

# EET&D

## MAGAZINE

Quarterly Issue 1, 2020 – Volume 23



**THE SPIRIT OF COLLABORATION  
BETWEEN IEEE PES AND  
THE UTILITY SECTOR**

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Elisabeth Monaghan, Editor in Chief

If you missed which industry trends to watch for, you can get a sense of what solutions are likely to have a significant impact on the electric energy sector by visiting the DistribuTECH 2020 website. You can also peruse this issue of EET&D to see what is on the mind of industry experts as they face the year ahead.

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The State Grid Corporation of China is developing and promoting 3D design standards to digitalize processes for lifecycle substation management throughout the country. The 220-kilovolt substation is the organization's CNY 120 million pilot initiative, and the first substation to use 3D digital modeling throughout construction, operations and maintenance.

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### **REINVENTING THE UTILITY INDUSTRY**

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Significant disruptions confront the energy and utility industry today, with challenges coming from seemingly every direction and at every level. New energy sources, inflexible infrastructure, consumer demands and climate change are just a few of the forces affecting this once stable and most traditional of industries.

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### **ADVANCEMENTS IN SUBSTATION AUTOMATION SOLUTIONS TRANSFORM USABILITY**

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Electric utilities face the challenge of managing aging and unsupported legacy automation and monitoring equipment at their substations and pole-tops. This equipment is critical for accessing data from intelligent electronic devices (IEDs) for measurement and protection, automating key functions and enabling remote users to securely control power-system devices.

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### **GOVERNMENT STAKEHOLDERS NEED TO PLAN FOR A MICROGRID TODAY**

Don Wingate, Schneider Electric

While it's impossible to completely remove the risk of power failure, microgrids are a proven strategy to harden the grid - preventing and reducing the impact of extreme weather on electrical systems. Coupled with their ability to enable the system to "bounce back," microgrids help mitigate power interruptions, increasing both life safety and business continuity.

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### **WORKING WITH REMOTE COMMUNITIES, MICROGRIDS POWER THROUGH**

Maxine Ghavi, ABB

Traditionally powered with dirty, high-cost diesel generation, today's microgrids typically seek to operate with high contributions of economically-viable and clean renewable generation. And remote communities have led the way toward a low-carbon solution because of the disproportionately high impacts of fossil-fuel based generation to their way of life.





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### **UTILITIES REMAIN A RESOURCE FOR CONSUMERS CONCERNED ABOUT THE CLIMATE CRISIS**

Jeff Hamel, Google

By lowering adoption barriers for smart home products across demographics, utilities are positioning themselves as champions of the smart home and climate movements. To continue to meet rising technology demands while supporting consumers and environmental goals, utilities must continue to educate their customers about available rebates and the benefits of owning smart devices.

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THE BIGGER PICTURE

### **WITH THE MARCH OF RENEWABLES, ELECTRICITY SECTOR LATEST INDUSTRY TO UNDERGO TRANSFORMATION**

Dave Leligdon, Jeremy Klingel and Dean Siegrist, Black & Veatch

Renewable energy and applications altering how energy is used are rattling the conventional power industry, hastening its transformation even as headwinds – things like rigorous regulations and consumer expectations of reliability – may make it feel like a bridge too far.

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SECURITY SESSIONS

### **PRIVATE STANDARDS ARE THE KEY TO LONGEVITY FIX**

Kathy Nelson, Ondas Networks

5G is all the buzz in telecommunications and even everyday life these days. People are wondering when it will be available, and the telecommunications providers market it as the answer to everyone's communications problems.

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POWERFUL FORCES

### **DR. BECCA JONES-ALBERTUS**

Elisabeth Monaghan, Editor in Chief

For this issue's Powerful Forces section we had the privilege of interviewing Dr. Becca Jones-Albertus, who is the Solar Energy Technologies Office Director within the Office of Energy Efficiency and Renewable Energy.

