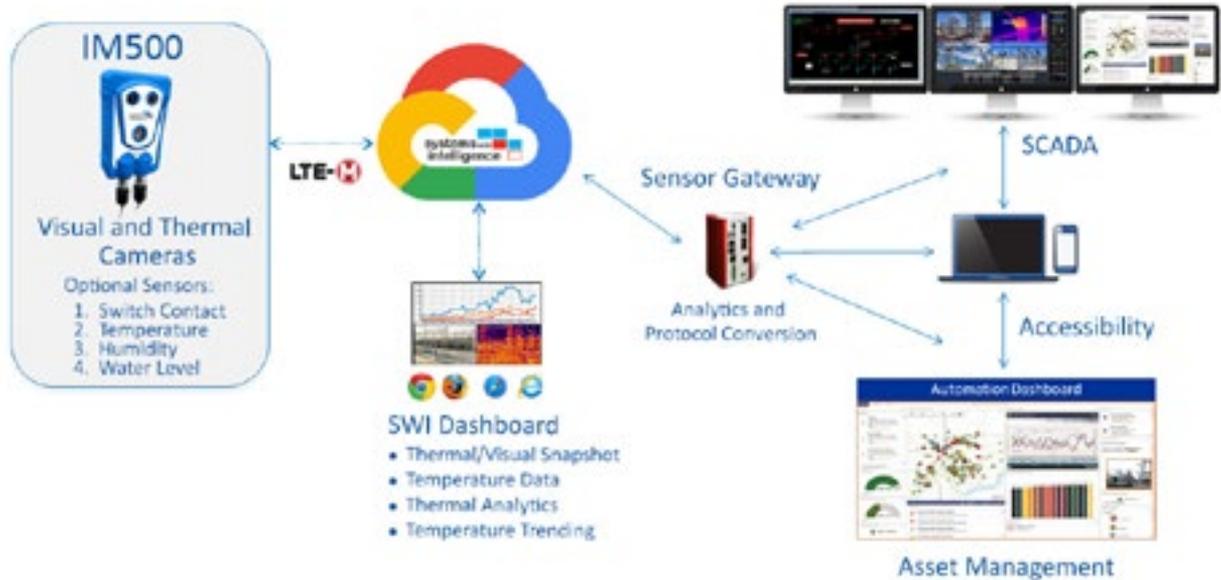
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NYPA WILL PROVIDE TECHNICAL SUPPORT AND CONSULTATION FOR THE OPERATION, MAINTENANCE AND MODERNIZATION OF THE ISLAND'S ELECTRIC GRID

January 2019

Governor Andrew M. Cuomo today (1/4) announced that New York State will provide technical assistance to the U.S. Virgin Islands for its ongoing efforts to rebuild and modernize the islands' electric grid. The U.S. Virgin Islands' power systems were heavily damaged when two Category 5 hurricanes Irma and Maria made landfall on the island in September 2017. A recovery effort by the Virgin Islands Water and Power Authority has been underway to restore and improve the island's electric infrastructure, and WAPA is now requesting assistance from the New York Power Authority through the American Public Power Associations' mutual aid process. A memorandum of understanding between NYPA and WAPA was signed today to put in place the needed mechanisms for New York to provide technical consulting support for the electric infrastructure rebuild.

"More than a year after these two devastating hurricanes made landfall, the U.S. Virgin Islands are still recovering, and New York is committed to helping our fellow Americans in their greatest time of need," **Governor Cuomo said.** "We welcome the opportunity to offer assistance and support as the islands work to rebuild their electric grid, and we will not rest until they are stronger and more resilient than ever before."

"Severe weather events have devastated communities across the country damaging homes and infrastructure," **said Lieutenant Governor Kathy Hochul.** "We're helping the U.S. Virgin Islands rebuild and recover after being hit by hurricanes last year, providing assistance to restore the island's electric grid and making improvements to ensure resiliency in the future."

WAPA, utilizing federal emergency support funding, is requesting assistance and guidance from NYPA in the pursuit of building a resilient power system able to withstand the impacts of acute weather events, including extreme weather resulting from climate change. WAPA will make investments in upgrading the island's generation, transmission and distribution systems to improve reliability, as well as incorporate a practical approach to alternative energy resources such as wind and solar to help reduce its reliance on fossil fuels.

Earlier this year, the Power Authority, leading a contingent of more than 450 New York utility personnel, completed power restoration to more than 300,000 customers in the San Juan metro-area of Puerto Rico, which also suffered severe damage from Hurricane Maria in 2017. NYPA continues to consult and assist Puerto Rico today as part of New York's commitment to support the rebuild of the island's power grid.

Gil C. Quiniones, NYPA president and CEO, said, "NYPA is standing ready to provide technical support for the rebuild and modernization of the U.S. Virgin Islands' electric grid. The mutual assistance process is an excellent, non-profit method to leverage the expertise of fellow utilities. The Power Authority is eager to provide support to WAPA to assist in its development of a modern, resilient electric system."

Lawrence Kupfer, Executive Director, U.S. Virgin Islands Water and Power Authority, said, "On behalf of residents of the USVI, we thank Governor Cuomo and NYPA for their favorable response and commitment to support the USVI capital improvement projects geared to increase resiliency and reliability of its energy system. I also commend the work of American Public Power Association for their role in facilitating the assistance through the existing Mutual Aid Agreements between all publicly owned utilities, which includes a commitment to help each other out in times of need. As we move forward, the assistance of NYPA and APPA will be rewarding and for the betterment of all USVI residents."

WAPA is requesting support in its rebuild and modernization effort in five key categories:

- The design, construction, operation, maintenance and repair of WAPA's power generation, transmission and distribution system, including the integration of renewable and other alternative energy generation sources, energy storage and demand management.
- The development of methodologies, policies and corporate governance practices for the improvement of power grid reliability and resiliency with respect to storms and other catastrophic, environmental and economic threats.

- The study and development of economically viable best practices to harden the power grid against likely major weather events in the future, including the use of new designs, materials, system monitoring and control methods to prevent or minimize the impact of outages and power grid damage, reduce repair costs, and shorten recovery times.
- The development of improved corporate capacity and support services, including supply chain sustainability, physical and cyber security management, critical contractor access and availability, repair and recovery equipment, available inventory materials, internal and external communications, and response and mobilization planning for significant events.
- Potential strategies for long-term infrastructure upgrade financing and economic partnering with customers, suppliers, investors and financiers.

Congresswoman Nydia Velázquez said, "Hurricanes Irma and Maria brought unprecedented damage and devastation to the U.S. Virgin Islands, destroying the islands' power infrastructure in the process. One cannot underestimate the need for a stable, modern electric grid that can support the island and endure future storms such as these. While we have made progress in restoring power to the islands, we must ensure that this sort of catastrophic power loss can never happen again. I thank Governor Cuomo for building upon our efforts and providing the islands with the assistance they so desperately need."

Congressman Gregory W. Meeks said, "The U.S. Virgin Islands remain greatly impacted from the devastating hurricanes of 2017. Restoring and fortifying their power grid is critical for letting residents resume their daily life, and though federal funding has helped, there is much more left to be done. I applaud Governor Cuomo for utilizing New York's expertise and lending a hand to help in this process."

Congressman Adriano Espaillat said, "We continue to make progress as the U.S. Virgin Islands work to rebuild their electric grid, but with more work to be done, assistance like this from the State of New York is invaluable. These hurricanes produced more damage than was ever imaginable, and rebuilding an electric grid in the wake of such destruction is a long, challenging task. I commend the Governor for providing such crucial support to the islands and for helping to modernize the electric grid more quickly and effectively than before."

Mike Hyland, Senior VP, Engineering Services at the American Public Power Association, said, "The American Public Power Association is excited to see the agreement between US Virgin Islands Water and Power Authority and the New York Power Authority. This is another example of the breadth and effectiveness of our national public power mutual aid network. We connect members to help not only in times of storm but also in times of calm so we can share lessons learned and be prepared for the next disaster."

NEW LAW: ENERGY EFFICIENCY CHARGE TO APPEAR ON JANUARY BILLS IN IOWA

January 2019

A change in state law means MidAmerican Energy Company's Iowa customers will soon see a monthly "energy efficiency charge" on their utility bills - though customers are not actually paying a new fee.

Beginning in January, Iowa's regulated utilities, including MidAmerican Energy, will show energy efficiency fees on a separate line on monthly customer bills. Utilities are required to use the fees to fund energy efficiency programs. MidAmerican Energy does not profit from the fees, and the money collected is passed through to other customers to support their energy-saving projects.

Law to lift ban on fee disclosure in January

The legislation, signed into law in May, requires utilities to itemize the energy efficiency charge beginning January 1. That's a significant change from the previous law that has barred utilities from listing the charge on monthly bills and required them to include the fee in the energy rate charge.

"Most of our Iowa customers, along with other regulated utility customers in the state, probably don't know they are paying the monthly energy efficiency fee, which funds energy efficiency programs," Kathryn Kunert, MidAmerican Energy's vice president of economic connections and integration, said. "That changes in January, when the law will require utilities to list the fee. We welcome that transparency, and we think our customers will, too."

Customers to see lower energy efficiency program charges later in 2019

The law will also reduce MidAmerican Energy customer utility bills by capping energy efficiency program spending. In 2017, MidAmerican Energy's Iowa customers paid, on average, more than 7 percent of their bills toward energy efficiency programs, the highest in the nation. During that 12-month period, an average single family home paid \$145.16, including \$67.50 on electric and \$77.66 on natural gas bills for energy efficiency programs.

The legislation will limit energy efficiency program spending at 2 percent for electric and 1.5 percent for natural gas. The spending caps will save MidAmerican Energy customers an estimated \$80 - \$90 million annually. On average, it will save about \$81 per year for MidAmerican Energy's residential gas and electric customers, \$172 for commercial and more than \$12,000 for industrial energy users.

Once the Iowa Utilities Board issues a ruling on MidAmerican Energy's latest proposed energy efficiency program spending plan, which the board must file by the end of March, the company's Iowa customers will pay reduced energy efficiency charges. Those reductions will take effect later in the year, depending on the board's ruling.

While MidAmerican Energy customers will pay less each month, the company will continue to offer energy efficiency programs and customer energy savings incentives.

"Since our Iowa customers will pay less every month into an energy efficiency fund, they are now able to make more of their own spending decisions," Kunert said. "Customers will also continue to benefit from robust energy efficiency programs, in addition to the clean, renewable energy that MidAmerican delivers to them."

New look for monthly bill

Separately, MidAmerican Energy customers will see a new monthly bill format beginning in January. MidAmerican Energy redesigned the bill, based on customer input, to make it easier to understand monthly energy use and charges.

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PREPARING FOR WHAT'S AHEAD



ELISABETH MONAGHAN
Editor in Chief

As I write this, the New Year has just begun, and I am still adjusting to writing 2019 when filling in the date. By the time this issue is in the hands of our readers, the New Year's celebrations will be long-forgotten. The chatter may have died down about the top industry wins in 2018, but all of us will continue working to address the industry's most pressing issues. To ensure we are helping electric utilities and other industry partners respond to the greatest challenges they face in 2019, our contributors to this issue discuss the tactics and proven solutions that have worked for them and which just might help the rest of us prepare for what's ahead.

Customer Engagement – A Must-Have Strategy

Every issue of *EET&D* we've published since I joined the magazine nearly two years ago has had at least one article that touched upon energy customers and their changing behavior. Business publications, marketing blogs and a variety of podcasts frequently remind us of how customers are demanding and expecting more, and how companies must be ever-focused on enhancing the customer experience.

In our industry, we hear so much about energy customers who no longer are "just rate-payers," but instead are prosumers who want to control how and when they use energy. They want access to smart device that allow them that control. And they want their energy providers to understand how these smart devices work.

In this issue's "Grid Transformation Forum" Jeff Hamel who is the director of global energy and enterprise partnerships for Google addresses consumers and smart technology. Hamel first lists the questions utilities must ask before they attempt to engage their customers. He then discusses what utilities can do to enhance customer engagement and explains how, not only this will benefit the consumers, but by working through smart technology solutions with end-users, it will improve energy efficiency and reduce carbon emissions.

Alex Corneglio co-founder of EnergyX Solutions, who wrote this issue's "Green Ovations" column, also writes about the importance of utilities engaging more effectively with their customers. Corneglio focuses his article on why utilities must include digital communication as part of their customer engagement strategy. Further, Corneglio explains why and how utilities should incorporate personalization into that strategy. As Corneglio points out, it is no longer the time for utilities to *think* about creating customer engagement programs; it is now time to have those programs already in place.

Roberta Bigliani with IDC also hits on the importance of implementing communications channels between customers and utilities. Writing in this issue's "The Bigger Picture" column, Bigliani recaps an IDC report that addresses a number of topics, including what the future holds for utilities. According to IDC Energy Insights, the customer experience will always matter. Like Alex Corneglio, the IDC report emphasizes the need for communication between utilities and their customers. What's more, the IDC report backs up Corneglio's point that utilities recognize that not only do their customers expect their utilities to communicate regularly with them – they also prefer that communication from modern (e.g., digital) channels.

Jeremy Klingel with Black & Veatch sums up a 2018 electric industry report, based on a survey that was issued recently to more than 300 utility, municipal, commercial and community stakeholders. The resulting report discusses what the survey respondents consider the most critical issues haunting the electric sector. In addition to discussing the electric survey questions and responses, Klingel also offers thoughts on what utilities should do to work more effectively – not only with industry regulators – but also with the customers. While the survey did not ask specific questions about customers, Klingel explains the significance of the responses regarding how utilities can better serve energy consumers.

There is no global or national initiative for utilities to embrace customer engagement, but from just the handful of articles I've mentioned here, it is evident that, as Roberta Bigliani writes in her article, the customer experience will always matter. For those utilities who are not yet on board with customer engagement programs, there is no limit to online information or other tools to help them get started on creating one.

Powherful Forces in 2019

Last year, when we introduced our "Powherful Forces" column, we profiled three women. For 2019, we are including the column in every issue. I have read about, and in some cases, actually met remarkable industry leaders, who happen to be women. With programs like STEM that encourage young students to learn about math and science, the future looks bright for female executives working in electric energy.

In this issue, we introduce our readers to Kathy Nelson, who, after spending 25 years with Green River Energy, recently joined Ondas Networks. Most of the female industry leaders we featured in 2018 shared stories about how their fathers were influential in helping them decide to become engineers. Nelson was fortunate to be among the powerful forces whose father instilled the value of formal education and who cultivated in Nelson a love for math and science. In describing her experience and the lessons she passes on to professionals looking to work as engineers, Nelson talks about the need to do more than "just show up for work." To learn about one's industry, and to be established as one of its leaders, Nelson urges professionals to get involved with trade organizations, read trade journals and attend industry shows. Submit articles for publication, as well as apply to speak at industry conferences. Interestingly, Nelson is not the first person who has given this advice. The others who have shared it also are industry executives. It seems they advise greater involvement in our industry because, having become established as respected experts and energy sector leaders, the advice works.

If you would like to contribute an article or if you have an idea about interesting technology, solutions, or suggestions, please email me at Elisabeth@ElectricEnergyOnline.com.

Elisabeth

REACHING CONSERVATION, CLIMATE AND CUSTOMER GOALS WITH USER-FRIENDLY SMART HOME TECHNOLOGY

JEFF HAMEL

Electric utilities around the U.S. and the world are in the midst of a transformation, facing new competition, higher consumer expectations, the ever-intensifying impacts of climate change and the emissions control policies being implemented to curb those impacts. These are just a few of the factors pushing utilities to change their business models, customer communication strategies and core philosophies about how to endure and thrive. Utilities at the forefront of their industry have made progress in recent years, taking bold steps toward redefining themselves to their customers as comprehensive energy services providers, instead of faceless companies that only interact with their “ratepayers” by sending them a bill each month.

To fully embrace this industry shift, technology companies and utilities alike need to ask, what will help take customer engagement to the next level? Cutting-edge smart home technology that is user-friendly and compatible with other devices will be the key to utilities reaching unprecedented levels of success in customer engagement, demand management and associated reductions in greenhouse gas emissions. Offering a central home energy platform with device control and interoperability is a good place to start.

Joining the Energy Innovation Movement

There is a lot of innovation taking place in the world of energy, especially with wind, solar and storage technologies. These relatively new renewable resources are essential for reducing carbon emissions, yet many innovations can take a very long time to achieve results and are not currently accessible to all consumers. →





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One of the simplest solutions for reducing energy use and emissions is to increase utility-customer communications and understanding in order to boost voluntary conservation and efficiency measures. Utilities have many incentives to actively engage with consumers: it adds flexibility to the grid, reduces emissions and increases customer satisfaction.



In reality, customers often don't think about a utility's offerings until their bill comes due or something goes wrong with service.



This isn't to say that it comes easy — energy use, demand response and whole-home energy management are incredibly complex undertakings for utilities to manage. They can also be difficult for customers to understand, which is a barrier to taking action to save energy in the residential sector. In reality, customers often don't think about a utility's offerings until their bill comes due or something goes wrong with service.

That said, there already are plenty of examples of how energy providers are using smart technology to engage with customers and form mutually beneficial relationships. Reliant/NRG and Xcel Energy, which recently distinguished itself by pledging to become a zero-carbon utility by 2050, are delivering voice activation services in Texas and Minnesota, pairing electricity plans with the latest smart technologies. Indiana Michigan Power (I&M) recently announced a partnership with Tendril and Google to provide customers access to voice-activated energy information. Alabama Power has also shared plans to build more Smart Neighborhoods — future-focused, energy-efficient communities that include homes outfitted with the latest energy-saving and smart home technologies. These partnerships connect the traditional utility business model and an existing customer base with the innovation and resources of big technology companies. Following the proven successes of these mutually-beneficial relationships and the advantages they confer to consumers, utilities around the country are again looking to smart technology to deliver the next-generation of customer engagement.

Turn Customers into Allies by Giving Them What They Want: Intuitive Devices And Convenience

So far, offering customers simple and effective technology resources has successfully increased participation in our energy systems. During the 2017 total solar eclipse, hundreds of thousands of Nest customers across the country heeded a call from Nest and its utility partners and activated their smart thermostats to counteract the loss of solar power. In recent years, online utility marketplaces have been an important tool for energy providers to improve customer acquisition and establish new revenue streams through the sale of energy-related home products like smart thermostats. Providers like Simple Energy, EFI and Enervee are making it easier than ever for utilities to launch these e-commerce platforms. Now it's time to think about how to take this type of engagement even further, and it's clear customers trust utility recommendations for what that looks like. A recent Smart Energy Consumer Collaborative survey found that 78 percent of consumers are more likely to participate in a program or purchase the product if their utility endorses it.



In a world packed with consumer technology, energy providers need to be conscious of consumer trends and what services and devices they are looking for.



In a world packed with consumer technology, energy providers need to be conscious of consumer trends and what services and devices they are looking for. At the beginning of 2018, Bloomberg noted that consumer demand for smart thermostats will steadily increase over the next five years, so we know the devices that have already been effective aren't going anywhere. The voice assistant industry is anticipated to generate revenues worth \$7.8 billion by 2023, and according to Parks Associates, 75 percent of consumers who are planning to buy smart home devices value interoperability with other products. →

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These market forecasts indicate that consumers would embrace a device they can easily communicate with and that automates or controls a wide range of actions and home devices from a central point. If hundreds of household energy-saving actions can be made from a single interface, and those capabilities are distributed across thousands of homes, the benefits would be profound and lasting — compounding the positive impacts we've already seen with the connectivity that smart thermostats offer to utilities and customers

The Future is an Orchestra of Smart Energy Devices

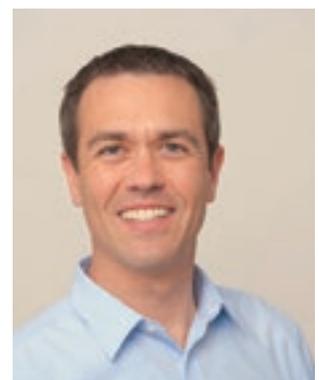
So where do we go from here? In the near future, utilities will be able to provide a richer, more personalized energy management experience to consumers — from alerts about storms and outages to reminders to pay a bill and easy ways to further save energy — to offer a more holistic view of home energy use from a single interface. This is the level of transparency and engagement consumers are craving.

Utility services can no longer be siloed, and interoperability of home devices is key for maximizing energy management and consumer engagement. Identifying new opportunities to connect customers with energy-saving opportunities that are immediately accessible, intuitive and easy to integrate into daily life are key to improving the efficiency and shrinking the carbon footprints of homes across the country.

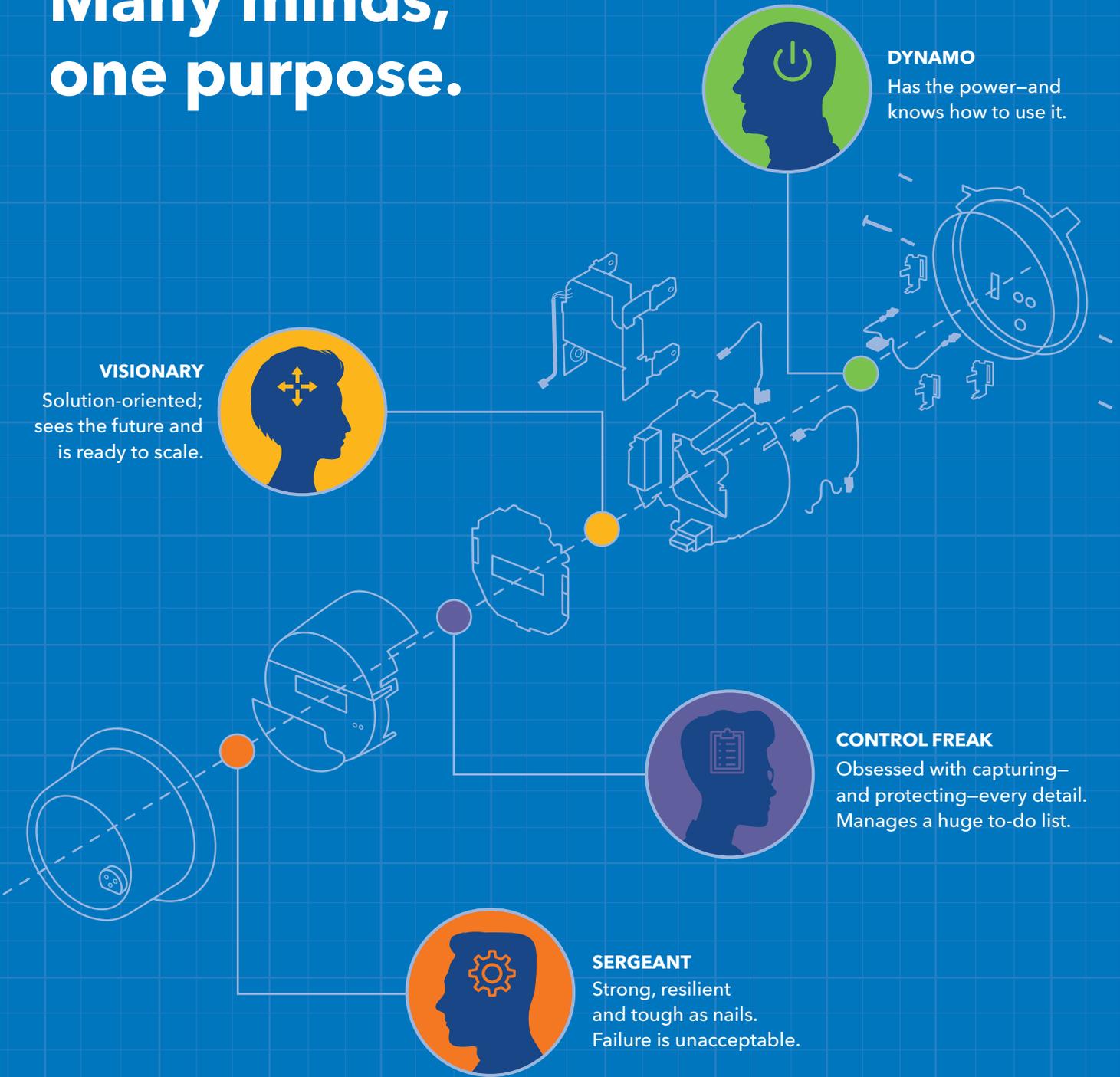


ABOUT JEFF HAMEL:

Jeff Hamel is the director of global energy and enterprise partnerships at Google and is responsible for developing and executing strategic partnerships with electric and gas utilities, solar providers and enterprise service providers that leverage Google hardware and services to deliver customer-focused programs. Previously, he was the head of North American energy partnerships at Nest Labs, where he worked with utility partners to develop customer-focused energy programs that leverage Nest products. Prior to joining Nest, Hamel was the executive director for EPRI's Power Delivery and Utilization team, with responsibilities for growing broad collaboration with global utilities and governmental agencies. Before joining EPRI in 2007, Hamel worked at General Electric and was responsible for managing and leading new growth in GE's power business. He earned his Bachelor of Science, a U.S. Coast Guard Merchant Marine License and his commission in the U.S. Naval Reserves while attending Massachusetts Maritime Academy. In addition, Hamel has also earned an MBA from Santa Clara University.



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TODAY'S ELECTRICITY CONSUMERS DEMAND PERSONALIZATION FROM HISTORICALLY IMPERSONAL INDUSTRY

A hand holding a white stylus over a laptop keyboard, with a tablet in the foreground and a person in the background.



ALEX CORNEGLIO

The Rise of Data and Digital Customer Services

For the past decade, electric utilities have been busy upgrading their operations with advanced meter infrastructure. Although customer acceptance of “smart” technology has been mixed, there is now overwhelming evidence that technology is transforming how customers expect to be engaged. It should come as no surprise that technology is also redefining how utilities can engage with their customers. Moving beyond online bill pay, real-time consumption charting and a digital presence across social media platforms, utilities must now also consider an expanding array of digital customer services, often driven by artificial intelligence, to better communicate with their customers on an individual level and generally improve operations.

This new-wave of digital communication and personalization is not a moment too soon. Today’s customers expect that digital tools and processes will provide them with personalized access to information and services through their laptop, tablet, mobile device and even conventionally printed formats. These modern customer expectations are being provided for across virtually all industries today, and customers now expect the same level of interconnectivity and congruence from their utility services. Utilities must augment traditional customer communication methods with innovative technology solutions that help to personalize the customer experience while simultaneously improving the cost-effective delivery of kilowatts and other initiatives. →

Over the last several years, I've had the opportunity to interact with utilities and their customers through a variety of mediums including online building assessments, site visits, building energy reports, and in-bound customer service queries. Based on the data collected through these interactions, there are a number of trends and findings that every electric utility should consider when planning their upcoming customer service delivery strategies, program and marketing campaigns, and even operational expenditures.

This article focuses on findings and trends in two main areas:

1. How utilities should communicate with customers, and
2. How utilities can personalize their communications

How Utilities Should Communicate

With so much emphasis placed on moving customer interactions to the digital realm, you may wonder if the sun is finally setting on conventional paper-based communications?

With most of the utilities I engage with, the percentage of customers that have an email address on file with the utility is less than 30 percent, which is undeniably low. This finding is echoed by a 2017 Accenture Report finding that “only 27 percent of energy consumers are active digital users. A third of energy consumers are still struggling with their experiences on their energy provider’s digital channels.” Meanwhile, a 2018 GSMA report on the mobile economy explains that smartphone penetration in North America is currently at 84 percent of the population indicating that the lack of digital customer engagement is likely not due to a lack of digital access, demographics, or even personal preferences.

With smartphone penetration in North America expected to continue growing through 2025 and digital engagement on the rise across all industries, it is hard to imagine that the majority of customers will continue to want to receive

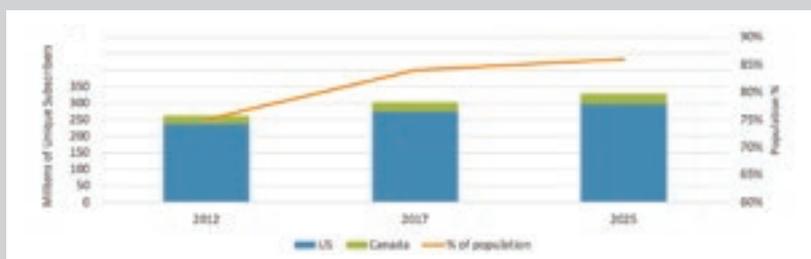
paper from their utility. Indeed, that day may already have come and gone. Another recent utility-focused study by Market Strategies International found more than 50 percent of customers would already prefer to engage with their utility digitally, but “only 33 percent of consumers recall any digital communication from their utility.” The Accenture Report found that 88 percent of customers were ready to engage digitally with their utility. The Accenture Report also outlined the myriad of benefits of a digital customer engagement strategy, including more than 50 percent reductions in customer service costs, lowering of operating expenses, and even improved productivity and innovation across the utility workforce.

In light of these trends and benefits, it is no wonder that other industries are pushing forward with digital transformations. Coleman Parkes, a UK based research firm, ranked industries’ efforts towards digital transformation on a scorecard and found utilities came in last out of 10 industry sectors examined. The leading industries according to the same scorecard were Telecom and Banking/Financial Services.

So, if customers are struggling to engage with their utility through digital channels, and utilities are struggling to find ways to boost digital engagement is there any hope of making progress? A recent program I was involved with indicates the answer can be a resounding “YES.” During a home energy assessment initiative in 2018, more than 100,000 households received home energy assessments and personalized home energy reports with the option to receive their report digitally via email or on paper via direct mail. During this engagement, we saw a complete reversal of digital engagement trends with more than 90 percent of program participants opting to receive their report digitally via email.

Reading between the lines, this speaks volumes to the perceived interest or value placed on typical utility communications and the customer’s motivation to engage with typical communications. There is an argument to be made that although the majority of utility customers

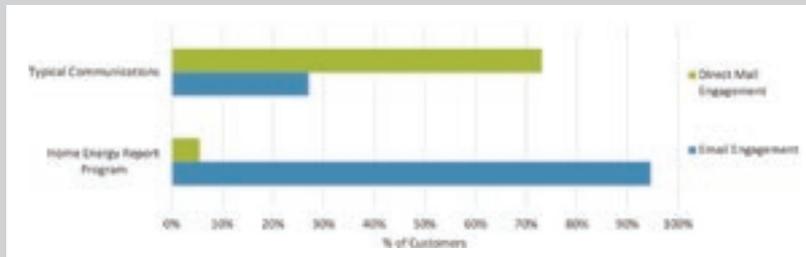
Figure 1. Smartphone Penetration in North America



Note: Smartphone Penetration in North America continues to rise, supporting an increased appetite for digital content

Source: GSMA Intelligence 2018

Figure 2. Customer Communication Preferences for Different Utility Initiatives



Note: Digital vs Direct Mail preferences can vary significantly, depending on content and customer motivations

Source: EnergyX Solutions Inc. 2018, sample size = 43k

continue to receive paper communications, they still aren't as actively engaged as the customers that do engage digitally. For example, looking at site traffic referrals across digital platforms in **Figure 3**, the majority of traffic comes from digital leads such as social media, web-ads and referral landing pages. Similarly, the largest upticks in our site traffic occur after digital marketing campaigns and integrations with online utility "customer account pages" and partner websites.

Digital marketing and leads are key to helping customers engage with digital content, they also tend to be more cost-effective and trackable than direct marketing activities. (Note: direct traffic is comprised of in-person engagements, direct mailings, conventional marketing, radio ads, etc.)

So, the future, and the present, for that matter, are digital. But what should utilities be talking about with customers across their developing digital channels? Research indicates that personalization is key to effective communication with customers. And luckily, digital mediums offer unprecedented personalization at lower unit costs than paper or other conventional mediums.

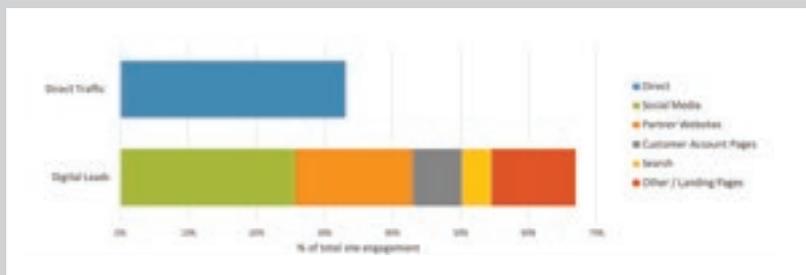
How Utilities Can Personalize Communications

The starting point for electric utilities that seek to better understand and communicate with their customers is often consumption history. Information about the customer's building can be just as informative, if not more so. Building data, such as building age, size and basic information about key equipment and appliances, can provide immediate insights into energy consumption patterns when analyzed through physics-based models or through machine learning algorithms.

Utilities have a strong use-case to collect building information directly from customers, and they are often able to learn a lot about a population in a relatively short amount of time. For example, building data collected over two months through an online building assessment was cross-referenced with actions taken to enroll in energy efficiency programs. When the data was sorted by region, a clear trend emerged: low participating regions had building stocks with a narrower age distribution across a more recent period, while high participating regions had a wider distribution of building ages with a significant number of older buildings.

Building data indicated a trend that older buildings were more likely to participate in energy efficiency programs. →

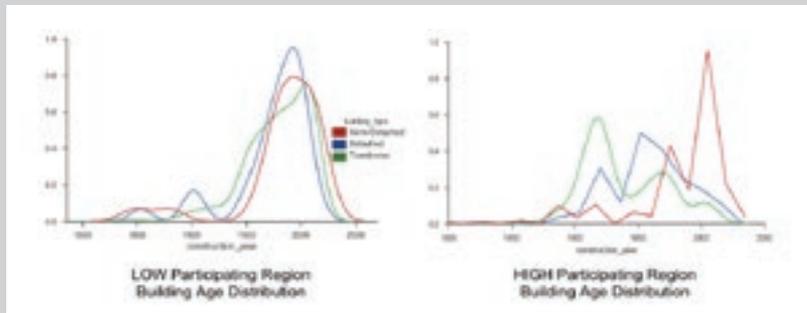
Figure 3. Breakdown of Website Engagement Origin



Note: Digital marketing and leads are key to helping customers engage with digital content, they also tend to be more cost-effective and trackable than direct marketing activities. (Note: direct traffic is comprised of in-person engagements, direct mailings, conventional marketing, radio ads, etc.)

Source: EnergyX Solutions Inc. 2018, sample size = 57k

Figure 4. Building Age Distributions for Regions with Low and High Program Participation



Note: Customer engagement can be significantly influenced by building stock and geography. Participation tends to be higher in areas where the building stock is older and more diverse

Source: EnergyX Solutions Inc. 2018, sample size = 100k

When the trend was applied in reverse, regions with older buildings were targeted with marketing campaigns to increase the likelihood of program enrollment, while simultaneously targeting older buildings with a higher average potential to reduce consumption. Relatively straight-forward initiatives like the example just provided indicate that data collected from customers can be used not only to personalize communications back to those same customers, but they can also uncover trends that facilitate more effective and personal communications with customers outside of the surveyed population.

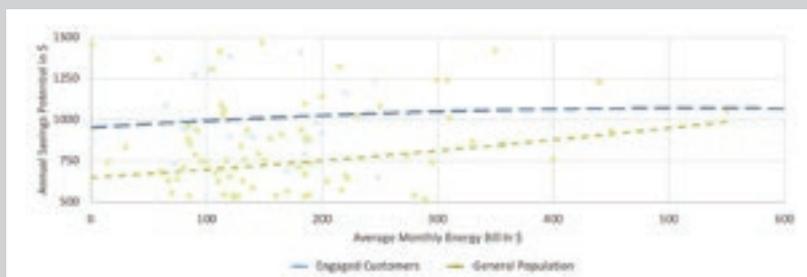
From this example, we can also see that personalization isn't limited to putting a customer's name and address on every message. Simply including facts, or even suggestions, targeted to specific building types, customer personas or geographical areas dramatically increases resonance in a historically "one-size-fits-all" industry.

Building data can also be combined with consumption data to provide new insights into customer motivation. In this example, data from an online building assessment platform was analyzed to estimate the difference between the building's current performance and a modern standard (i.e., annual energy-saving potential). Savings potential was then compared to average historical monthly energy bills provided by a utility partner.

Although the general population saw an increase in their maximum savings potential correlated with higher average monthly energy bills, the population that engaged with the program did not. The engaged population was characterized by an above-average savings potential, regardless of their current average bill amount, and the average annual savings of the engaged population was relatively flat. This indicates that targeting customers simply based on high consumption or high bills is not effective. Engaged customers are often looking for high return-on-investment or above average performance increases, which are not necessarily correlated with high energy bills.

In addition, building data provides some of the best insights into what topics, services, and energy products customers are most interested in. Customers tend to be most interested in products and services that are related to building features and equipment they currently have. The more unique the building feature or piece of equipment, the more likely a customer is to engage or convert on products and services related to that equipment. In another program, where digital home energy reports were sent to residential consumers, clicks on information regarding certain recommended building upgrades were tracked to reveal that the most infrequently recommended services often had some of the highest conversion rates. This indicates that utilities

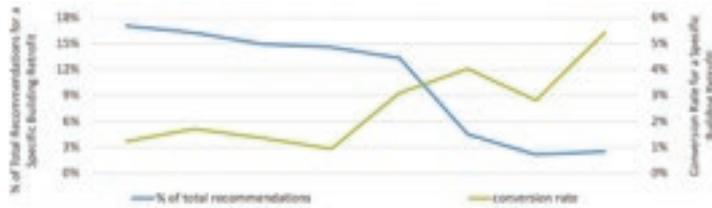
Figure 5. Customer Communication Preferences for Different Utility Initiatives



Note: Engaged customers do not necessarily have higher energy bills, but they do have a higher savings potential on average. In this case, savings potential is determined by building characteristics and equipment that consume more energy than modern, efficient equivalents

Source: EnergyX Solutions Inc. 2018, sample size = 43k

Figure 6. Congruance of Recommendation and Conversion Rates for Energy Efficient Building Retrofits



Note: Conversion rates tend to increase for products and services that are recommended to fewer people. Products like attic insulation were recommended for more than 12 percent of a population, but only achieved conversion rates of less than 2 percent. Conversely, more specific improvement recommendations like tankless water heaters were recommended for less than 3 percent of a population, but achieved conversion rates of up to 5 percent.

Source: Source: EnergyX Solutions Inc., sample size = 75k

are likely to get the highest relative customer engagement on relatively “niche” topics; and conversely, attempting to engage customers on common or overly broad topics does not guarantee broad engagement or high conversion rates.

Conversion rates tend to increase for products and services that are recommended to fewer people. Products like attic insulation were recommended for more than 12 percent of a population, but only achieved conversion rates of less than 2 percent. Conversely, more specific improvement recommendations like tankless water heaters were recommended for less than 3 percent of a population, but achieved conversion rates of up to 5 percent.