## DOUBLE THE SHARE OF RENEWABLES IN THE 'DECADE OF ACTION' TO ACHIEVE ENERGY TRANSITION OBJECTIVES

January 2020

The share of renewables in global power should more than double by 2030 to advance the global energy transformation, achieve sustainable development goals and a pathway to climate safety, according to the International Renewable Energy Agency (IRENA). Renewable electricity should supply 57 per cent of global power by the end of the decade, up from 26 per cent today.

A new booklet 10 Years: Progress to Action, published for the 10th annual Assembly of IRENA, charts recent global advances and outlines the measures still needed to scale up renewables. The Agency's data shows that annual renewable energy investment needs to double from around USD 330 billion today, to close to USD 750 billion to deploy renewable energy at the speed required. Much of the needed investment can be met by redirecting planned fossil fuel investment. Close to USD 10 trillion of non-renewables related energy investments are planned to 2030, risking stranded assets and increasing the likelihood of exceeding the world's 1.5 degree carbon budget this decade.

***"We have entered the decade of renewable energy action, a period in which the energy system will transform at unparalleled speed," said IRENA Director-General Francesco La Camera. "To ensure this happens, we must urgently address the need for stronger enabling policies and a significant increase in investment over the next 10 years. Renewables hold the key to sustainable development and should be central to energy and economic planning all over the world."***

***"Renewable energy solutions are affordable, readily available and deployable at scale," continued Mr. La Camera. "To advance a low-carbon future, IRENA will further promote knowledge exchange, strengthen partnerships and work with all stakeholders, from private sector leaders to policy makers, to catalyse action on the ground. We know it is possible," he concluded, "but we must all move faster."***

Additional investments bring significant external cost savings, including minimising significant losses caused by climate change as a result of inaction. Savings could amount to between USD 1.6 trillion and USD 3.7 trillion annually by 2030, three to seven times higher than investment costs for the energy transformation.

Falling technology costs continue to strengthen the case for renewable energy. IRENA points out that solar PV costs have fallen by almost 90 per cent over the last 10 years and onshore wind turbine prices have fallen by up half in that period. By the end of this decade, solar PV and wind costs may consistently outcompete traditional energy. The two technologies could cover over a third of global power needs.

Renewables can become a vital tool in closing the energy access gap, a key sustainable development goal. Off-grid renewables have emerged as a key solution to expand energy access and now deliver access to around 150 million people. IRENA data shows that 60 per cent of new electricity access can be met by renewables in the next decade with stand-alone and mini-grid systems providing the means for almost half of new access

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# DEWA LAUNCHES ITS SMART APP ON HUAWEI STORE TO ACHIEVE CUSTOMER HAPPINESS AND ENHANCE DIGITAL TRANSFORMATION

December 2019

Dubai Electricity and Water Authority (DEWA) has launched its smart app on the Huawei store to facilitate access to its smart services. This is in accordance with the wise leadership's approach for innovation and excellence in providing the best smart services with high quality and efficiency.

DEWA's smart app gives customers a seamless experience, by combining several steps, reducing the hassle of searching and browsing, to enhance customer experience and happiness. On logging in, customers can immediately view all DEWA's services, such as Activation of Electricity/Water (Move-in), Deactivation of Electricity/Water (Move-out), bills payment, getting the Green Charger Card, easy payment, request for a clearance certificate, deposit refund, among other services.

*"DEWA is one of the first government organisations to provide all its services through various smart channels in line with our efforts to achieve the vision of His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, and the directives of His Highness Sheikh Hamdan bin Mohammed bin Rashid Al Maktoum, Crown Prince of Dubai and Chairman of the Executive Council of Dubai, to transform the Government of Dubai into a fully digital government and the first paperless government by the end of 2021. Smart adoption of DEWA's services reached 94% so far. DEWA strategies and initiatives are aligned with the UAE's leading national strategies, including UAE Centennial 2071, a long-term government plan to prepare the UAE and young Emiratis for the future; the National Strategy for Artificial Intelligence 2031, and the UAE Strategy for the Fourth Industrial Revolution; to make its customers happier, as well as the community as a whole, and bring a comprehensive change to government work," said HE Saeed Mohammed Al Tayer, MD & CEO of DEWA. →*