Final Takeaways

Digital communication strategies offer a host of information about customers that savvy organizations use to improve their service offerings, including the percentage of customers engaging via mobile devices, open and read rates for utility communications and conversion rates for utility services and programs. Building information provides deeper insights into building performance and predicted consumption patterns and can be a strong indicator of customer sentiment, engagement and action.

In conversation with utility executives and directors, it is apparent that gaining access to customer information is becoming a top business concern – and it is easy to see why. Customer service strategies, marketing decisions, program planning and even CapEx and OpEx planning are all influenced by our understanding of the customer base. As utility executives realize the growing importance of customer information as a planning resource, safeguarding and leveraging the customer resource is of increasing importance.

Modern digital communication strategies provide a number of mechanisms (e.g., email reporting, web

analytics, digital ad stats, etc.) for utilities to collect customer feedback and create conversations with customers. Furthermore, the available options for digital communication channels continue expanding through the popularization of chatbots, artificial intelligence, tracking pixels and advanced customer profiling. As the cutting-edge advances, the utility’s objectives in building out new digital strategies and communication channels to improve personalization in a historically impersonal industry have never been more achievable. And, if all that wasn’t enough, customers simply want a more personal, accessible experience with their utility.

In a time of unprecedented change, where we see consumer choice growing exponentially as new technologies come to market with increasing speed, utility executives have already started asking whether they can afford NOT to make the transition to a more accessible and personal relationship with their customers. With this outlook, the quest to better understand and communicate with the customer becomes an important part of every utility’s near- and long-term planning.

ABOUT THE AUTHOR:

Alex Corneglio is co-founder and CTO of EnergyX Solutions Inc., a technology company specializing in providing digital solutions and automation for utility energy efficiency programs and customer service initiatives. Corneglio has made his career in strategic operations and engineering for energy companies in the United States, Canada and Europe. He holds a Bachelor of Science in engineering from the University of Michigan and an MBA from the Rotterdam School of Management, Erasmus University.

Corneglio currently lives in Toronto with his wife and four children.

OLD CONCERN – UTILITY SURVIVAL HAUNTS THE NEW ENERGY ECONOMY

JEREMY KLINGEL

Systems are only as good as their uptime. No one understands this more than utility managers, who told Black & Veatch in the company’s 2018 Strategic Directions: Electric Industry Report that the long-time challenges of reliability, security and infrastructure are just as important today as they have been in years past.

When asked what critical issues haunt the electric sector today, survey respondents pointed to familiar challenges – grid reliability, cybersecurity and aging infrastructure, long-term investment and physical security as important or very important issues (**Figure 1**).

These responses have consistently ranked among the most pressing concerns for the power sector over the past five years. Reliability – the ability to provide consistent service to consumers – sits at the heart of these issues because it mandates that operations continue unabated despite cyber attacks, grid-battering storms, power-quality issues or simple failure of decades-old equipment that’s reached the end of its useful life. →

Top Issues Over the Last Five Years					
Rank	2014	2015	2016	2017	2018
1	Reliability (4.58)	Aging infrastructure (4.52)	Reliability (4.56)	Reliability (4.69)	Reliability (4.65)
2	Environmental regulation (4.41)	Reliability (4.38)	Cybersecurity (4.37)	Cybersecurity (4.52)	Cybersecurity (4.49)
3	Cybersecurity (4.26)	Environmental regulation (4.38)	Environmental regulation (4.37)	Aging infrastructure (4.31)	Aging infrastructure (4.28)
4	Aging infrastructure (4.23)	Cybersecurity (4.33)	Aging infrastructure (4.36)	Environmental regulation (4.30)	Long-term investment (4.23)
5	Economic regulation (4.22)	Aging work force (4.12)	Long-term investment (4.13)	Long-term investment (4.29)	Physical security (4.18)

Figure 1. Please rate the importance of each of the following issues to the electric industry using a 5-point scale, where a rating of 5 means “Very Important” and a rating of 1 means “Not Important at All.” (Please select one choice per row) **Source:** Black & Veatch



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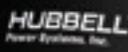
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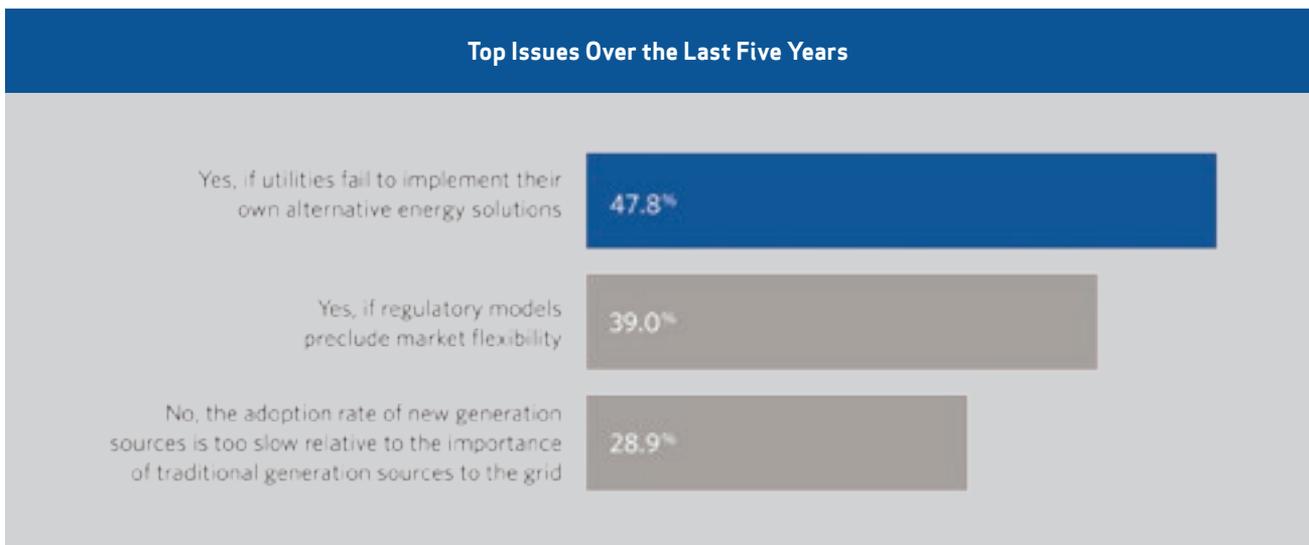


Figure 2. Do you perceive this “utility death spiral” as a real, potential outcome? (Select all that apply). **Source:** Black & Veatch

What complicates the reliability challenge is the financial uncertainty utilities face in the so-called “utility death spiral.” Utilities and the regulatory bodies that oversee them must find a way to keep power providers viable, or the industry may have a hard time meeting reliability goals and, perhaps, even surviving.

Death Spiral and Taxes

By definition, the death spiral is that ugly Catch-22 that occurs when more and more customers switch to self-generation and drop from the traditional grid, except for the need of a provider of last resort. That makes power more expensive for remaining customers unless fixed infrastructure costs can be equitably recovered. If utilities raise rates for remaining customers, the added costs could make self-generation even more attractive, and the spiral widens.

Such a situation would occur if utilities fail to implement their own alternative energy solutions or if regulatory models preclude market flexibility, survey respondents agreed.

The utility death spiral wasn’t on the above issues list in the Strategic Directions survey – rather, it warranted its own question. According to survey results, most utility survey respondents see the death spiral as a real, potential outcome (**Figure 2**).

Customers are certainly jumping into the power supply game. The business community is making a strong commitment to alternative energy. Under the RE100 banner, more than 120 multinational giants – including Apple, Walmart, Bank of America, General Motors, Starbucks, eBay, Kellogg’s, Hewlett-Packard and more – have announced a goal of 100-percent renewable energy. In April, Apple announced that all of its global data centers, retail stores and offices in 43 countries now are 100-percent powered by renewable electricity, either from solar or wind power.

Many companies are generating their own energy through rooftop solar and buying renewable-based power from offsite grid-connected generators. In a recent survey of RE100 participants, companies said that in addition to the environmental benefits, the business case for switching to renewable energy is becoming stronger. Sustainable energy is now more than environmental policy; it is a competitive advantage.

This should be particularly alarming to utilities because C&I accounts make up two-thirds of U.S. electricity use, according to data from the Energy Information Administration. Along with declining sales, utilities will need to accommodate behind-the-meter renewables. This will take a new game plan.

What's in Storage?

Findings from the Strategic Directions: Electric Report survey reveal what energy professionals are thinking as they plan and build their renewables projects. When asked to choose the best options for renewable integration, utility-scale energy storage was the preferred choice at 66 percent, with grid improvements coming in a distant second at 41 percent (**Figure 3**).

The dropping cost of storage technology is good news for utilities because high prices long have been a challenge to integration efforts. Today's lower costs are enabling much more competitive offerings, as seen recently in Colorado. There, Xcel Energy received bids from energy developers to supply solar and wind-generated electricity – with battery storage included – at a lower cost than conventional generation. While Colorado's supportive regulatory environment helped make this a reality, the takeaway from this development shows that renewable energy at utility scale can be price-competitive with fossil fuels and even cost less.

Along with battery energy storage systems, there are other ways to address intermittency without investing in new equipment or infrastructure. Survey respondents were asked what system improvements they recommend.

A variety of tools are available to help utilities deal with the variability of renewables, including demand management, storage management, real-time monitoring and rapid cutover solutions to meet a sudden drop in output.

For example, demand response no longer means that businesses or residential customers will have their power interrupted for an hour or more during peak energy demand periods. Demand response management systems now use machine learning to facilitate aggregation of load shedding that lets utilities power down just a few devices at a site for brief periods, leaving the customers participating in these programs nearly undisturbed by load shedding events.

More accurate forecasting of wind and solar output is another lever, as it is changing the way power producers are incentivized or potentially penalized for over- or under-generation.

The most popular choice was quick response resources, selected by 56 percent of survey participants, followed closely by load control devices (51 percent) and advanced system control devices (48 percent). Utilities typically use a combination of the resources listed. While these are admittedly partial measures, they can help grid operators respond to output fluctuations with minimal investment. →

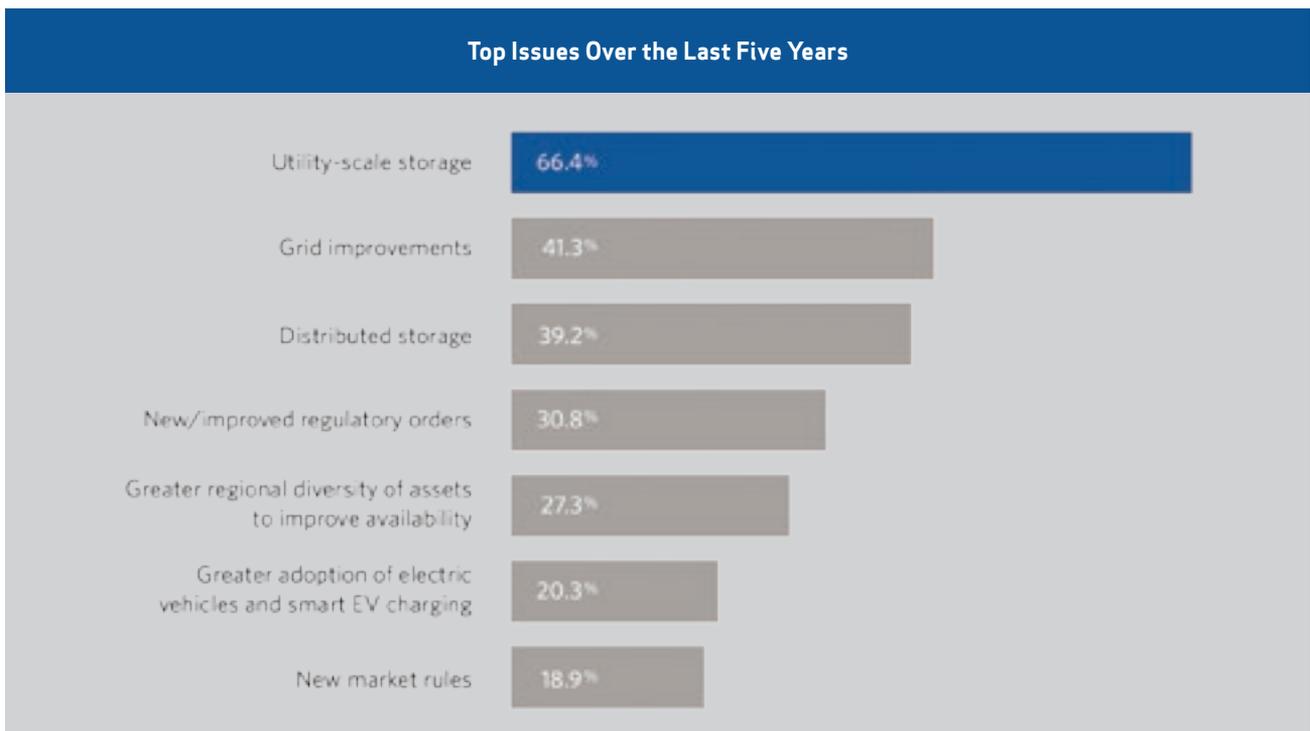


Figure 3. Where do you see the best options for utility-scale renewable integration? (Select up to three choices) **Source:** Black & Veatch

Finding the Funding

There's no doubt about it: Integrating renewables and DG will require new funding mechanisms. Knowing the proliferation of DER will continue with increasing speed, utilities report that finding the money is the biggest hurdle they face to implementing the distribution system of the future they'll need to make widespread distributed generation viable.



California now requires solar power on all new homes after 2019, and New York has effectively blocked utilities from owning distributed generation.



On the regulatory front, states are making momentous decisions that will significantly impact electric utilities and other market participants. For example, California now requires solar power on all new homes after 2019, and New York has effectively blocked utilities from owning distributed generation. The federal government

is weighing in as well with new rules to open the wholesale power market for battery storage.

Along with expensive grid upgrades and uncertain regulatory climates ahead, utilities must grapple with the fact that market definition at a regional and local operating level is still nascent making it difficult for utilities to ground their strategies and investment plans in fact-based assumptions. Absent this clarity of direction, utilities need to develop a flexible market model and align their capital allocation strategies to support data-driven predicted outcomes. They'll need to figure out:

1. What is the role of the grid operations considering the emerging, distributed energy markets?
2. What new market processes, operating models and business requirements will result from this role?
3. What new types of companies will become players in the power grid market of the future?

In answering these types of questions, companies can begin to finetune their capital allocation decisions. And, they'll start reinventing themselves. For instance, Hong Kong-based CLP (formerly China Light and Power) is exploring a variety of markets outside their regulated territory, including smart cities, DER, microgrids and data centers.

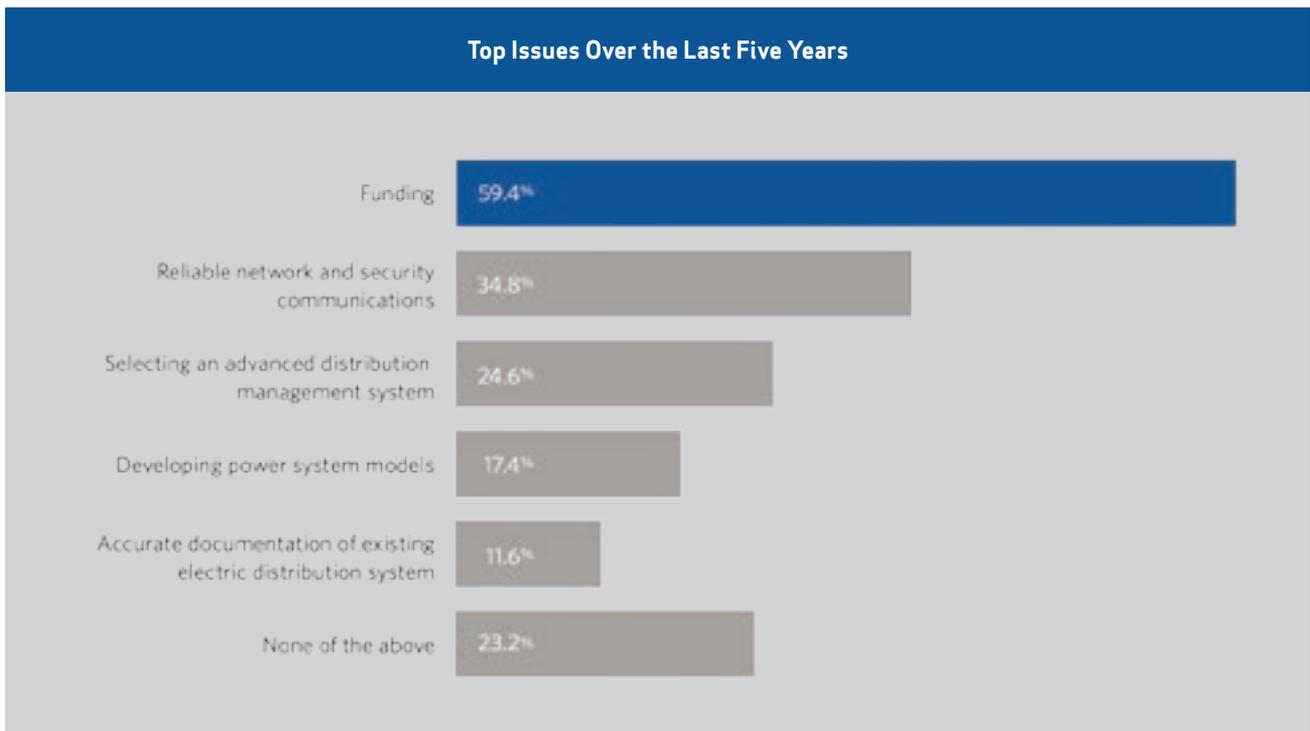


Figure 4. What are your biggest challenges in implementing smart distribution systems? (Select all that apply). Source: Black & Veatch



Partnering with customers is another strategy that utilities can and likely will follow. Load control programs, for instance, provide non-wires alternatives that enhance reliability without incurring as much cost as system upgrades. Example: ConEdison's Brooklyn-Queens Demand Management program deferred a \$1 billion substation upgrade with a \$200 million investment.

Microgrids are another option. Utilities could build microgrids onsite at customer premises that can be used for capacity, backup generation or demand response. Arizona Public Service (APS) is currently cost-sharing on a microgrid owned by Aligned Data Centers. In addition to power back-up for a data center, the microgrid also provides frequency regulation and capacity services to the grid. APS secured regulatory approval to recover costs for the percentage of microgrid capacity that supplies those services.

Looking Ahead

If utilities can prove that they are willing to serve customers in new, creative ways, negotiating with and presenting a business case to regulators will be much easier. Enabling such unique offerings as performance-based rates, community solar and solar-plus-storage for

all customer sizes can assist in shifting the utility model enough to slow down the proverbial downward spiral in earnings. Building a marketplace for distributed energy will be a critical step.

Utilities will need buy-in and support from regulators to make changes that align with growing clean-energy mandates and the business transformations they will require. If power providers don't secure this regulatory vote-of-confidence, they may drive away their bread-and-butter C&I accounts, especially those that are big enough and financially sound enough implement their own renewables, distributed generation or storage solutions. Such defections would make the system more expensive for all remaining customers because utilities would need to invest in new technology to maintain an increasingly complex network and then spread fixed costs among fewer customers.

Try beefing up cyber security, replacing aging infrastructure or investing in new reliability solutions with declining revenues and a customer exodus on your hands. The financial future of utilities is uncertain, and until we get this figured out, today's power system stands at risk.

ABOUT THE AUTHOR:

Jeremy Klingel is a senior managing director for Black & Veatch management consulting, where he is responsible for developing and delivering the market strategy regarding end-to-end grid-related initiatives for electric utilities. Klingel has led more than two dozen smart grid development projects.



“REAL TIME” COMMUNICATIONS:

GIVING ELECTRIC UTILITIES THE UPPER HAND IN MONITORING CRITICAL UNDERGROUND INFRASTRUCTURE

JILLIAN LEINEN

Electric utilities are required to operate and maintain the critical infrastructure that is so vital to the overall health of an electrical network. In many cases, these systems or installations are un-manned, often located in places like distant substations or underground manholes. With these remote sites, engineers, operators and technician crews must be physically on-site to collect data manually, monitor conditions or perform maintenance. This can present utilities with significant issues. Problems may not be discovered until utility personnel is on-site, and in the event of equipment failure, time is of the essence.

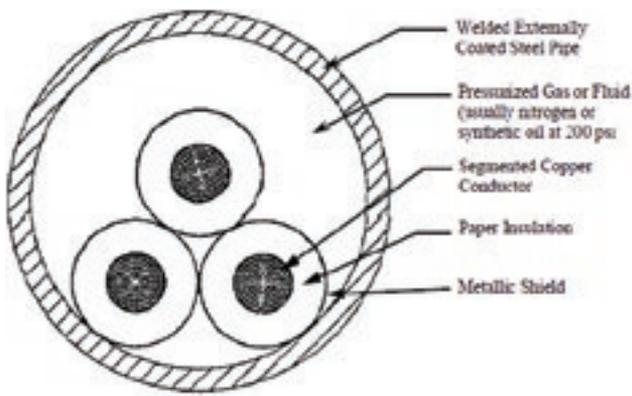
HPFF & XLPE Underground Cable Transmission Networks

Underground transmission cable is at the heart of most urban transmission networks. There are approximately 4,500 miles of transmission cable in service that ferry high voltage power into cities across the United States. New York, Washington DC, Chicago, Detroit, Houston, Los Angeles – all the major metropolitan areas in the country and more, are fed by these cable systems. →

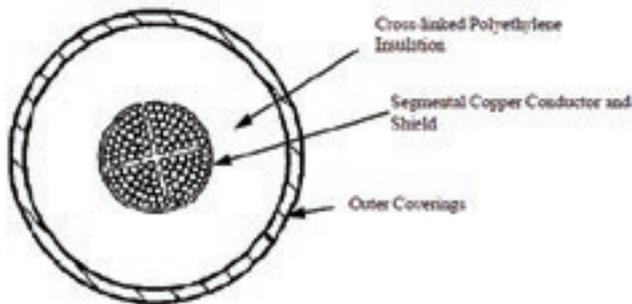


Often, Critical Infrastructure is Located Remotely, Requiring Personnel to Be On-Site to Monitor Conditions





High-Pressure Fluid-Filled Cable (HPFF)



Solid Cross-Linked Polyethylene Cable (XLPE)

There are two dominant types of transmission grade cable: High-Pressure Fluid-Filled (HPFF) and Cross-Linked Polyethylene (XLPE). HPFF AND XLPE cables are completely different in terms of their construction, technology and respective capabilities. What they have in common is a reliance on communications solutions that are pivotal for monitoring cable performance and health.

While XLPE is the newer technology, the majority of our underground network is made up of aging, but critical, High-Pressure Fluid-Filled systems. A typical HPFF underground feeder consists of steel pipe containing three high voltage conductors which are surrounded by dielectric fluid. Pressurization plants are employed to maintain the dielectric fluid pressure at 200 psi to insulate the cable. Additionally, there is a myriad of ancillary gear to transform the cable from underground to aboveground equipment.

Establishing a communication link to provide “real-time” data about your underground cable network greatly benefits the engineers and technicians tasked with overseeing the system’s health. Some key parameters that require monitoring to maintain feeder health include:

- Maintain insulating fluid pressure inside the pipe
- Maintain pothead pressures at ground to air transition points
- Mitigate hot spots in the pipe run

- Monitor pipe cathodic protection
- Sample dielectric fluid for cable deterioration indicating gases
- Monitor fluid levels during dynamic level changes for indication of underground leaks
- Audit multiple critical parameters within the pressurization plant. Fire, access, pump availability, etc.

All of the above topics can be monitored accurately in real time and reported in a manner consistent with a utility’s standard operating procedure.

Catastrophic Unmonitored Conditions

A chain is only as strong as its weakest link. This phrase especially rings true when applied to the transmission, distribution and control of electrical power. With an underground transmission cable network, when one component fails, the whole system can fail, causing catastrophic results. A condition as simple as placing the pump operating switch to “off” during a test or calibration and forgetting to return the switch to an operating condition before exiting the premises can be disastrous – with the feeder pressure degraded, no start or backup would be available to maintain a safe electrification pressure. Cable and potheads could be compromised. If only one pump were chosen for operation, an overload on that pump could result in similar failure modes.

“
**The more quickly a leak is detected, the shorter
 the time and the lower the expense will be
 for cleanup and re-energization.**
 ”

The benefits of monitoring and reporting are many; however, there is one that is most advantageous to electric utilities – the ability to save precious time. Time is a priceless commodity when dealing with feeder complications. Pipe leaks can result in astronomical cleanup costs. The more quickly a leak is detected, the shorter the time and the lower the expense will be for cleanup and re-energization. Leak detection algorithms can mitigate the high volume or long-term spill of dielectric fluid. Hot spots are problematic and destructive. They can be mitigated with slow circulation or oscillation to the benefit of the cable. Loss of cathodic protection will cause eventual pipe

corrosion it is designed to prevent. High current in the cathodic system often signals a coating failure which should be addressed. Pothead pressure is essential to the cable transition from underground to aboveground. Pump health can be monitored using current transducers and algorithmic settings. Predicting future failures or poor pump performance can prevent downtime and help schedule maintenance visits. Other parameters reported could include fire system health, access and enclosure temperatures. More sophisticated reporting such as nitrogen blanket integrity, pump vibrations, moat liquid levels and oxygen levels in the enclosure is possible.



Predicting future failures or poor pump performance can prevent downtime and help schedule maintenance visits.



Establishing a Link

When determining which communications system is best to fit a utility's needs, there are six variables that need to be considered:

1. What manner of instrumentation will be used to collect information?
2. Will the information be transmitted as raw data or pre-analyzed by the collection system?
3. What communication medium is most readily available while also considering future upgrades?
4. Is there a security level to be maintained?
5. Will only reporting be performed, or will there be the possibility of some control? This will impact the security levels necessary.
6. To whom or where will the collected information be sent or displayed?

Complete or modified systems of information can be delivered to suit the utility's needs and philosophy. Information can be transmitted from an installation like an HPFF pressurization plant using a plethora of platforms such as telephone lines, T1 lines, fiber, radio and cellular, just to name a few. Security levels can also be implemented to meet all NERC reliability standards and beyond. →



Communications Equipment Can Be Mounted on Pre-Existing Structures Like Transmission or Cell Towers

Using one communications medium with an eye to upgrading security or even control is more a planning decision than a technical roadblock. Collecting the data at the site also has a number of options. Good science and common sense can produce a collection system which is specific to the location of the installation and the needs of the utility. The result is an increase in security, improved cable performance and confidence in feeder integrity.

Perhaps the last consideration in a solid monitoring system is where the reporting is displayed. Critical infrastructure like pressurization plants should be available or monitored 24/7. Alarms at the reporting site are common, and ease of access to information is paramount. Real-time values increase confidence in the system. When maintenance or operations arrive on site, good feedback instills confidence in any repair or modification made to remove the alarm condition. Utilities all over the country are formulating plans and procedures to extend the life of these HPFF cable systems. Good communication from cable system to operations is a key component to extending system life.

XLPE and Big Comms in the Big Apple

While most large cities are heavily fed by HPFF cable, utilities are also laying new XLPE cable runs to supplement the network. If you were to peel back a New York City street, a super highway of critical infrastructure would be revealed. The essential systems and assets that make New York City go are all intertwined right below your feet. Telecommunications, water supply, public transportation, natural gas and electricity networks all coexist in not-so-perfect harmony. It takes an army of professionals and cutting-edge technology to keep the city that never sleeps up and running.



It takes an army of professionals and cutting-edge technology to keep the city that never sleeps up and running.



Typical Underground Vault

As utilities install new transmission feeders to keep up with peak demand, they also include ancillary equipment to support the new feeder's health by monitoring and reporting performance and conditions. Essential underground vaults or manholes are constructed along the feeder path to accommodate XLPE cable splices. However, in addition to cable splices, utilities are now using these spaces for sophisticated communications equipment to monitor and report on both cable and vault conditions. Installed fiber cables are run between the manholes to support system connectivity and strengthen communications capabilities.

Depending on location, these vaults can be supplied with a multitude of different components. Vibration sensors can be employed to report on conditions that might arise from subway activity or overhead street construction. Special cameras can also be used to give the utility a pair of eyes in the vault to detect water levels, track vault access and observe other visual conditions. Temperature sensors are installed to monitor environmental conditions such as extreme temperature changes. Displacement sensors are invaluable to utilities on reporting any movement of the feeder or vault which can signify problems with cable health. Real-time and accurate surveilling of this equipment is paramount because of the isolated nature of the location. Because of the difficulties associated with access, utility-manned maintenance checks might only be scheduled about once every few years. Remote data collecting is imperative to the well being of these unique installations.

Critical Asset Communications and Connectivity

Information is the lifeblood of electric utilities' critical infrastructure. The ability to collect, analyze and share this information is crucial to operators and engineers maintaining their network. Communication is key and electric utilities are uniquely qualified to find the solutions they need in the digital age. These solutions can be specifically tailored to fit the distinctive needs of the utility and help them securely monitor, control and automate in real time. Levels, alarms, pressures, leaks, environmental conditions and more can all be recorded using an abundance of medium including fiber, radio, copper, cellular and more. Today's electric utilities are continuously adapting and using the tools available to gain the upper hand in maintaining the health of their critical underground infrastructure. The balance is tipping in their favor.



ABOUT THE AUTHOR:

Jillian Leinen is the owner and CEO of Walker US, a company that designs and manufactures solutions for electric utilities. She is responsible for running all facets of the business as well as managing high profile projects. Leinen joined Walker after graduating Villanova University, with a BSE in chemical engineering. She quickly put her engineering expertise to use and successfully executed projects that have brought the company into the electric utility industry. She succeeded Bob Ryan as CEO and became the majority shareholder of Walker US in 2016.

HOW INSTANT REBATE TECHNOLOGY IS TRANSFORMING CUSTOMER EXPERIENCE IN THE ENERGY EFFICIENCY SECTOR

HEATHER GATES

The evolving energy industry is constantly experiencing disruption as new technologies emerge and customer preferences change. In years past, consumers sought safety and reliability from their energy utility, but have evolved to also expect comfort, convenience and control. Energy efficiency and demand response programs, coupled with connected and smart appliances, allow utilities to engage customers and address these new preferences.

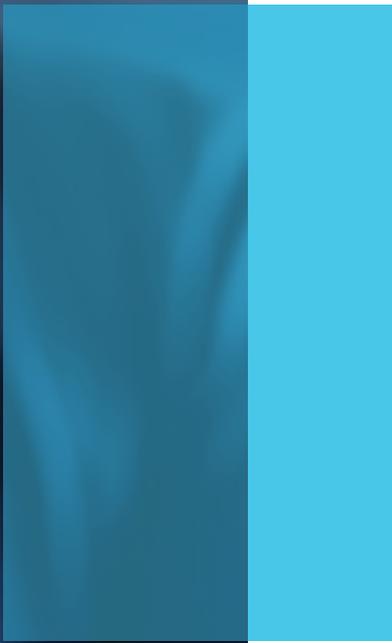
The emergence of smart home products, such as smart thermostats monitored through mobile phones, digital keypads offering keyless entry, cameras integrated into doorbells and smart lighting solutions, have led home automation companies to also develop products that support energy efficiency initiatives. For example, while traditional thermostats served a utilitarian function, newer models tend to be programmable, self-learning and sensor driven.

As utilities nationwide have adapted to navigate the new environment and meet their customers' changing needs, a growing demand for Instant Rebate Tools has emerged. Knowing consumers are firmly rooted in their digital devices and platforms, utilities benefit from teaming up

with retailers, in partnership with manufacturers, that sell energy efficient products and offering instant rebates to consumers who buy their products. Instant rebate programs streamline the experience for customers by offering savings in real time and incentivize participation in energy efficiency utility programs. Such tools also help utilities and manufacturers take their customer-centric efforts to the next level.

Value of and Implementation of Instant Rebate Technology

Instant Rebate Tools support the evolving energy business model by allowing utilities to empower customers to make their own purchasing choices, while also decreasing strain on the grid. Instant rebates are fundamental to providing a transformative customer experience as they meet customer expectation, immediately at point of purchase versus delayed traditional mail-in rebates. Knowing a smart thermostat can help the average homeowner save up to \$145 per year in energy costs, customers can also expect to see increased savings over time on their utility bills. →



Another benefit of Instant Rebate Tools is that, in comparison to downstream, both the development and implementation support cost-effectiveness. Programs can be productized for profitability for varying utility and market sizes, but still customized to meet utility needs without losing market awareness. Relationships with retailers and manufacturers provide more leveraged support in marketing campaign efforts. Instant Rebate Tools enable utilities to tailor programs to meet the economic climate they operate in, as well as the client base they serve.



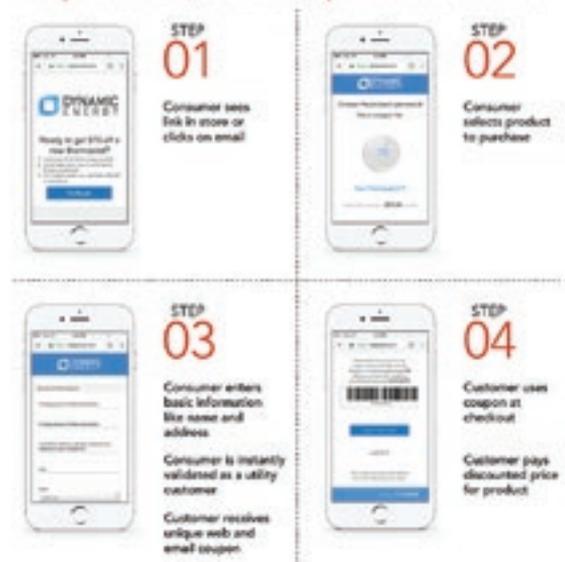
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Instant rebate engagement opens the door to logical cross promotion for other programs, like demand response. By putting a spotlight on the need to save energy, rebate tools provide an opportunity to educate consumers about the importance of home energy conservation and connectivity, including techniques to impact power consumption during peak hours. The tool, coupled with marketing, also allows utilities to engage targeted audiences, like the low- and moderate-income (LMI) demographic, effectively aiding those most in need with a pathway to lowering their own cost expenditure over time.

Accessibility is another benefit of implementing an instant rebate program as the tool is conducive to in store and online shopping. Many utilities are challenged with rural markets and the Instant Rebate Tool allows customers to get rebates from their homes without having to drive miles to the nearest participating big box store. Convenience is not just about the ability to choose the product, it's about where and how you purchase it. Meanwhile, as technology advances to adapt to the needs of the average consumer, it is a necessity to give users control while they are on the go. Web-enabled platforms are designed to work on mobile phones and tablets to streamline participation, offering users immediacy and control while shopping in brick and mortar store locations.

The process is quick and simple for the customer:



Another advantage instant rebates offer is early stage validation to help inform customers' purchasing decisions. Customers enter verifiable information, like a name and home address, into the app or website to verify their qualification. Historically, patrons have been required to complete and mail in a cumbersome application that could take weeks to process upon submission. By informing customers they are eligible for a rebate prior to purchase, the process is streamlined and the cost savings is immediate, resulting in an improved customer experience.



By informing customers they are eligible for a rebate prior to purchase, the process is streamlined and the cost savings is immediate, resulting in an improved customer experience.



Mostly, participation is designed to be easy. The respective retailers, and sometimes partners, provide a unique barcode to be used at participating retail stores upon the purchase of energy efficient products, like smart thermostats and heat pump water heaters. One example is a rebate program launched in Illinois which offers \$100 instant rebates to customers who purchase a new ENERGY STAR certified thermostat—select the product, verify eligibility, receive the barcode, save instantly at the point of purchase.

Overall, launching an Instant Rebate Tool can be an integral step forward in a utility's effort to delight customers, and a critical move to be a trusted partner when customers have increasing choices in who to turn to for their energy solutions. The tool and technology will continue to evolve, the products and offers will continue to expand, and the customer engagement opportunity could be limitless. By providing instant savings on select energy efficient products, utilities, retailers and market partners empower customers to make smarter, more affordable purchasing decisions that will ultimately save them time, money and energy.

ABOUT THE AUTHOR:

Heather Gates joined CLEAResult in 2012 and leads product management for Instant Rebates Tools, CLEAResult's featured customer engagement software platform. Prior to managing Instant Rebates, Heather led the Northwest Account Management team focused on retailer and manufacturer engagement and led new offers for Mid- and Upstream program design. With more than nine years of utility energy efficiency experience, she previously worked with a small Northwest co-op utility, leading residential programs. Gates holds an MBA in sustainable business from Marylhurst University and received her undergraduate degree from the University of Washington Tacoma.



PESTECH INTERNATIONAL USES DIGITAL TWINS

TO HELP IMPROVE WORKFLOWS ON MALAYSIA SUBSTATION PROJECT

TERESA ELLIOTT

The 2018 winner of Bentley System's Year in Infrastructure award in the Utility Transmission and Distribution Category was Pestech International's Malaysia Substation Project. Following is a description of the project.



Source: courtesy of Pestech International

Olak Lempit is located within the district of Banting, Selangor Darul Ehsan, Malaysia. Most of the population of Olak Lempit is of Javanese origin who migrated from Indonesia. Olak Lempit is located near the Lempit River, from which the town's name derives. With its strategic location 30 minutes from Malaysia's largest international airport, KLIA, and 45 minutes from the country's busiest shipping port of Klang, the village rapidly developed into an industrial zone with various plants and manufacturing factories, commercial offices, shops, residential houses, and international schools. This growth has resulted in the need to expand the power supply in the region.

The Olak Lempit substation will be expanded from a 275/132-kilovolt substation to a 500-kilovolt substation. The owner, Tenaga Nasional Berhad (TNB), expects the work to be done using the latest substation technology.

TNB awarded Pestech International Berhad an RM 79.5 million contract to build this next-generation substation in Olak Lempit. The scope of work was to supply, erect, commission 2 x 1050 MVA autotransformers, 500kV switchgears, 275kV switchgears, and the ancillary equipment with associated civil work for the main intake substation.

The Challenge

The usual complications existed for this project. There were tight deadlines, and the team wanted to move beyond some historically manual processes – Bill of Materials (BOM) generation, preparation of cable management schedules, and verification of the as-built drawings. Additionally, with this substation, the cost to supply materials is unusually high due to air freight charges, and errors in design could create material shortages that could cause urgent procurement requests increasing costs. Finally, this substation is brownfield, and the lack of as-built drawings or inaccurate as-built drawings could create challenges for matching the existing substation. Other considerations included clash detection across disciplines – C&S, Electrical, Architectural – and error checking during design to minimize risk of rework during construction. →



Facing a tight 15-month schedule and knowing the significant benefit that this project will have on the region for generating additional power, Pestech undertook a robust, collaborative, efficient, and digital approach to deliver a very challenging project.