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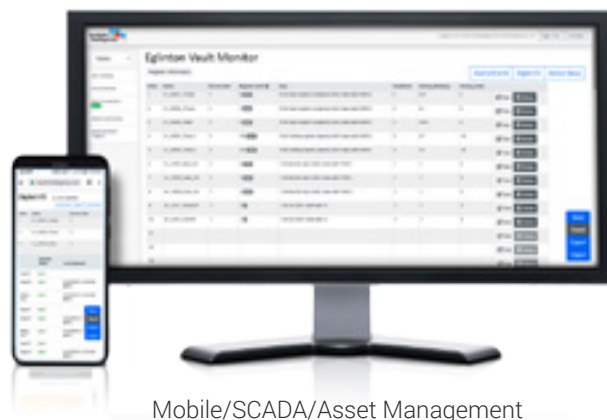
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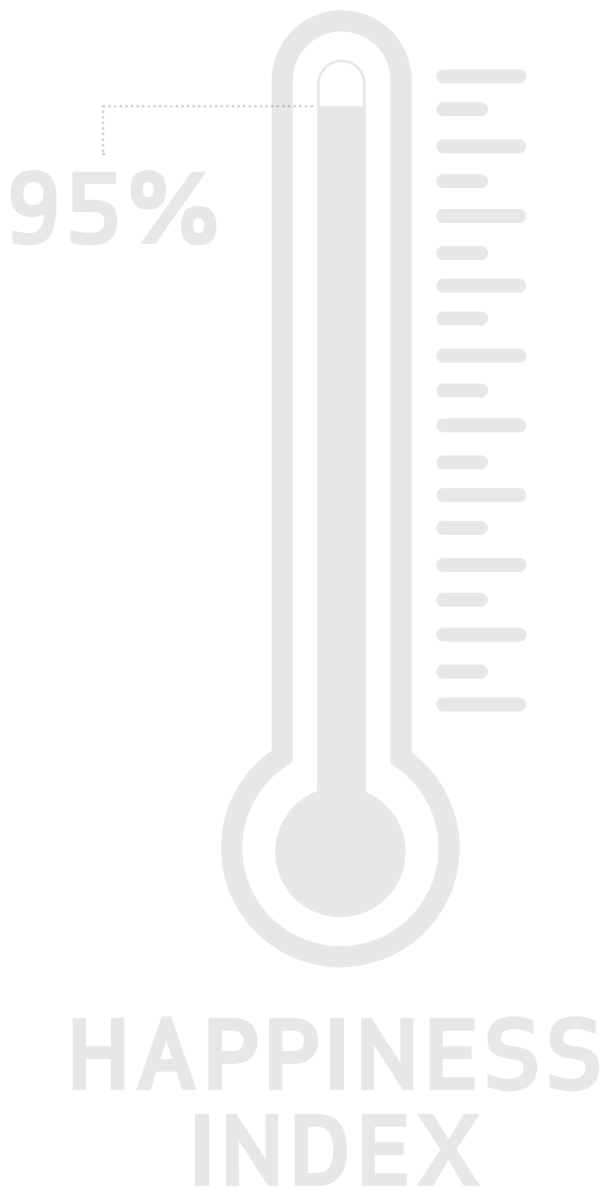


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*“The strategic partnership with Huawei, which is a global leader in telecommunications and information technology, has resulted in many important achievements supporting DEWA's efforts to achieve promising government strategies to make customers happy. We spare no efforts in adopting the latest technologies to enhance our achievements. We have maintained our top position in the large Dubai Government entities category for the second consecutive year with a score of 95%, according to Smart Dubai's Happiness Index,” added Al Tayer.*