Complicating this project are a number of topological, environmental, and economic considerations. The existing and planned sites are surrounded by palm oil plantations and villages. Multiple contractors will be working on the site to deliver both the new transmission lines as well as other expansions to the substation facility. Utilizing existing infrastructure where possible, while minimizing raw material and equipment costs, places an additional economic and logistical challenge on the project. Lastly, the existing design must be future-proof for future expansion, including the addition of a new power generation plant that is expected to enter the grid in 2023.

Facing a tight 15-month schedule and knowing the significant benefit that this project will have on the region for generating additional power, Pestech undertook a robust, collaborative, efficient, and digital approach to deliver a very challenging project.

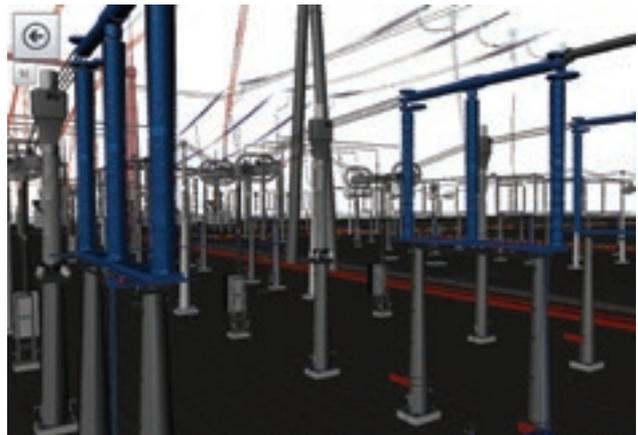
The Solution

Pestech created a digital twin of the existing site and leveraged the power of the integrated solutions to create a new substation design.



The photos taken using the drone and converted to reality models included drawings-to-scale which is considerably important on brownfield substation projects where interfacing with the existing substation is crucial in insuring smooth delivery of the project. In addition, by creating this digital context of the existing substation, the team was able to perform planning on the storage area and equipment transportation access helping to minimize the impact to the environment and villagers nearby. **Source:** courtesy of Pestech International.

From creating 3D models of the existing region to checking for obstructions, obstacles, and clashes, to using intelligent modeling to optimize the substation design, this digital approach enabled Pestech to realize a more complete and cost-effective design.



With creation of the database, 2D and 3D symbols based on manufacturer inputs, the team designed an intelligent model, rather than just graphical, and could navigate from signal line to 3D layout. **Source:** courtesy of Pestech International.

Enabling seamless collaboration between previously disconnected disciplines, while also implementing a connected data environment that maintained engineering information accurately, allowed virtual models of the design to be realized.

Sean Lee, an assistant manager with Pestech, said, “[We] implemented Bentley Substation throughout the project [on the] primary and secondary design: Bentley Raceway and Cable Management for cable routing design; Navigator for walk-throughs and clash detections; ProjectWise for document management; and MicroStation for 3D modeling. Using symbol libraries and report templates developed in 2D and 3D are easily produced with reports automatically generated. This had reduced the design time by an average of 50 percent out of the different functions implemented.”



Cable and raceway management is integrated with the overall workflow. The BOM for the cable ladder accessories (Tee Joints, Cross Joints, Reducers, etc.) can be automatically generated. The fill capacity of each ladder can be pre-determined, the exact length of the multi-core can be generated with a click of a button, and rerouting of the multicore can be done automatically based on the cable schedule. **Source:** courtesy of Pestech International.

The Result

Because of Pestech's digital workflows, numerous benefits to the project have been realized. These include a 50 percent reduction in drawing creation time, a 60 percent reduction in revisions due to clashes and interferences, a reduction of cable schedule reviews from days to hours, and a 10 to 20 percent reduction in cable and electrical component waste. These savings have helped Pestech realize an RM 200,000 savings compared to similar projects. Pestech's digital advancement has realized savings not only for this project, but also contributed to realizing the continued future growth of Olak Lempit.

ABOUT THE AUTHOR:

Teresa Elliott is the industry marketing director for Utilities at Bentley Systems. She has been in the infrastructure industry for 20 years and spent most of her career focused on design, GIS and asset management solutions across various infrastructure segments including communications, electric, gas and water utilities, transportation and photogrammetry. Working with customers to tell the story of how technology helps them to enable intelligent information management processes across asset lifecycles is a passion for Elliott. She loves collaborating with customers and industry experts on digital transformation topics in infrastructure, and helping to improve how we define and communicate the value of Connected Data Environments, Digital Twins, BIM, and GIS in support of project delivery and asset performance.



HOW CARBON FIBERS HELP REDUCE CARBON EMISSIONS

AND WHY IT MATTERS

DAVE BRYANT

Most people I've met seem to be well aware of ongoing concerns regarding climate change. While many believe it is just part of a natural cycle – which may be true to some degree – I believe that we should do everything we can to combat it. Why? Ask the folks in California about the increasing severity of droughts, low humidity, high winds and record-breaking fires that have leveled entire neighborhoods. Ask families along the Gulf Coast about the increased severity and frequency of hurricanes. Or ask people in the North East to describe what it's like to deal with ice storms and a loss of power for days or weeks at a time. “One-hundred-year floods” seem to happen every two or three years these days. It's obvious that we are being impacted more than ever by changing weather patterns, and I share the opinion of others that we ought to do whatever we can to fight back.

Many entities are striving to reduce their carbon footprints by leveraging renewable/clean energy resources and moving away from fossil fuel consumption that emits carbon and other emissions. While we are beginning to see electric-powered vehicle deployment in the transportation sector, we are also seeing much more innovation and technology deployment in the electric power sector.

In addition to substantial improvements in wind and solar generation, energy storage, smart meters and distributed generation assets, we are also seeing significant advances in overhead conductor technologies. Conductors (also known as high-voltage power lines), manufactured with

carbon fiber cores to replace steel core conductors, are now being installed to not only increase line capacity – to enable the integration of more renewable resources, they are also reducing electrical line losses.

While carbon fiber technology has been used widely to improve product reliability, performance and longevity in automotive, aerospace and other applications, due to its high-strength, light-weight and resistance to cyclic load fatigue and corrosion in the conductor sector, carbon fiber's very low coefficient of thermal expansion also helps prevent conductor sag. Power lines heat up as higher amounts of energy are transmitted, due to the electrical resistance of the conductive aluminum strands. These higher temperatures cause the materials to expand, resulting in conductor sag.

In October 2018, CAL FIRE blamed excessive conductor sag on starting one of the worst fires in California history in 2017. Excessive conductor sag also contributed to the major East Coast power outage of 2003. While these are just a few examples, excessive conductor sag is a well-known problem in the T&D community.

Getting back to the efficiency message, the use of carbon fiber cores enables the utilization of increased aluminum content and quality for overhead conductors of any size in any diameter (without a weight penalty). The added aluminum content not only serves to carry more electrical current, but it also reduces the electrical resistance of the wires which serves to reduce electrical line losses. →



Recycle

Sustainable
development

Climate
change

CO₂

Environment

Industry

Energy
saving

In 2016, American Electric Power won the Edison Electric Institute's Edison Award for replacing 240 circuit miles of conventional steel reinforced conductor with carbon fiber reinforced conductor (which they did while the line remained energized). While AEP's primary goal was to substantially increase line capacity to serve growing seasonal demand (without having to replace existing structures), the use of the carbon fiber core conductor also reduced line losses by thirty percent. This reduction in line losses saves AEP over 300,000 MWh of electricity per year. Based on all combined sources of generation in Texas, it also reduces carbon (CO₂) emissions by more than 200,000 metric tons per year. That is the equivalent of removing 34,000 cars from the road. This is not an insignificant number. Looking at it from another perspective, the reduction in line losses also freed up over 28 MW of generation. AEP's investment served them and their customers very, very well.

In the past, little attention was given to the efficiency of power lines, as the cost of line losses was generally passed through to the consumer and considered to be insignificant. Today, it is becoming more apparent that line loss reductions use carbon fiber conductor technology is a big deal.

Looking back, utilities spent billions of dollars improving the efficiency of generation resources and transformers to reduce operating costs. They also spent billions more creating incentives for their customers to use less electricity by using more efficient appliances. While paying customers to buy fewer of your products may seem to be a strange business model, the utilities had little choice, as securing permits to build more (conventional) generation resources was a losing proposition. In the advent of carbon fiber conductors, utilities now have the option to improve the efficiency of the grid itself.



Carbon and glass fiber ACCC conductor core uses over 600,000 individual carbon fibers



Sag comparison ACSS and ACCC



Conventional ACSR and modern high capacity low loss ACCC conductors



Composite Material Applications



ABOUT THE AUTHOR:

Dave Bryant is director technology at CTC Global Corporation in Irvine, California. Bryant was a co-inventor of the patented ACCC conductor and ancillary hardware components. His 35-year background as a design engineer has focused on the use of advanced composite materials in numerous industrial applications, which has helped expedite the development, testing and commercialization of the ACCC conductor, which has been deployed to more than 650 projects in 50 countries.



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BUILDING THE ROADMAP FOR A SUCCESSFUL JOURNEY TO ADVANCED GRID MANAGEMENT

SANDY SIMON

Introduction:

The utility industry today is rife with technology marketed toward improving grid management and control techniques. Capturing the limelight is Advanced Distribution Management Systems (ADMS). ADMS has vaulted to the top of utility executives' priority lists based on its promise of integrating existing real-time systems with advanced visualizations and functionality that streamline operations ensuring utilities are better positioned to meet reliability and resiliency goals. ADMS is also viewed as a cornerstone to the utilities' ability to respond and participate in a changing market in a way that keeps them relevant to both consumers and emerging players. Most utility organizations place ADMS front and center.

However, ADMS is only an element of what should be a utility's overall Advanced Grid Management program. Thinking about Advanced Grid Management, regarding ADMS alone will result in missed business opportunities and misplaced or wasted investment (e.g., rip and replace), causing the need for significant additional investments in the future. Instead, utilities should first pause and develop a holistic strategy for Advanced Grid Management that incorporates technology, systems, people and processes needed to support the evolving fundamental shift in how today's utilities operate. Building a roadmap based on such a strategy will help utilities be more assured that the

technology decisions they make, such as implementing an ADMS, will support their long-term objectives and minimize risk.

What is Advanced Grid Management?

The key to any grid modernization strategy is the combination of automated operations across the entire utility value chain from generation (central or distributed) through transmission and distribution, and to the customer and back. It enables the dynamic operation of the grid and includes grid automation, operational digitization and grid management and operations.

While each of these categories includes advanced technology, individually, they do not achieve Advanced Grid Management. Advanced Grid Management must include the integration and optimization of these technologies and their related data, alterations to business processes and changes to the skills required for grid operations. Advanced Grid Management brings them together in an orchestrated fashion to provide real-time situational awareness and enhance decision making while increasing the safety and reliability of the grid. →



GRID MODERNIZATION



Maintain
Safe, Reliable,
Cost-Effective
Grid



Manage
Distributed
Energy
Resources
(DERs)



Enable
Customer
Choice



Support
New Business
Models &
Market Reform

ADVANCE GRID MANAGEMENT

Grid Automation (AMI, DA), Visualization, Situational Awareness

ADMS, DERMS (OT)	Analytics	Operational Digitalization	Augmented Reality	Security
Back-office (IT)	Modernized Processes	Integrated Processes	Adaptable Personnel	Junior Staff Enabled

The Need for an Advanced Grid Management Strategy

Utilities have a plethora of reasons why they are thinking about the advancement of their grid technology and engaging in the deployment of various technologies. Some of these include reliability improvements, energy efficiency gains, the management and integration of DER, combined T&D situational intelligence, analytics that enable operations to become highly effective in making decisions on real-time events to contribute to highly-effective, lower cost operations in the control center and the field.

Developing a holistic strategy for Advanced Grid Management will ensure that not only these objectives are met but, there is a logical, well thought out plan for achieving them. An Advanced Grid Management strategy defines what is needed to grow the utility business, bringing value

to shareholders while also helping to ensure their utility stays relevant in a future where customers have more options. Regulators are still “figuring out” what they will/will not demand from utility operations. Proactively developing an Advanced Grid Management strategy is in a utility’s best interest and can help drive the regulator’s decisions as well as ensure the utility meets its obligations despite the changing environment.

Specifically, the Advanced Grid Management strategy will:

- Identify the capabilities and functions needed to achieve business objectives
- Align the investment strategy with the maturity of the technology and the marketplace
- Ensure investments are purposeful and minimize misplaced investment

- Align activities to the end game to ensure focus for the enterprise
- Support the organizational change management needed to support the grid of the future
- Maintain flexibility to ensure the objectives are aligned to changing market, regulatory environment and the utility's future objectives

Developing an Advanced Grid Management Strategy

One of the keys to formulating the strategy will be the alignment of the utility's vision and objectives. From selecting and implementing new or upgraded technologies and the data integration strategy between the systems to the analytics and change management strategies -- everything must be aligned. Users must be prepared with the right skill sets and supporting processes at the time of deployment to ensure a successful, new functionality rollout. This applies to all new products or services, including new information to customers on grid performance, consumption and alternative energy products.

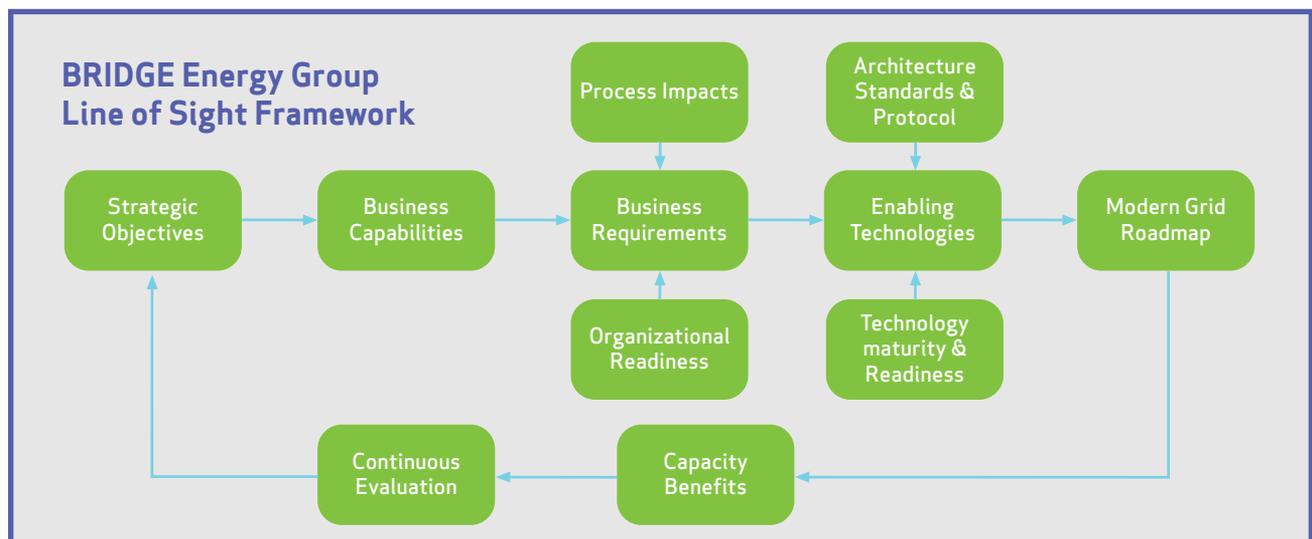
The strategy must also consider the digital utility of the future. A digitally integrated utility can automate work and incorporate new technologies such as wearables, systems automation, digitalization of operational process, automating security and compliance. This will also enable grid edge analytics that makes decisions on how to utilize assets in real-time for power quality, load, energy efficiency, energy arbitrage, restoration of service and public and utility member safety.

To achieve these objectives, an effective Advanced Grid Management strategy must consider:

- Integration of management systems into a holistic view of transmission and distribution operations
- The change in how users interact to coordinate and organize the work of managing the grid
- Capitalizing on new information sources that provide more insights than what is currently available
- Bridging the gaps between utility operations and customer activities with real-time data
- Bringing new value through analytics, to both grid managers and customers.
- How to be adaptable to industry changes
- Incorporation of new and evolving distribution automation technology
- Grid edge enabled decision making
- How to maintain and enhance ROI through reliability, safety and energy management
- Integration of DER and flexibility to enable future energy market opportunities
- Extensibility for incorporating new, future technologies
- Full integration with all IT and OT systems
- The ability to provide efficiency through operation and control center situational intelligence

An Advanced Grid Management strategy that is missing one or more of these is likely to under deliver on the expected value while potentially increasing workload rather than gaining the intended efficiencies.

Significant benefits can be realized by following a robust methodology to define an Advanced Grid Management strategy. →



Source: BRIDGE Energy Group

The key output from an Advanced Grid Management strategy development effort will be a robust roadmap for the utility to follow that defines the prioritized sequence of investments necessary to ensure alignment with an achievement of the utility's "Grid of the Future" vision and objectives. There are four primary components to defining the strategy and developing this roadmap to the future.

1. Capabilities assessment & technology alignment

The capabilities and functionality desired will drive technology architecture and decisions and will impact how the grid of the future is managed. For example, how you offer DER integration services will affect the requirements for your DERMS systems and the integration with your ADMS platform. If the utility is the owner of the inverter technology, this can significantly simplify how DERMS works. However, if you are in a jurisdiction that mandates open markets to third-party DER providers, being able to perform switching functions can quickly become difficult and unsafe where DER installations are not known. This is only one example of why the technology decisions and integration points are critical, others include:

- A unified operated state across all integrated systems
- Ability to communicate securely with SCADA and distribution automation devices
- Ability to have separate, secure communications channels for DER managements
- Considering the future of distribution-based energy trading from third-parties and prosumers
- Effectively provide insights into the best DER deployment locations
- Enable grid edge decisions through distributed and centralized analytics
- Have a secure, integrated service bus for real-time information exchanges among systems like ADMS, GIS, OMS, EMS, DERMS, DRMS

These decisions will have a dramatic impact on your technology decisions and the investments necessary to support the desired capabilities.

2. Investment plan

The investment plan takes into consideration the technology and integration gaps identified, the required investments, the value of the investment and the time-to-value needed to create the strategic roadmap for deployment of the technologies and change management necessary to support Advanced Grid Management. The investment plan is one of the key drivers for turning the strategy into an actionable deployment roadmap for Advanced Grid Management.

The plan identifies technologies already in place (i.e., grid automation, management systems like SCADA and GIS) and considers the "quick hit" visualization opportunities, system enhancements, or integrations that can be deployed near-term to add immediate value while planning and selections for longer-term deployments and integrations (i.e., DMS, DERMS, DRMS) are taking place. These "quick hits" not only add immediate value but also can be vital to testing use cases and determining requirements for these more robust grid management applications.

3. Data assessment, integration and governance framework

One of the key benefits on the path to enabling Advanced Grid Management is the ability to understand and enhance the use of data. In many utilities today, data is still siloed, costly to integrate, lacks significant governance and is not able to be leveraged to provide the power of information for better business decisions.

Development of the roadmap in support of the Advanced Grid Management strategy should include an understanding of the data necessary to support the capabilities and functionality of Advanced Grid Management, a verification of the existing data and the gaps, as well as a data validation approach and governance framework to ensure data availability and accuracy.

4. Organizational change management

Implementation of the Advanced Grid Management strategy will require a significant change to the organizational processes and people that support it. For example, while the fundamental efforts of repairing assets or restoring customer power may not change, the amount of information that becomes available to the operators and field workers is game-changing. How that information is presented to knowledge workers, and the effective use of it will have significant process impacts.

There will also be emerging cases of situational intelligence that have never been seen before due to predictive analytics running at both the grid edge and the grid management core. These predictions will often contradict the experiences and group knowledge that operators have relied on in the past. Knowledge workers must be equipped with the tools to adapt to new information that situational intelligence workers will encounter. It is imperative that understanding organizational change readiness - development of the change management strategies are an integral part of the development of the overall strategy to ensure a successful implementation of the Advanced Grid Management.

A Cautionary Note

Realizing the full potential of Advanced Grid Management will require careful attention to current regulatory compliance requirements and, in some cases, may necessitate new pressure to examine the validity of a requirement in this new paradigm. For example, NERC CIP mandates that technology mitigating control must be in place for sufficient wall off access to EMS/SCADA systems, remote terminal units (RTUs) and connected devices providing instrumentation of the transmission network. The security associated with the implementation of Advanced Grid Management technologies such as ADMS systems must carefully consider this separation between the distribution and transmission network. Now that the exchange of data between the worlds of transmission and distribution is a “critical path” to enabling Advanced Grid Management, the entire security strategy must be redesigned to ensure “bad actors” or internal mistakes are quickly identified and dealt with in near real-time fashion.

Security and compliance factors can bring considerable consternation to your Advanced Grid Management roadmap if not well thought out in advance. Thinking through how physical and virtual control centers work and will be secured and maintained in compliance in the new world is a must to ensure mitigation strategies remain viable, enforceable, and documentable.

Conclusion: The Journey to Advanced Grid Management

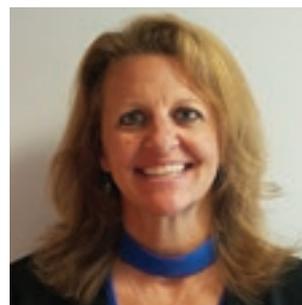
Advanced Grid Management is not an application. Rather, it is a complex journey with great potential, and its success is realized through a significant commitment. It requires the development of a holistic, well-defined strategy that should begin with the end in mind and move the utility through a logical, methodical process that results in an actionable investment plan and roadmap. The roadmap is then used to drive the necessary incremental investments and decisions for implementation which are informed and validated through analytics, assure compliance and security are maintained, and incorporate the appropriate organizational changes along the way to ensure success.

A well-planned Advanced Grid Management strategy and supporting roadmap will create shareholder value in newly deployed assets and will enhance customer satisfaction by providing valued information and relevant offers, enabling faster decision-making and the increasing reliability that will result in a safer utility for both employees and customers.

ABOUT THE AUTHOR:

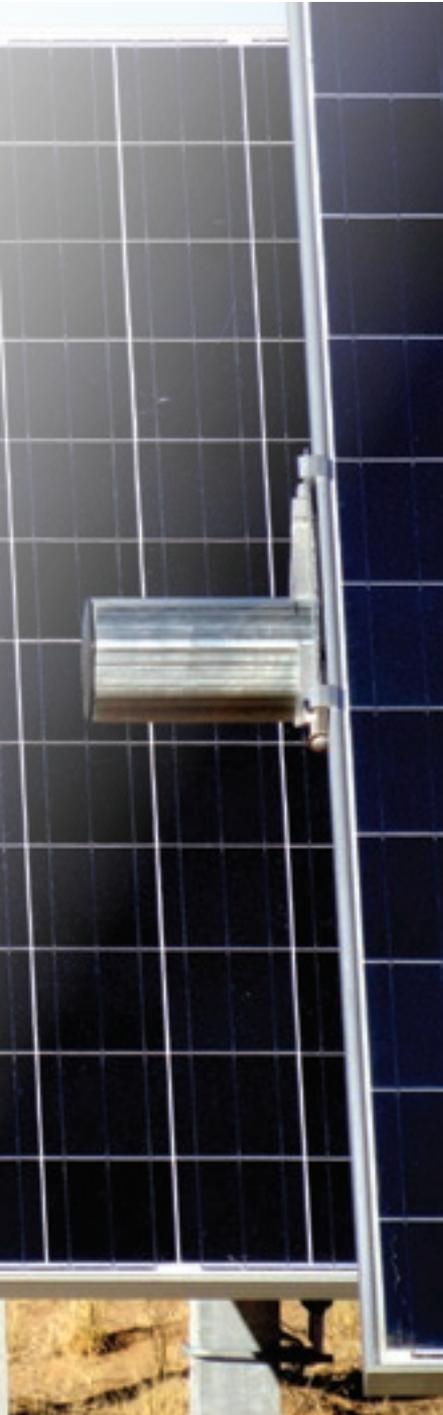
Sandy Simon is VP of BRIDGE Energy Group’s Transmission and Distribution Business Operations and has more than 20 years of extensive industry experience. Before joining BRIDGE, she was the COO at USGRDCO. Before joining USGRDCO, Simon was a consultant at GE, helping lead the design, implementation and deployment of an advanced project management office to govern and manage their AMI SaaS initiatives. Her consulting experience also includes delivery and integration of strategic, smart grid solutions for HCL America and EnergyGrid Networks.

Simon was instrumental in the incubation, development, launch and oversight of the SmartGridCity™ initiative in Boulder, Colorado. She holds a Bachelor of Business Administration and a Bachelor of Science from Evangel College in Springfield, Missouri as well as an MBA from the Daniels College of Business at the University of Denver.





FINANCING, OWNING, AND INSURING SOLAR FARMS: REDUCING INVESTMENT RISK



JIM FUSARO

In recent years, prices for utility-scale solar projects have plummeted to an all-time low. With purchasing mechanisms such as public bids growing in popularity, there has been a “race to the bottom” in pricing, and today, the cost of solar farms is typically less than traditional fossil-fuel powered plants. This has created unprecedented growth in technology adoption and investment alike, showing promise for the clean energy transition of the future. But this doesn’t come without challenges.

To deliver a solar project from concept to completion involves many parties; developers, independent engineers, lenders, EPCs, insurers and system owners all have a stake in the project. While each party’s goal is to achieve its maximum project returns, not all parties have the same metrics to achieve this, nor the same level of incentive to ensure the highest return over the lifetime of the system. Project lenders, insurers, and system owners will have the most at stake in the project’s long-term performance and with so many parties involved, they must pay close attention to risks.

Investing in Utility-Scale Solar

For an investor to take an interest in a solar project, risk must be reduced to an absolute minimum. A solar array must generate electricity at a predictable operational cost structure in order to deliver long-term, reliable returns.

The PV industry has made great strides in delivering certainty for the investment community. The ever-increasing number of institutional investors that are now backing PV projects is a testament to the promise of solar in delivering steady and predictable cash flows, but there is still a way to go to ensure the highest yield over the 20-30 years of the system’s lifetime performance. →

Testing and Due Diligence

Many project developers turn to independent engineers and quality assurance providers to carry out the required due diligence when it comes to key PV power plant components. This is particularly true with regards to solar modules. Testing laboratories and regimes are quite sophisticated, with the ability to expose modules to extreme operating conditions and simulate their likely performance over their operating life.

Module failures are well documented and, in some cases, such as potential induced degradation (PID), documented in great detail. Unfortunately, this isn't the case with the range of components often lumped together under the tag "Balance of Systems." This includes components such as electrical cabling, connectors and tracking systems; and this is a crucial oversight.



The deployment of solar tracking technology has grown rapidly.



Taking a Closer Look at Trackers

The deployment of solar tracking technology has grown rapidly. This is not surprising, as the technology significantly cuts down the amount of land necessary to host the solar plant and can increase generation output by approximately 20 percent. GTM Research forecasts tracker implementation as high as 80 to 90 percent in key PV markets including the U.S., Latin America, Middle East and Australia, as soon as this year.

This makes it all the more worrisome that the risks posed by component failure in tracker systems are not well understood, analyzed or priced. What's more concerning, there is a lack of understanding of the impact that tracker failures or faulty operation can have on a project's bottom line and Net Present Value (NPV). Given this, independent analyst TÜV Rheinland conducted the first-of-its-kind investigation on tracker reliability. The resulting "Risk and Economic Analysis on Two Tracker Architectures" report looked at the most popular tracker architectures, centralized and decentralized, investigating each according to its individual component and system reliability.



Assessing Risk and Economic Impact

The report found that the centralized architecture had vastly lower scheduled and unscheduled Operations and Maintenance (O&M) costs when compared to the decentralized architecture studied.

Findings showed the centralized tracking architecture loses 39 percent less energy due to component failures compared to the alternative architecture; has a 6.7 percent lower levelized cost of energy (LCOE); and nearly 4.6 percent higher net present value (NPV).

The Bottom Line

Breaking down the O&M costs in more detail, the report found unscheduled O&M costs to be the most damaging to a PV project's bottom line. This should give cause for investors to take a closer look at all components when investing in utility-scale solar. Notwithstanding the fundamental differences between tracker architectures, many solar plant financial models incorrectly assume identical O&M expenses. Financial returns on solar PV power plants can be significantly impacted by erroneous O&M modeling assumptions.

As the PV industry enters the next stage of its evolution, and society moves toward an energy transition, there is good reason to believe that all risks of a solar PV array will be assessed in greater detail. More scrutiny may uncover potentially underperforming components and high O&M costs before an investment is made. For investors, this can't happen soon enough.

ABOUT THE AUTHOR:

As CEO at Array Technologies, **Jim. Fusaro** is using his wealth of engineering and business experience to lead the company into its next era of growth. Fusaro began his career in aerospace in 1985 and soon gained experience in all business sectors. Throughout his career, he has served as a senior executive for multinational corporations including Motorola, Amkor Technology, Avnet and global conglomerate, Honeywell. Bringing a unique mix of functional and operational knowledge, Fusaro is a seamless addition to the leadership at Array. Fusaro holds a Master of Science in mechanical engineering from Rensselaer Polytechnic Institute and a Bachelor of Science in mechanical engineering from Arizona State University. Additionally, he is a certified Six Sigma Black Belt, has more than 60 technical publications and holds a number of US Patents.

YOU CAN'T PREDICT THE FUTURE OF SMART GRID INTEGRATION, BUT YOU CAN MANAGE IT



BRAD HARKAVY

Every day, operating the grid efficiently becomes more complicated, and the jobs of engineers and Distribution System Operators (DSOs), more difficult. Today, there is an explosion of Distributed Energy Resources (DERs) such as wind, solar and storage being added to the grid daily. While Neils Bohr famously said, “Prediction is very difficult, especially if it’s about the future,” what is clear is the need for scalable technologies to manage an increasingly complex grid of devices, data and systems of systems from here forward.

In conversations with utility system architects, the discussions repeatedly address how complex the grid is becoming. More sensors, more devices, more DERs, more systems to manage all of the new automation equipment is a common theme. A typical scenario is the following:

1. A DSO is about to purchase a new Outage Management System (OMS)
2. The DSO has limited Distribution Automation (DA) today
3. The DSO is using their Energy Management System (EMS) to manage their limited DA
4. The DSO plans to purchase a Distribution SCADA (D-SCADA) system but is unsure about the cost of a D-SCADA system and the complexity of having two different screens/interfaces for their control room operators (one for D-SCADA and one for their OMS)
5. The DSO will want to integrate an Advanced Distribution Management System (ADMS) in the future
6. The DSO also knows they will need a Distributed Energy Management System (DERMS) in the not too distant future →

7. The DSO is interested in integrating new IOT-like fault detection as well as voltage and current sensors that don't necessarily need to be interfaced with the company's SCADA system
8. The DSO desires an open architecture so they can mix and match best-in-breed applications and systems
9. The DSO knows that there will be an increasing number of new real-time applications from existing and new solution providers. The company leaders want to ensure they can easily integrate these applications that don't even exist today

As you can see in this scenario, the DSOs are faced with great uncertainty (and opportunity) managing complexity and a system of systems that is changing much more rapidly than anything utility companies have seen in the last 100 years of operations.

The challenge of supporting legacy equipment simultaneously with state-of-the-art DERs while monitoring disparate applications on both the OT and IT systems has created headaches across the industry. Utility operators have the view of the grid that they want and the data that comes with it, but their systems are not designed to handle this type of dataflow from the current system of systems integrations. SCADA systems are sometimes used to integrate this complicated system of systems. Designed primarily to control devices and acquire simple data sets, SCADA systems are not optimized to manage complex dataflows and do not support plug-and-play integrations of new grid applications.

To overcome these challenges, utilities are using the Operational Technology Message Bus (OTMB) architectural pattern within their OT/IT hybrid architectures. This pattern provides an over-arching organization for connecting all the components in a system of systems. OTMB architectures are built on OT-centric middleware. OTMB systems provide for bi-directional communication between SCADA, ADMS, OMS, DERMs and other OT systems, assets and devices utilizing various protocols (ICCP, DNP3, MODBUS, OPC, REST, etc.), IT and OT analytics applications, SQL and historian databases.

OT middleware solves the integration problem of establishing bi-directional communication and control between multiple DERs and systems using a variety of protocols. This single architectural layer enables utility

engineers to unify and manage distributed assets and data regardless of their relation to a system or protocol language. Rather than building a point-to-point solution (either in-house or through a team of consultants) every time a new system needs to be integrated into the OT architecture, an OTMB architecture provides a consistent, efficient framework for integration among all devices and protocols.

OTMB architectures are not just about the data plumbing required to manage dataflows among disparate systems. OTMBs can be extended to execute tasks and workflows. For example, they can help manage the challenge DSOs face in matching namespaces (also known as Measurement Management) across systems such as SCADA and OMS. The namespace metadata requires timely maintenance every time new devices are added to the grid or a device location is changed, often consuming much of an operating technician's time. This time would be better spent optimizing the operation of the system of systems instead of tediously moving configuration files from machine to machine. A well implemented OTMB software pattern will automatically manage the integration of namespaces and measurement metadata across disparate systems and devices, as well as having robust tools to aid in maintenance and manage naming exceptions.

Managing the Future with an OTMB

The previous scenario explains how an OTMB futureproofs this system evolution.

Phase 1 – OMS/EMS integration

The OTMB creates a bridge between an existing EMS and new OMS. This initial step ensures quick integration time between the OMS and EMS. Utilizing the OTMB's measurement management features ensures the EMS and OMS namespaces are automatically updated as new devices are added to your more and more automated grid. Perhaps as part of this first phase, you would like to add a new or existing operational historian (time series database) into your system of systems. You can achieve this easily through an OTMB. Additionally, the OTMB may be architected to sit in the cybersecurity DMZ. This creates a well-defined secure protocol data exchange bridge between the critical DA system network and your OMS, which sits closer to the IT network.

Figure 1. OTMB creates a bridge between EMS and OMS. Utilizing the OTMB's measurement management features ensure the EMS and OMS namespaces are automatically updated as new devices are added.

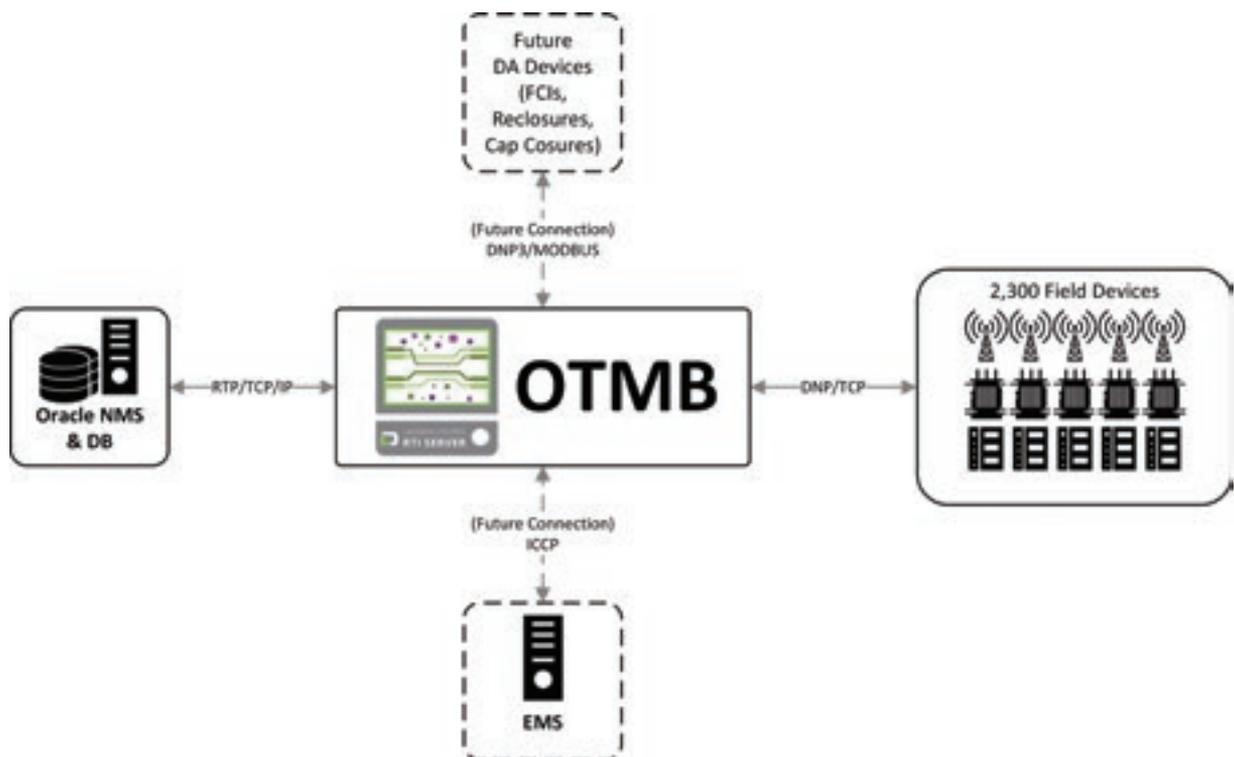


Phase 2 - Expanding Distribution Automation

Traditionally, DSO architects would implement a D-SCADA system to manage a fleet of DA devices such as automated switches. This scenario works great when you employ an OTMB as part of your system of systems of architecture. The OTMB offers a standard interface and quick integration. Some DSOs have chosen to take a different path. As shown in **Figure 2**, Evergy (formerly KCP&L) implemented an OTMB architecture and uses the SCADA-lite capabilities to control 3000 field devices directly from their OMS without using a traditional D-SCADA system.

It should be noted, that many DSOs are taking a hybrid approach (see **Figure 3**) to managing their fleet of DA devices. They are implementing new or re-purposing existing D-SCADA systems to manage their primary DA assets. They are also bypassing their D-SCADA system to integrate some IOT like devices such as current sensors and fault line indicators. Additional expansion in this phase is increasingly including cloud-based, real-time analytics systems with REST interfaces to manage DERMS functionality such as grid storage scheduling and optimization.