*“DEWA's efforts are focused on entering the race for the future, in line with promising government strategies that aim to employ the Fourth Industrial Revolution's technologies such as Artificial Intelligence to provide state-of-the-art smart services and solutions,” said Marwan bin Haidar Executive Vice President of Innovation and the Future at DEWA.*

*“DEWA collaborates with national and international companies to exchange solutions, experiences, and best practices in innovation and digital transformation. Our smart app on Huawei store will encourage our customers to use their smartphones to facilitate transactions and shorten the time and effort needed. This aligns with DEWA's strategy to achieve customer happiness,” added bin Haidar.*

DEWA has recently revamped its smart channels after extensive research based on customer usability and their needs. The research focused on advanced smart channel information engineering. The services are grouped according to the category of users: customers, project creators, partners, suppliers, students, government organisations, and job seekers. The new website also follows the best international standards for accessibility to provide a better experience for people of determination



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# POWER YOUR WAY: RELIANT PERSONALIZES ELECTRICITY SHOPPING AND LAUNCHES NEW "TRULY FREE 7 DAYS" PLAN

January 2020

Reliant is kicking off the new year with a commitment to personalize power. In 2020, Reliant is empowering customers with "Pick Your Free," a new experience that takes the guesswork out of choosing an electricity plan by helping customers find the one that is right for their lifestyle. The company is also offering a new electricity plan that provides customers free electricity for their seven highest usage days every monthly billing cycle. The Reliant Truly Free 7 Days plan, paired with a Google Nest Hub, is designed with busy Texans in mind.

Reliant is the only retail electric provider in Texas currently offering three free time-of-use plans simultaneously to help its customers find the best fit for their lifestyle - Reliant Truly Free Weekends, Truly Free Nights, and its new plan Truly Free 7 Days, all with a Google Nest Hub at no additional cost.

***"We are passionate about meeting our customers' diverse needs and making power more personal this year," said Elizabeth Killinger, president of Reliant. "We are delivering meaningful innovations, affordable products and easy-to-use account management tools - all designed with our customers in mind. Our promise is to provide power your way, whatever your lifestyle."***

Regardless of how customers manage their energy, whether they like to monitor usage regularly or set it and forget it, Reliant has them covered with electricity plans that suit a variety of lifestyles:

- **NEW: Reliant Truly Free 7 Days + Google Nest Hub** offers free electricity for the seven highest usage days every monthly billing cycle. This plan works best for customers who do not want to worry about when they use electricity the most. Truly Free 7 Days appeals to frequent travelers, shift workers or stay-at-home parents who often have fluctuating schedules.
- **Reliant Truly Free Weekends + Google Nest Hub** offers free electricity every weekend, from 8 p.m. Friday to 12 a.m. Monday. This plan works best for customers who can hold or move their high electricity usage activities to the weekend. Truly Free Weekends appeals to those who spend their weekends at home binge-watching, meal-prepping, having family and friends over, and catching up on laundry.
- **Reliant Truly Free Nights + Google Nest Hub** offers free electricity every night, from 8 p.m. to 6 a.m. This plan works best for customers who use their electronics, appliances and AC most in the evening. Truly Free Nights appeals to those who are night owls and enjoy the simple pleasure of sleeping extra cool on warm Texas nights.

As part of Reliant's continued partnership with Google, customers can experience voice-activated convenience and energy usage insights. Innovations like the Google Nest Hub empower customers to monitor and manage their energy use, so they can shift usage and activities according to their plan and maximize their savings.

Customers can sign up for one of the Pick Your Free plans and receive a Google Nest Hub at no additional cost, or learn about other plan offerings, by visiting [Reliant.com](http://Reliant.com) or calling 1-866-Reliant. From offering the Reliant Texans plan and Reliant Cowboys plan for the ultimate sports fans, to providing the Reliant Local Solar plan and Reliant Electric Vehicle plan to eco-conscious consumers, Reliant is committed to personalizing electricity for all customer lifestyles

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# NARUC-NASEO TASK FORCE ON COMPREHENSIVE ELECTRICITY PLANNING DEVELOPS NEW RESOURCE LIBRARY

January 2020

The National Association of Regulatory Utility Commissioners and National Association of State Energy Officials Task Force on Comprehensive Electricity Planning has developed a new resource library, which includes presentations and recordings from the task force's summer webinar series and dozens of resources that are relevant to comprehensive electricity planning. The resource library was announced recently at the NARUC Annual Meeting and Education Conference in San Antonio, Texas.