Figure 2. OTMB architecture employed to integrate SCADA functionality into an NMS transforming it into an ADMS



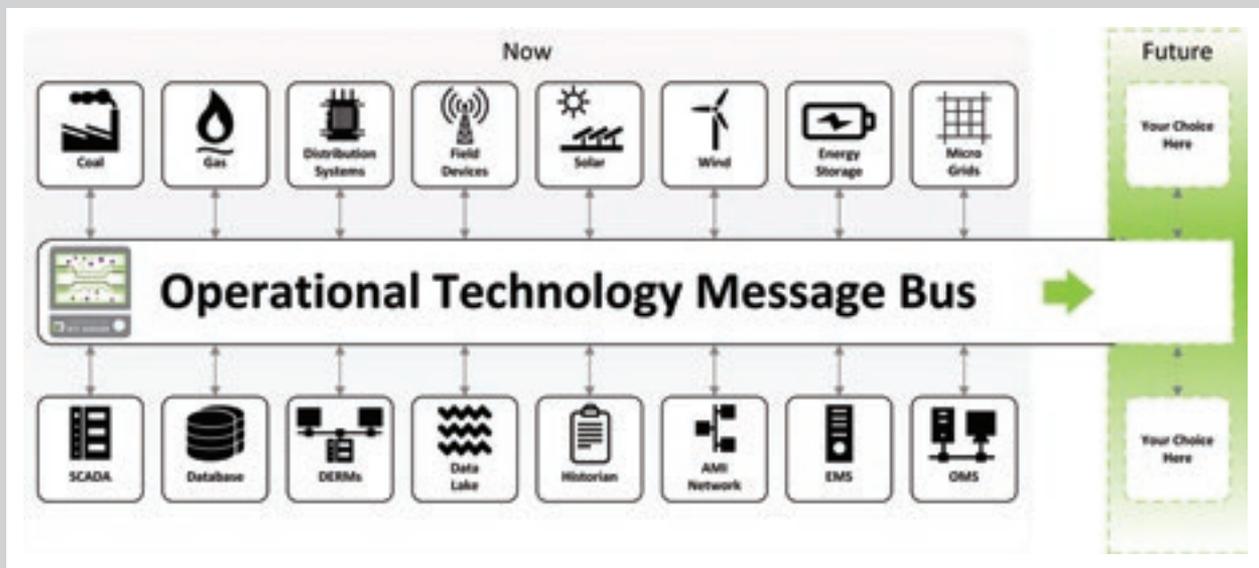
Phase 3 – The Future

As mentioned earlier, the future is hard to predict, but two trends are clear:

1. Distributed Energy Resources, IOT sensors and increased distribution automation will continue to grow at an exponential rate.
2. Smart start-ups with founders still in high school will develop new devices and OT applications that will be must-haves for DSOs managing a much more automated grid over the next 20 years.

Implementing an OTMB allows DSOs to take an organized evolutionary approach to adopting best-of-breed technologies over the coming years. It also allows DSOs to make smart choices about solutions without being locked into a single vendor. Although the future is uncertain, there is much you can learn from the enterprise software architects from 20 years ago. When faced with integrating an explosion of new HR, accounting, MRP and other enterprise solutions, IT architects have adopted middleware solutions. DSOs and OT architects are starting to embrace the same approach with OTMB (OT centric middleware) architectures to ensure a stable OT-centric integration platform to manage the future.

Figure 3. An OTMB architectural pattern allows for integration of all legacy, modern and future devices and systems.



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Brad Harkavy is the president of LiveData Utilities, a business unit of LiveData, Inc., and leads business development, strategy and overall management of LiveData's utilities business. He was the COO of Sagewell Inc, a city scale thermal imaging energy efficiency company and the CEO of BPG Inc, a novel electric motorcycle company. Harkavy has extensive executive-level experience leading public and private clean energy and high tech businesses. Through his executive positions, consulting and public and private board positions, he has successfully accelerated ideas and technology into innovative products and services for more than 20 companies. He is a frequent speaker on Operational Technology (OT) integration systems, and actively mentors start-ups through Cleantech Open, TechStars, Mass Challenge and the MIT Clean Energy Prize programs.



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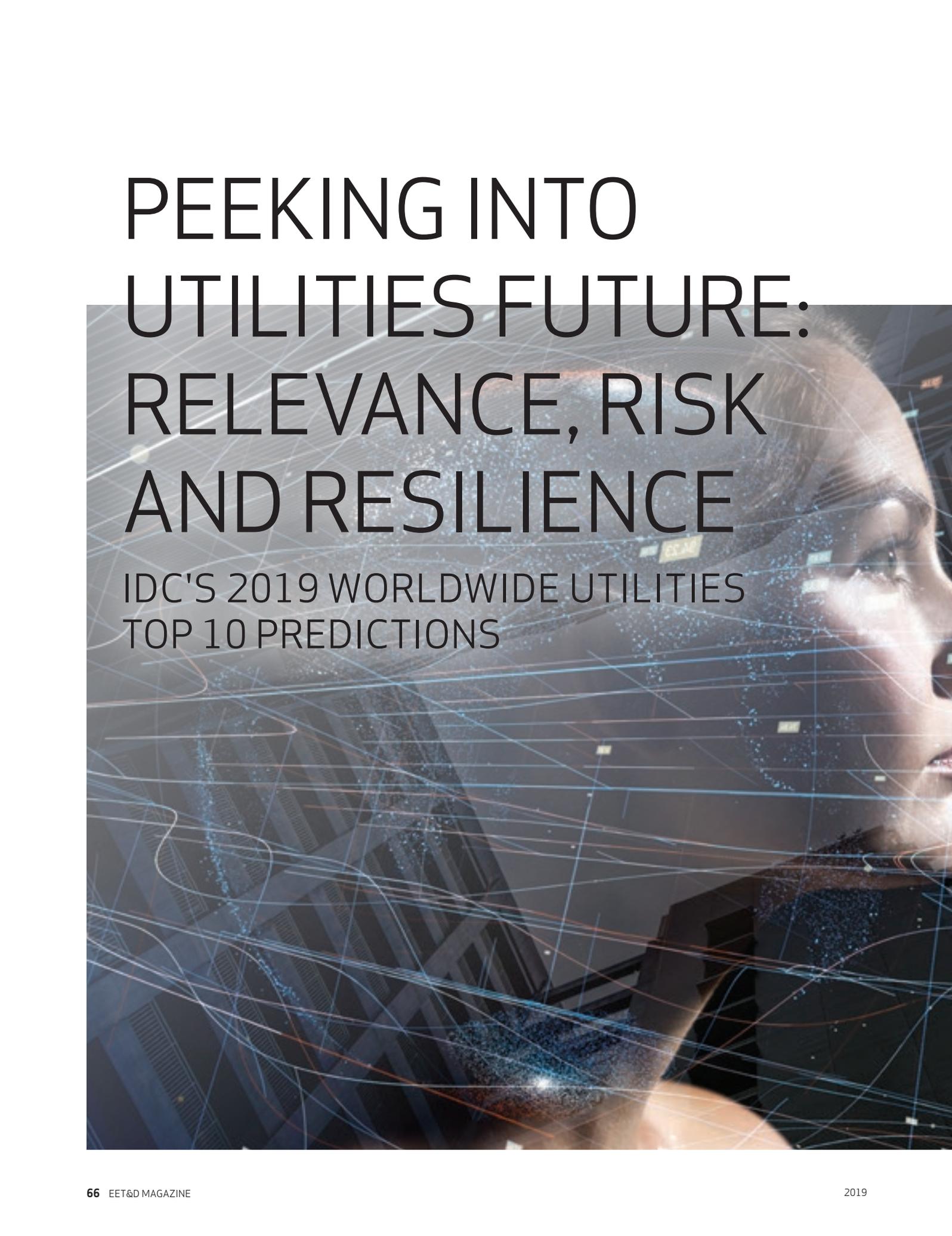
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PEEKING INTO UTILITIES FUTURE: RELEVANCE, RISK AND RESILIENCE

IDC'S 2019 WORLDWIDE UTILITIES
TOP 10 PREDICTIONS



ROBERTA BIGLIANI

Utilities across the world are radically transforming their businesses. This is happening despite different regulatory regimes and across the diverse electricity, gas, water and waste businesses. For instance, technology is changing how energy is produced, transported, consumed and conserved. Technology is key to reduce waste of water. On the other side, customers are not just raising experience expectations – they are becoming prosumers with an active role in energy markets. New business models are emerging, thus requiring utilities to go beyond the traditional commodity business. Offering combining distributed generation and energy storage at home is just one among the several examples of how utilities are changing the way to accomplish their mission. Digital disruptors are circumventing industry entry barriers, and utilities are being reborn in 3D: decentralized, divergent and digital. →



Digital is a Key Constituent of the Utility Renaissance

IDC classifies organizations in two macro categories — digitally distraught and digitally determined — 41 percent of utilities now belongs to the latter. Digitally distraught utilities are either running digital as an impromptu effort, running multiple digital strategies initiated by the line of business, or operating with a short-term perspective. It's no surprise that these organizations are distraught. It is difficult to accomplish a major transformation when efforts are not well orchestrated. On the other hand, a digitally determined utility has digital embedded in its enterprise strategy. It does not have a separate digital strategy since digital is the strategy.

IDC Energy Insights predicts that "by 2022, percent of digitally determined utilities' revenues will come from new products and services. "Digitally determined utilities will be best positioned to evolve their businesses, adding new business models and revenue streams, as well as carving efficiencies out of their core operations, with data as the pillar of innovation. With the traditional commodity business becoming progressively unsustainable, utilities need to redefine their strategy to be "relevant."

Resilience at the Top

According to IDC Energy Insights "by 2023, 65 percent of electricity companies will have invested in digital technologies and platforms to support flexibility services, thereby activating a load potential of up to 35 percent of installed capacity."

The energy transition is not only changing how we generate and use electricity but crucially, also boosting our ability to conserve it, changing the way we operate networks and balance systems. Non-dispatchable renewables (wind and solar) already represent a quarter of power generation capacity in Europe and more than 15 percent in China. By 2030, IDC Energy Insights expects them to generate 20 percent or more of all electricity in Europe, China, India and parts of the U.S., soaring to almost 30 percent in Australia and 40 percent on the U.S. West Coast. While they have only played a minor role to date, "negawatts" and storage and are becoming important elements of renewable systems. Two decades from now — with electric cars and heat pumps adding to the mix — flexibility will be a hard currency in most of the world's electrical systems, and it will be difficult to imagine power supply without it.

While the past decade was one of technology development, utilities have now started putting in place the building blocks of their flexibility plays, from demand-side management (DSM) and vehicle-to-grid (V2G) technology to full-fledged distributed energy resources management system (DERMS). Aggregation and virtual power plants (VPP) offer electricity companies a way to add grid services to the revenue mix, increase protection

from price peaks, and offer distributed energy resource (DER) owners access to the market. System operators must oversee, use and coordinate flexibility in their grids as part of their active management responsibilities and as a tool to operate cost efficiently. VPPs, for instance, can make DER and loads more predictable and dependable for the system.

Recent field work by IDC Energy Insights confirmed that more than 80 percent of utilities have either launched or are planning to establish a flexibility services business within two years and that more than a third believe flexibility will be a critical value contributor to their retail operations by 2025.

The Edge

Edge analytics and computing is becoming a higher priority for worldwide power, gas and water utilities. The ability to monitor, analyze and act on data from devices in the field will become the standard to react in a timely manner to operational events and inefficiencies. Using smart meters and sensors and applying cognitive computing and analytics at the edge, utilities will vastly improve their operational performance.

Edge analytics and computing will change traditional approaches to asset maintenance for utilities. The collection and analysis of real-time operational data will enable utilities to observe asset operation anomalies in advance of asset failures, which will increase asset performance while minimizing downtime. Additionally, edge computing and analytics can improve the productivity of utility field workers by providing data such as operational performance data, which will lead to operational excellence and utility customer satisfaction. Edge computing and analytics will help minimize service interruptions, improve outage restoration times, and provide timely information, communication and interaction with utility customers.

IDC Energy Insights predicts that "by 2020, 65 percent of power, gas and water companies will have invested in edge analytics/computing as they strive for operational excellence and the best optimization of their assets."

Customer Experience Always Matters

Customer experience is a top priority for everyone, including utilities and energy retailers across the globe, independent of whether the market has been liberalized or continues to operate in a regulated regime. As more consumer purchasing power shifts into the hand of more tech-savvy generations, utilities and energy retailers are increasingly investing in technologies that can best support them to cater to these customers as well as trim spending, and artificial intelligence is one such technology. →

IDC Energy Insights research revealed a strong desire for utility and energy retail customers to move from more traditional communication channels (e.g., phone calls) to modern communication channels (e.g., mobile messaging applications). However, regardless of the communication channel, there is an abundance of use cases for leveraging artificial intelligence to support the customer experience with convenience, customization and control. For instance, considering phone calls – which continue to force utilities to bear significant costs for call centers – artificial intelligence can be leveraged to listen to the content and tone of conversations to not only provide real-time support to customer service representatives, but also to gather insight into the general sentiment of customers toward the company. This enables a utility/energy retailer to preemptively carry out personalized marketing campaigns to support favorable opinions of the brand.

Considering more modern, and less expensive, communication channels such as mobile messaging applications and text messages, specialized chatbots support utilities and energy retailers to provide their clients with convenience, customization and control. It should be noted that additional IDC Energy Insights research revealed that an overwhelming majority of customer contact was driven by billing inquiries, so not a particularly complex artificial intelligence augmented messaging would be needed to meet most customer demands.

As utility and energy retailers expand into new revenue streams, such as selling or leasing photovoltaic panels or energy storage systems, or both as a package, it will be fundamental for these companies to provide customer experience comparable to those of customer-centricity leaders. Otherwise, the possibility to sell beyond a commodity will not be grasped.

For this reason, IDC Energy Insights expects that "In 2019, utilities/energy retailers will double their investments in artificial intelligence to improve convenience, customization, and control for clients, thus enhancing customer experience."

Embracing Risk

IDC Energy Insights predicts that "In 2020, managing the risk of operational technology/IT cyberattacks and data privacy compliance will cost utilities an average of 1 percent of annual turnover."

Utilities are faced with a double challenge – protecting customers' personal data and securing operational technology from potential threats that could affect physical infrastructure. Since energy is considered "critical" infrastructure, its security is of special

interest, not least because of external, state-sponsored cyberattacks. Consequently, the cost of addressing this challenge will continue to rise in the forthcoming years. On the privacy front, data leakage and its prevention have drawn and will continue to draw the attention of regulators worldwide, in line with the new sensibility regarding privacy. As utilities venture to the smart home domain, as well as residential energy production and storage, utilities will also have to secure and protect access to personal data. The prospect of heavy fines will force utilities to be cautious and accept high compliance costs in the short term, in exchange for lowering the probability of being held liable for inadequate security measures. Regulatory compliance, in general, has topped utility executives' agendas for years, above that of the single IT department, and it will continue to be an area of zero risk tolerance.

Year after year, the impact of personal data breaches on customers' trust on service providers has been more and more devastating. Utilities are no exception to that trend, though to a lesser extent thus far. As this traditionally asset-centric industry is evolving toward increased data sophistication, the risk of becoming the target of cyberattacks is also set to become higher, and the same applies to corresponding fines. Strategic foresight regarding the IT and business sides of the problem will therefore prove invaluable.

IDC Energy Insights' Recommendations

The above are just some of the top the predictions IDC has developed for utilities (see **Figure 1** for the full overview). Impact and detailed guidance for all them has also been developed. In summary, in order for utilities to continue to be relevant, resilient and embrace risks, IDC Energy Insights recommends the following:

- **Strategize your own disruption.** Do not wait to be disrupted by others, and initiate your business transformation journey, embed digital in your enterprise strategy and do not separate it since digital is the strategy.
- **Execution matters.** Develop an agile enterprise road map that is modular (break the effort into chunks/use cases, delivering immediate business value), scalable (think through how the road map will evolve) and extendable (to accommodate changes as they unfold).
- **Digital platform matters.** Develop a digital platform that integrates digital innovation and the enterprise-wide systems together in a single platform. The platform enables digital products, services and experiences while modernizing and integrating the internal IT environment.

- **Culture eats strategy for breakfast.** Foster the development of a company culture that values innovation, proves commitment to employees' success, leverages agile and design thinking methodologies and creates a borderless organization capable of crowdsourcing talent.
- **Time for new KPIs.** Size your success along the journey by integrating traditional performance indicators with a new set of KPIs measuring innovation rate, customer and employee advocacy, data valorization, business operations, work and labor supply.

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As vice president for IDC Energy Insights, **Roberta Bigliani** advises both vendors and end-user clients and is responsible for research-based advisory and consulting services for the energy industry. Her main areas of expertise include business and IT issues relevant to the utilities industry and oil and gas companies, as well as digital transformation, customer experience, big data and analytics.

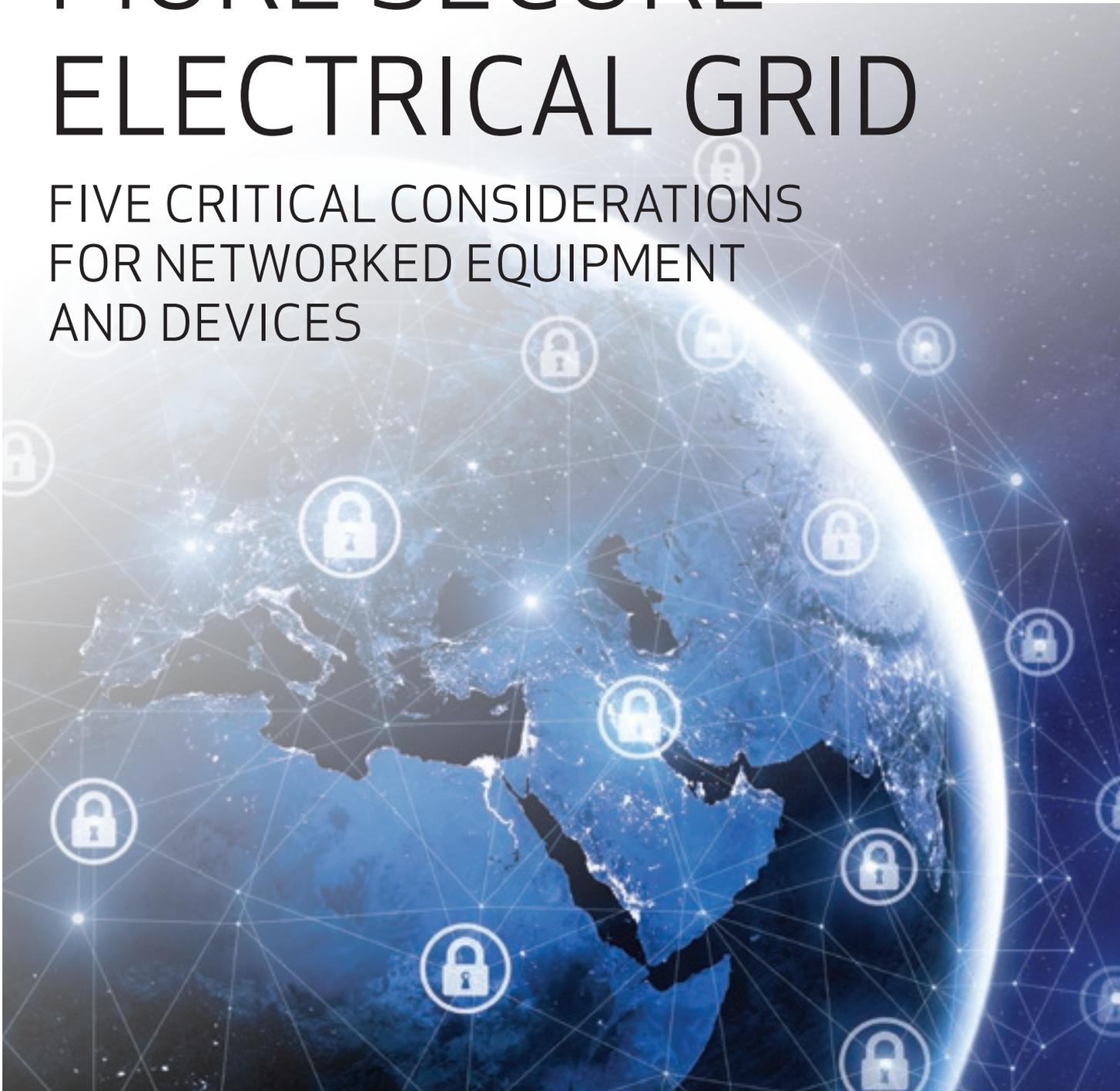
Figure 1. IDC FutureScape: Worldwide Utilities 2019 Top 10 Predictions

1	DIGITAL DETERMINATION	By 2022, 20% of digitally determined utilities' revenues will come from new products and services.
2	DISTRIBUTED GENERATION AND STORAGE	By 2021, 55% of utilities will derive 20% of gross margin on average from combined distributed generation and storage packages for prosumers.
3	EDGE ANALYTICS	By 2020, 65% of power, gas, and water companies will have invested in edge analytics/computing as they strive for operational excellence and the best optimization of their assets.
4	FLEXIBILITY	By 2023, 65% of electricity companies will have invested in digital technologies and platforms to support flexibility services, thereby activating a load potential of up to 35% of installed capacity.
5	CUSTOMER EXPERIENCE	In 2019, utilities/energy retailers will double their investments in artificial intelligence (AI) to improve convenience, customization, and control for clients, thus enhancing customer experience.
6	CONNECTED ASSETS	By 2023, utilities will have digitally connected 75% of their critical assets to predict and prevent equipment failure and prescribe best maintenance options to optimize and extend asset life cycles.
7	FUTURE OF WORK	By 2021, 35% of utility CEOs will have access to an intelligent personal assistant at work.
8	PLATFORMS	By 2022, 55% of utilities will use a core digital platform to automate, optimize, and orchestrate assets, business processes, customers, and employees, thus improving efficiency and business outcomes.
9	REVENUE PROTECTION	By 2020, artificial intelligence applied to revenue protection will enable water, gas, and electricity companies to reduce revenue losses by 70%.
10	SECURITY	In 2020, managing the risk of operational technology/IT cyberattacks and data privacy compliance will cost utilities an average of 1% of annual revenues.