Task force members identified a set of key topic areas that would enable further education on issues related to comprehensive electricity planning.

With support from the U.S. Department of Energy, the Task Force was formed in November 2018 as a two-year collaborative initiative of NARUC and NASEO to provide a forum for participants from 12 to 15 states to examine key planning process intersections to test concepts, learn from national-caliber experts and outline policy and technical needs. Direct participants develop tools and roadmaps available to all NARUC and NASEO members to adapt and refine for use in their states. The task force provides a forum for the development of state-led pathways toward a more resilient, efficient and affordable grid.

The library is comprised of several topic areas ranging from data access to utility best practices for integrated planning.

***“One of the goals of the resource library is to help educate our state utility regulators about evolving electricity planning processes,” said Co-Chair Jeffrey Ackermann, of the Colorado Public Utilities Commission. “This resource should greatly aid in aligning state energy planning efforts.”***

***“Commission and state energy office participants have been tasked to create innovative and visionary roadmaps using collaborative problem-solving methods,” said Co-Chair Laura Nelson, PhD, of the Utah Office of Energy Development. “This is a great starting point for accomplishing that goal.”***

The library can be accessed online at [www.naruc.org/taskforce/resources](http://www.naruc.org/taskforce/resources)

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# HAPPY 2020!



**ELISABETH MONAGHAN**  
Editor in Chief

Typically, at the end of each year, industry analysts list the trends that have made their mark over the past 12 months, or at the start of a new year, they inform us about emerging technology to keep an eye on. If you missed out on these lists, you can get a sense of what solutions are likely to have a significant impact on the electric energy sector by visiting the DistribuTECH website and looking at the tracks presented at DistribuTECH 2020. There, you'll see topics like cyber security, asset management, DERMs, grid management, energy storage and the changing profile of energy consumers. You can also peruse this issue of *EET&D* to see what is on the mind of industry experts as they face the year ahead.

## As renewables emerge, utilities must pivot to trusted advisors

According to the International Energy Outlook 2019, the U.S. Energy Information Administration (EIA) projects that renewables will collectively increase to 49 percent of global electricity generation by 2050.<sup>1</sup> That means that even though 2050 may seem like a long time from now, utilities cannot wait until then to integrate renewable energy.

In her article about reinventing the energy and utility industry, Kelly James with Velocity writes about the role utilities can play in shepherding consumers through the disruption caused by renewable energy. To manage this disruption, James says utilities must attract a highly skilled workforce and keep the workers engaged. Simultaneously, utilities must change the way they work with customers – treating them as partners, not just consumers.

James goes on to write about the tools that utilities can work with to help build that relationship. For example, by implementing CRM platforms, utilities allow customers access to secure information, where they can see their usage patterns or monitor their carbon footprint. Working with such tools helps utilities “accelerate this customer-centric shift and provide the technology that underpins the new relationship between customer and the utility.” This makes it easier for customers to manage their energy consumption while positioning utilities as trusted advisors “on all issues relating to energy and consumption habits.” →

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<sup>1</sup> U.S. Energy Information Administration, International Energy Outlook 2019  
<https://www.eia.gov/todayinenergy/detail.php?id=41533>





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### Addressing climate change

As utilities endeavor to evolve with the digital age, they will continue to seek out the most cutting edge resources and industry partners to ensure a smooth transition. But there is one disruptive challenge the power sector faces that is becoming more concerning by the day – climate change. To emphasize this point, five of the articles in this issue of *EET&D* mention or focus on the climate crisis.