Source: IDC FutureScape: Worldwide Utilities 2019 Top 10 Predictions

CREATING A MORE SECURE ELECTRICAL GRID

FIVE CRITICAL CONSIDERATIONS
FOR NETWORKED EQUIPMENT
AND DEVICES





MAX WANDERA

Managing the grid has never been more challenging because it's no longer enough to simply provide reliable electrical power. Today's utilities must balance the need for smarter solutions and grid automation with the increased cybersecurity threats that come with connectivity and intelligence. At the highest level, recent security breaches have demonstrated three basic things:

1. Cybersecurity threats continue to evolve
2. Companies need to think about cybersecurity as an integral part of product lifecycles so that assets are less vulnerable to attacks
3. Establishing rigorous standards, testing and methodologies to reduce risk is critical

These concerns are nothing new; utilities and equipment manufacturers have long recognized the importance and potential impacts of cybersecurity threats.

As utilities implement innovative connected technologies, they're challenging suppliers to provide substantial cybersecurity assurance against emerging cyber threats. Although both the utility and manufacturer share responsibility when it comes to creating a secure grid, product cybersecurity should be an integral consideration much like product quality, with strict protocols placed on the people, processes and technologies at every phase of product creation. →

Establishing Rigorous Engineering Standards

We know that the electric grid is a complex web spun from the equipment produced by many different manufacturers. If each manufacturer has a different view of what makes a networked device cyber secure, then utilities would have a hard time being confident in the security of their systems – and this complex web could ultimately fail. The idea is to make sure each strand of the web, or all of the components within the power system, meet the same high standards.

Creating the framework for a robust, consistent cybersecurity approach will help reduce risk while ensuring that all system components meet the same established industry standards. This can be achieved via independent, third-party verification that offers peace of mind and less product uncertainty.

In the summer of 2017, UL published general requirements for cybersecurity: UL 2900 Standard for Software Cybersecurity for Network-Connectable Products. These guidelines include processes to test devices for security vulnerabilities, software weaknesses and malware. UL also established a Data Acceptance Program (DAP) for cybersecurity. With this program, organizations can demonstrate that their labs adhere to aspects of the cybersecurity standards – building further proof of defense against emerging cyber threats.

By adhering to UL's new standards and processes, manufacturers can help utilities build trust in network connected technologies by demonstrating that the technologies adhere to consistent and measurable cybersecurity criteria. This process also provides tangible proof that technologies are designed to be cyber secure.



Source: Eaton

Defense-in-Depth

No method is completely secure. A “defense-in-depth” mechanism that is effective today may not be effective tomorrow because the ways and means of cyberattacks constantly change.

From inception through to deployment and maintenance, the modern manufacturer needs to instill cybersecurity best practices via training, threat modeling, requirements analysis, implementation, verification and ongoing support. Likewise, customers need to make periodic vulnerability and security assessments of deployed solutions on their sites.

It only takes a single security breach to impact safety, lifecycle costs and your reputation. Cybersecurity threats must be met proactively with a system-wide defensive approach specific to organizational needs. When selecting suppliers, it is critical to ensure they have a robust process for designing secure products.

When working with equipment manufacturers to support security throughout all phases of the device lifecycle process, the following approach is recommended:

1. Understand product requirements

Collect important background information from product teams to initially classify the product, whether the product to be built is a sensor, actuator, field device or system.

2. Learn how it's built

Review the architecture of the products in order to identify physical interfaces, protocols, data flows, deployment context and access scenarios. This can help set the stage for discovering where risks may hide.

3. See where the risk may lie

Methodically examine every facet of the design and create threat models to identify conceivable cybersecurity issues that may be a concern in the customer environment. With findings in hand, you can then finalize cybersecurity requirements.

4. Work to remove risk

Apply secure-by-design principals by ensuring cybersecurity is embedded in each phase of development – such as design, code reviews and product assessments – and correctly applied. Align findings with your framework requirements to confirm that you're meeting the product's cybersecurity goals. You should then document secure hardening and deployment guidelines according to industry best practices.

5. Confirm security

Validate requirements and findings from product assessments in order to help developers identify and fix any bugs discovered before developing a process to address any future vulnerabilities discovered in the field.

Closing Thoughts

It is essential to recognize that cybersecurity, even when designed into technology, is dependent on how solutions are applied as threats continue to evolve. For example, the blame cannot be placed upon a smartphone provider if you failed to download the latest update or security patches. Similarly, the way a customer applies technology and updates determines the cybersecurity of the product.

As threats evolve, the industry needs collaboration to identify where risk may lie, develop solutions to remove risk and ensure updates are applied to products regularly. An important part of the process is making sure that customers are aware of those updates and have trained resources to take advantage of the latest technologies and best practices available.

For manufacturers, a proactive and consistent enterprise-wide approach to cybersecurity will help utility customers gain confidence that digital solutions meet rigorous testing standards to support the highest level of defense against emerging cyber threats. Likewise, utilities need to continue to work closely with manufacturers to ensure we're building a connected grid that is not only more intelligent, reliable and sustainable – but also more secure than ever before.

ABOUT THE AUTHOR:

As director of the Cybersecurity Center of Excellence for Eaton, **Max Wandera** provides leadership and oversight in the strategic planning, development and assessment of Eaton products. He is responsible for the Secure Product Development Lifecycle Policy and compliance; including the research, design, development and implementation of security technologies for products, systems and software applications. His role works cross-functionally with corporate officers, business and functional leaders. Wandera acts as the voice of Eaton on product cybersecurity matters, interfacing with various government entities including the Department of Homeland Security, customers, industry forums and other industrial control security organizations.



KATHY NELSON

DIRECTOR OF TECHNICAL PRODUCT MARKETING AND INDUSTRY RELATIONS AT ONDAS NETWORKS



For this issue of *EET&D*, we are pleased to spotlight Kathy Nelson, a “powerful force,” who leads industry relations and product marketing for Ondas Networks. With 25 years of experience as a telecommunications engineer in the electric utility space, Nelson has both witnessed - and participated in creating - the myriad changes the industry has undergone - especially over the past decade.

When Kathy Nelson recently joined Ondas Networks as the director of technical product marketing and industry relations, she went from her role with Great River Energy, which focused on the utility space, to a position that serves five different critical infrastructure verticals - electric utilities, oil & gas, water, rail & transportation, and government/military. For Ondas, Nelson’s primary role is to educate those working in these mission-critical verticals on the IEEE 802.16s standard that her company uses in its technology and products.

Introduced in 2017, this narrow channel communications standard was developed with input from the Electric Power Research Institute (EPRI), the Utilities Technology Council (UTC), and several utility companies. The IEEE 802.16s standard was designed to operate in private radio frequency (RF) spectrum critical infrastructure industries have access to, as opposed to standards such as LTE, WiMAX, etc. that are designed for broadband spectrum, which critical infrastructure entities typically do not have access to. According to Nelson, this is the only standard that was designed for critical infrastructure industries and not for the consumer industry. It is also a standard on which her company continually works to enhance and improve. To inform her customers and industry partners about the standard, Nelson works closely with trade associations in each of the verticals. She speaks at industry conferences, delivers webinars and white papers and publishes articles about the standard in trade publications.

Nelson draws upon her expertise in the electric energy sector while learning her way around the verticals in which she had not worked, before Ondas. “I am enjoying working with the four other verticals which are new to me,” says Nelson. “The communications side of each is similar to those in the utility space, but the equipment that’s hanging on the other end of the communications network is different.”

While she considers herself more of an introvert, Nelson enjoys interacting with Ondas’ customers and seeing first-hand how they are deploying the company’s technology. “Meeting with the ‘boots on the ground,’ I am able to get a better sense of how they use our technology. Just being able to help them do their jobs better, and listening to what they say is a great learning opportunity,” says Nelson. While all of these meetings are educational; some come with a side of adventure. For instance, Nelson recently visited an oil field, and she is planning to visit a rail switchyard soon.

Although the utility industry, along with the other verticals on which Nelson is now focused are mostly made up of men, Nelson believes the industries are starting to attract more diversity. When she speaks at conferences, she emphasizes the signifi-

cant role women and people of color play in adding value to the industry. To those just entering the workforce or looking to get the most out of their professions, Nelson encourages them to join trade organizations or industry-related programs. As Nelson explains, workers who are engaged in their industries will gain more than knowledge of their trades. “If people get involved with trade associations and attend industry events, their careers and impact on their industries can be greater than their jobs,” asserts Nelson.

With STEM and STEAM programs gaining popularity, there is a greater awareness that parents and teachers can do a better job of encouraging girls to explore math and science. But when she began her career 25 years ago, Nelson didn’t have the option of a STEM program. So, what was her motivation to pursue an engineering degree? Nelson says it started with her father. “My dad was a professor of engineering technology, which is like engineering, without calculus,” explains Nelson. “He also wrote textbooks for engineering programs, so I grew up with an innate awareness of engineering and what the field required.” Nelson further explains that she and her two older sisters understood the importance of formal education, so there was never a question about whether she or her sisters would attend college. Deciding on majors, turned out to be a different issue. “Dad always wanted an engineer. Both of my older sisters started out majoring in engineering, but they each ended up switching to English majors. I started out studying architecture, but I switched to engineering,” says Nelson.

Not only was she encouraged at home to pursue careers in math and science, but Nelson also had teachers, who inspired her love of math, beginning as early as the second grade, and through her senior year of high school. In college, Nelson had a Power Systems professor, whose approach to teaching, further solidified her decision to enter the utility space as an engineer. “He made our power systems classes fun, interesting and lively. I worked with many engineers at Great River Energy who also went into the energy sector because of him and his classes.”

When she first went to work for Green River Energy, Nelson had a hiring manager who was also her champion. Steering her towards telecommunications engineering, as opposed to substation engineering, the manager told her, “60 cycles has been the same for 100 years; it doesn’t change. Telecommunications is much more interesting. Technology changes all the time.”

Over the years, Nelson has continued to receive encouragement from colleagues. After she had been in the industry for several years, Nelson got involved with the Utilities Technology Council (UTC), sitting on its board of directors for nearly 10 years. The support she received from her fellow board members was a welcome surprise. “I would go to those meetings, where I felt comfortable vocalizing my thoughts, and the board was open to my ideas. I received feedback like, ‘You have a really good perspective,’ and over time, my colleagues suggested I move into a leadership position within UTC. That support helped shape my view of leadership and the fact that I wanted to be an industry leader.” Nelson pursued leadership with UTC, serving as its public policy division chair for four years. In 2017, Nelson was named chair of the UTC board through May 2018. She left UTC’s board in August of 2018 when she went to work for Ondas.

As much as she relishes what she is learning about other mission-critical industries and helping companies improve their processes by adopting IEEE 802.16s, Nelson will always have an affinity for the utility sector and those within the sector who have taught her valuable lessons about leadership and human interaction. “Utilities may not be the sexiest places to work, but there is so much technological innovation changing the way the industry runs that I think it’s become one of the most exciting industries,” says Nelson. “I was able to experience many of those changes and have been given opportunities to explore so many different things throughout my career. I have no regrets about the work I have done. And now, after so many years in one industry, I am happy to have begun this newest chapter with Ondas.”

IEEE 802.16S STANDARD – THE ANSWER FOR MISSION-CRITICAL APPLICATION NEEDS

KATHY NELSON

The electric utility industry is undergoing a transformation to modernize and secure the power grid. Grid modernization involves the development of the Industrial Internet of Things (IIoT) or Mission-Critical Internet of Things (MC-IIoT). The challenge, however, is that IIoT and MC-IIoT require increased connectivity provided by secure and reliable wireless field area networks in order to communicate with remote monitoring and control technologies. Unfortunately, most available network solutions were not designed to support the continuously changing demands of the MC-IIoT.

The electric utility and other critical infrastructure industries need standard technology options to deploy highly reliable field area networks on private radio frequency (RF) spectrum. While wireless standards have existed for broadband spectrum, it is only recently that there has been standard technology that could be used on frequency channels less than 1.25 MHz wide. The smallest channel size for LTE is 1.4 MHz, and the smallest channel size for standard WiMAX is 1.25 MHz. Most critical infrastructure entities do not have access to these wideband channels which are high cost, leaving most of them faced with adopting proprietary technology solutions or to rely upon commercial carriers which do not have the reliability and availability for mission-critical applications, such as Supervisory Control and Data Acquisition (SCADA). Additionally, standards such as LTE, were designed for the consumer industry, not mission-critical industries.

Proprietary solutions, regardless of the size of the technology vendor or provider, pose multiple challenges to utilities. While a proprietary solution may meet demands and provide a sound design at the time of purchase, utilities face the constant risk that the vendor may go out of business or discontinue their product line, leaving customers unsupported.

The Evolution of a Standard

IEEE 802.16s effort was a grassroots effort launched for electric utilities looking for a standard technology that could be used in narrow channel bands they possess access to, typically purchased on the secondary market (700 MHz

A band, 217 – 219 MHz, 1.4 GHz, etc.). These spectrum bands do not have enough bandwidth to support other standard technologies.

Public broadband wireless technologies are evolving towards higher speeds and smaller cell sizes and are focused on consumer applications. The public Internet of Things (IoT) services such as Narrow Band LTE (NB-LTE) are being deployed with a focus on consumer market applications and are not well suited for MC-IIoT applications.

The IEEE 802.16s standard is designed for the mission-critical private broadband wireless market. It provides multimegabit throughput using relatively narrow channel size (between 100 kHz to 1.20 MHz) and long range (e.g., 25 miles and beyond) to minimize spectrum acquisition and network infrastructure cost.

IEEE 802.16s is optimized for mission-critical remote-control applications, not the consumer market. Many mission-critical applications such as SCADA require more data to go from the remote devices, such as a substation, to a master device. This is a reverse asymmetrical data flow and is nearly opposite to the consumer market which is heavily driven by data that goes from the network to the remote device, such as in streaming Netflix videos, etc. IEEE 802.16s addresses this by adopting Time Division Duplex (TDD) with a downlink to uplink traffic ratio up to 1:10.

Frequency Division Duplex (FDD) vs. Time Division Duplex (TDD)

LTE and several proprietary technologies are based on FDD because that spectrum has historically been paired. To understand the difference between FDD and TDD, think of FDD as a freeway where there is the same number of traffic lanes going into and out of a city. During morning rush hour, all the traffic lanes going into the city are clogged, and traffic is moving slower due to congestion, while the traffic lanes going out of the city are mostly empty. It would be more effective if some of those lanes could be configured so that more of them could go into the city because there is more traffic. TDD allows for that “traffic lane” configuration. →



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The number of “lanes” moving in each direction can be configured for each specific system, making more efficient use of the RF spectrum. This is very important when the RF spectrum is limited and is the basis of IEEE 802.16 and IEEE 802.16s.

IEEE 802.16s Highlights

While IEEE 802.16 is a good base for an efficient wireless technology, changes were needed to adapt it and make it even more efficient in narrower channels, namely reducing the overhead so more user data could be transmitted. The standard is designed so it can be reverse asymmetrical, meaning more throughput for upstream than downstream, which is how most mission-critical systems function although it can be symmetrical or asymmetrical, depending on system requirements.

Several changes were made to IEEE 802.16 to make it more efficient for narrower channels. IEEE 802.16s supports channel sizes between 100 kHz and 1.20 MHz, in 50 kHz increments. The sampling clock is reduced to accommodate narrower channel bandwidth resulting in a reduction in subcarrier spacing. The number of sub-channels is reduced to avoid excessive subcarrier spacing reduction, and IEEE 802.16s uses an adjacent subcarrier per sub-channel allocations scheme known as Band Adaptive Modulation and Coding (AMC), which is more efficient in smaller channel sizes than Partial Use of Sub-Carriers (PUSC) which is commonly used in IEEE 802.16. Air interface protocol changes were made in IEEE 802.16s to make better use of spectrum:

- Convolutional Turbo Coding (CTC) is mandatory. This lowers the Forward Error Correction (FEC) Code thresholds relative to Convolutional Coding (CC).
- Make 64 QAM 5/6 a mandatory scheme to enable higher frequency utilization (30 bytes per slot) if conditions allow.
- Use single zone with band AMC in both downlink and uplink directions to avoid the overhead of multiple zones scheme.

- Support new frame durations of 10 ms, 12.5 ms, 20 ms, 25 ms, 40 ms, and 50 ms to reduce per frame overhead for narrower channels while maintaining the IEEE 802.16 standard 5 ms frame duration for use at higher ends of the channel bandwidth.
- Support of Cyclic Prefix values of 1/8, 1/16 and 1/32 to reduce overhead if multipath conditions allow.
- Supports DL:UL ratio in the range 10:1 to 1:10 to support asymmetrical and reverse asymmetrical applications.

What Does This Mean for Electric Utilities?

As more data is required and more intelligence and processing for utility networks moves to the edge of the distribution grid, the capability of communications networks needs to increase. This newly developed, highly efficient, narrower channel standard enables utilities to deploy mission-critical applications on private, licensed, standard, and secure wireless communications networks.

ABOUT KATHY NELSON:

Kathy Nelson is the director of technical product marketing and industry relations at Ondas Networks, formerly Full Spectrum, where she leads Ondas' industry relations and product marketing across all industrial verticals including electric utilities, oil and gas, water, transportation and government. Nelson has 25 years of experience as a telecommunications engineer in the electric utility industry, focusing primarily on SCADA and land-mobile radio telecommunications systems. She served as UTC Chairwoman of the Board in 2017-2018, ending a tenure of nearly 10 years on UTC's board of directors, four of those years as public policy division chair. Nelson has a B.S. in electrical engineering from North Dakota State University and is a registered professional engineering in Minnesota, Wisconsin and North Dakota.

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