In the fourth quarter of 2019, Black & Veatch released its 2020 Strategic Directions Megatrends Report. For this issue's article in "The Bigger Picture" section, Dave Leligdon, Jeremy Klingel and Dean Siegrist with Black & Veatch discuss how climate concerns are affecting the debate on renewables. As they explain, "Environmental and climate concerns are grabbing more global attention, blunting debate about whether renewables are going to be the cornerstone of tomorrow's power generation. It's in that vein that the electricity sector and businesses need to show they're serious about clean power and collaborate on energy solutions ...

Consumers, equipped with increasingly sophisticated technology ... are demanding real-time, transparent engagements with their utility. And along with a growing number of businesses, they're demanding power in cleaner, greener ways.

The onus of being nimble is thrust onto electricity providers, who admit flexibility to adapt to what's coming is atop their wish list. "

According to Don Wingate with Schneider Electric, when it comes to preparing for widespread power failure caused by extreme weather, microgrid technology is a solid strategy. While he acknowledges there is no way to remove the risk of power outages, Wingate points to microgrids as a way to shore up the grid and explains why we cannot afford to wait on deploying this technology.

While government stakeholders can incorporate strategies like microgrid technology into bolstering the grid, technology companies can also play a role in helping consumers reduce their energy usage. In his article, Jeff Hamel, who is the director of industry partnerships at Google, says that utilities are positioned to transform how they deliver power to meet today's requirements for "innovation, emission reductions, customer engagement and environmental responsibility." By making smart home devices like smart thermostats accessible to all customers, including low-income households or other under-represented populations, utilities can make it easier for consumers from all demographics to save on electricity costs while using less energy.

This is just a sampling of the conversation around climate change. The concern over our climate is not new, but I am hopeful that over the next year, our contributing writers will inspire us with their expertise, insights and tips on steps we can take to be more mindful when it comes to responsible energy consumption.



### **Bentley Systems Year in Infrastructure and a visit to ABB**

In October, I attended Bentley System's Year in Infrastructure Conference. This was my third time attending the Bentley YII event and the second year in which I participated as a member of the awards jury for the Bentley YII Awards. Of the 571 nominations, submitted by more than 440 user organizations, 54 finalists were selected. The award for the Communications and Utilities category, which my fellow panelists and I judged, went to POWERCHINA Hubei Electric Engineering. You can read about the award-winning project in this issue's "Green Ovations" section, which was written by Brent Jensen, who is a sales enablement director for Bentley Systems.

Additionally, I had the opportunity to attend the ABB Electrification Media Day in Bergamo, Italy. The day-long session included presentations by ABB President of Electrification Tarak Mehta and members of the Electrification team. The event wrapped up with a tour of ABB's facility in Dalmine, Italy, which produces medium-voltage switchgear, disconnectors and switchboards. ABB does not simply offer some of the industry's most innovative solutions, the company also "puts its money where its mouth is." In October, ABB announce that it has invested in a rooftop photovoltaic system for its Dalmine plant. The system will reach a total installed capacity of about 900 kW to optimize energy costs and environmental welfare.

I enjoy it when I get to meet our industry partners at trade shows or user conferences. I especially appreciate it when I have the opportunity to see our vendor partners' technology or solutions in action. I always come away from those meetings with a clear understanding of the difference these vendors make in offering their customers the most innovative resources, and of just how much value they bring to those customers.

*If you have an idea about emerging or innovative technology, or would like to suggest a topic to cover, please email me at [Elisabeth@ElectricEnergyOnline.com](mailto:Elisabeth@ElectricEnergyOnline.com).*

*Elisabeth*



# THE SPIRIT OF COLLABORATION BETWEEN IEEE PES AND THE UTILITY SECTOR

BY ELISABETH MONAGHAN



For the Q1 issue of *EET&D Magazine*, we spoke with Dr. Shay Bahramirad, vice president of engineering and smart grid at ComEd, the IEEE PES vice president of new initiatives and outreach and the IEEE PES T&D Conference chair, about the role IEEE PES plays in working with utilities and energy consumers.

**EET&D – What does IEEE PES consider to be the most significant technological advancements to impact the electric energy sector over the past three years?**

**SB –** Like the entirety of the industry, IEEE PES is acutely aware of the changing energy needs of society. Today, the impacts of climate change are being felt deeply, and communities are pushing for not just the ability to deploy clean power, but in such a way that they can be resilient in the face of disruptive events. This is a difficult task, but there are technologies, from microgrids to distribution phasor measurement units, not to mention advanced substations to new distribution system designs, that make it possible. IEEE PES is very proud of the role it has played in publishing the research,

establishing the standards, and spreading the word throughout the industry about these technologies, as well as others, that is transforming the electric energy industry.

**EET&D – Can you talk about how these advancements have made it easier for utilities to better serve their customers?**

**SB –** These advances make the grid more effective, but the ultimate value of a technology is determined by how it is used. The work that utilities are doing to design, plan and operate the grid as customers adopt technologies like DER at a higher rate, makes it possible to provide clean and resilient power to communities. →







**EET&D** – What, if any, are the reasons utilities may be reticent to embrace them (e.g., the market, in general, has yet to adopt them widely, the deployment is cost-prohibitive, the utilities are focused on more pressing issues like aging infrastructure and upgrading their cyber and physical security measures)?

**SB** – The challenge with doing anything new is always ensuring that the benefits are made tangible to those who need them. This is why technology valuation is so important. What we're seeing now is utilities working to measure the impact of emerging solutions both on the grid, but also on the communities that rely upon it to enable their objectives.

**EET&D** – Do you believe utilities, in general, are willing/able to participate in industry forums and events? If not, what do you think is holding them back?

**SB** – Absolutely. One of the exciting things about the utility industry is the spirit of collaboration that comes from a recognition that we are all facing common challenges of providing the customers we serve with reliable, resilient and sustainable energy. Conferences like IEEE PES T&D are an exciting demonstration of this, as we see academic and industry leaders from across the world coming together to share best practices and their most innovative ideas to make the whole field stronger.

**EET&D** – Can you provide any ideas on steps organizations like IEEE PES can take to engage the utilities?

**SB** – Organizations like IEEE PES are taking all the right steps to make these events even more engaging for utilities. At this year's IEEE PES T&D Conference and Exposition, there will be a first-of-its-kind executive summit, in which thought leaders and decision makers from across the energy sector will have an opportunity to collaborate and network together. There is also a new offer allowing utilities to register ten of their engineers for only \$1000 enabling more of their employees to experience and gain insights from this global event.

**EET&D** – What are some steps utilities can take to ensure they are keeping up with emerging energy, digitization, or a more informed customer base/prosumers?

**SB** – Utilities must engage directly with the communities they serve. Having a clear vision of not only what communities need in terms of power, but also what communities need in terms of education and resources. This helps energy providers ensure that the emerging technologies they implement are being fully leveraged by the communities they serve. To do this effectively, it is critical that utilities benchmark with industry leaders, share lessons learned and participate in the development of industry standards to continue moving forward. →



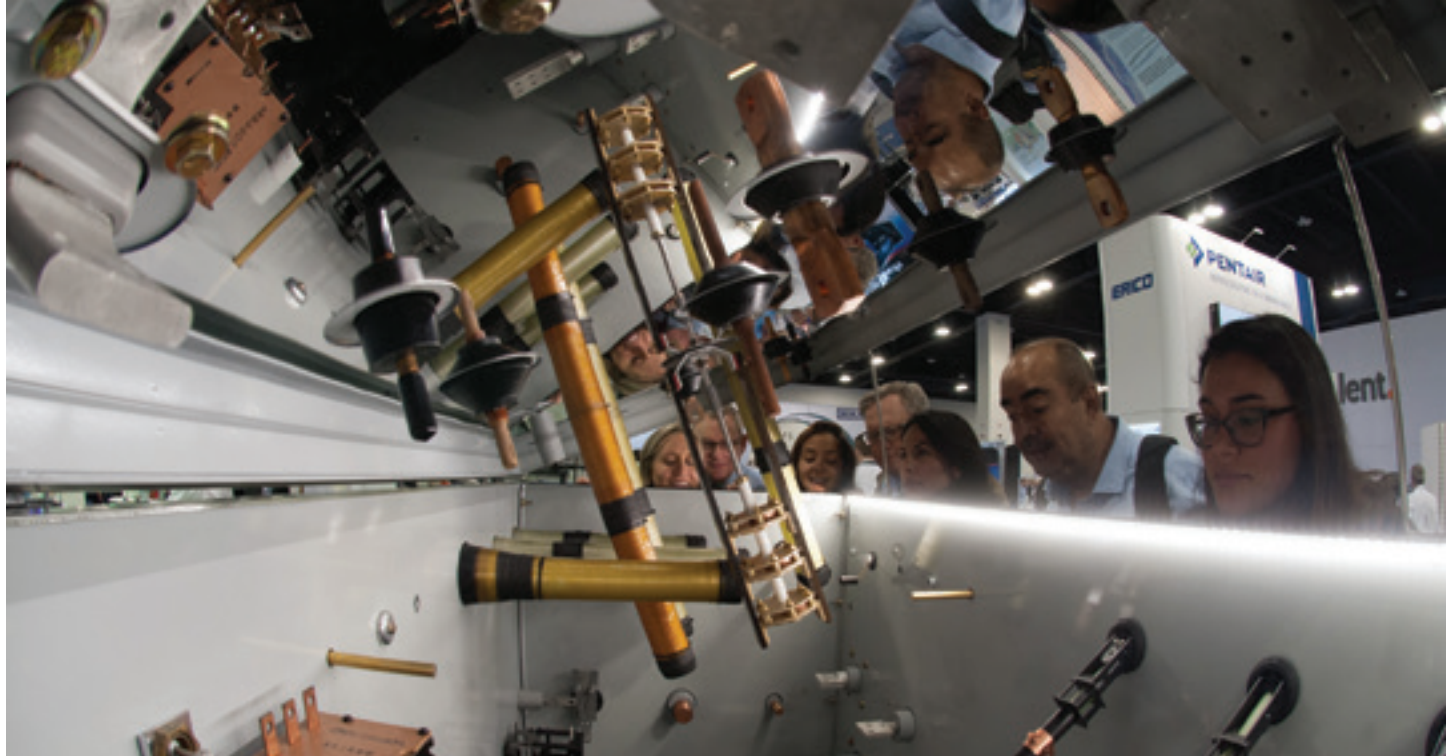
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**EET&D** – Are there any case studies or examples you can cite of utilities that are making headway in their attempt to catch up, or better, stay on top of today's distributed energy systems?

**SB** – Right here in Chicago, where the IEEE PES T&D Conference will be held, ComEd is installing the Bronzeville Community Microgrid, which is the first utility-operated microgrid cluster in the nation, as part of a broader Community of the Future program, which leverages smart grid technologies to lift up communities in need. Conference attendees will have the opportunity to see some of the exciting projects that are part of this, from the DERs that make the microgrid work, to an electric vehicle mobility project that is using cutting-edge technologies to solve first/last mile transportation challenges of senior citizens on the South Side of Chicago.

**EET&D** – What other areas of concern will you address at the IEEE PES T&D Conference, and how can we draw more attendees by mentioning these will be topics for discussion at the event in Chicago?

**SB** – This upcoming conference is attracting more than 14,000 energy industry professionals from all over the world, which means virtually every important issue in the field will be up for discussion. I'm especially excited to hear more about how the industry is planning on providing clean power to communities, addressing the aging workforce by implementing aggressive reskilling efforts, including providing STEM education, particularly for underserved communities, and recognizing the role of women in making this field as vibrant as it is. But what excites me even more is knowing that the conversations and collaborations that will occur in this conference will drive the industry even further forward.

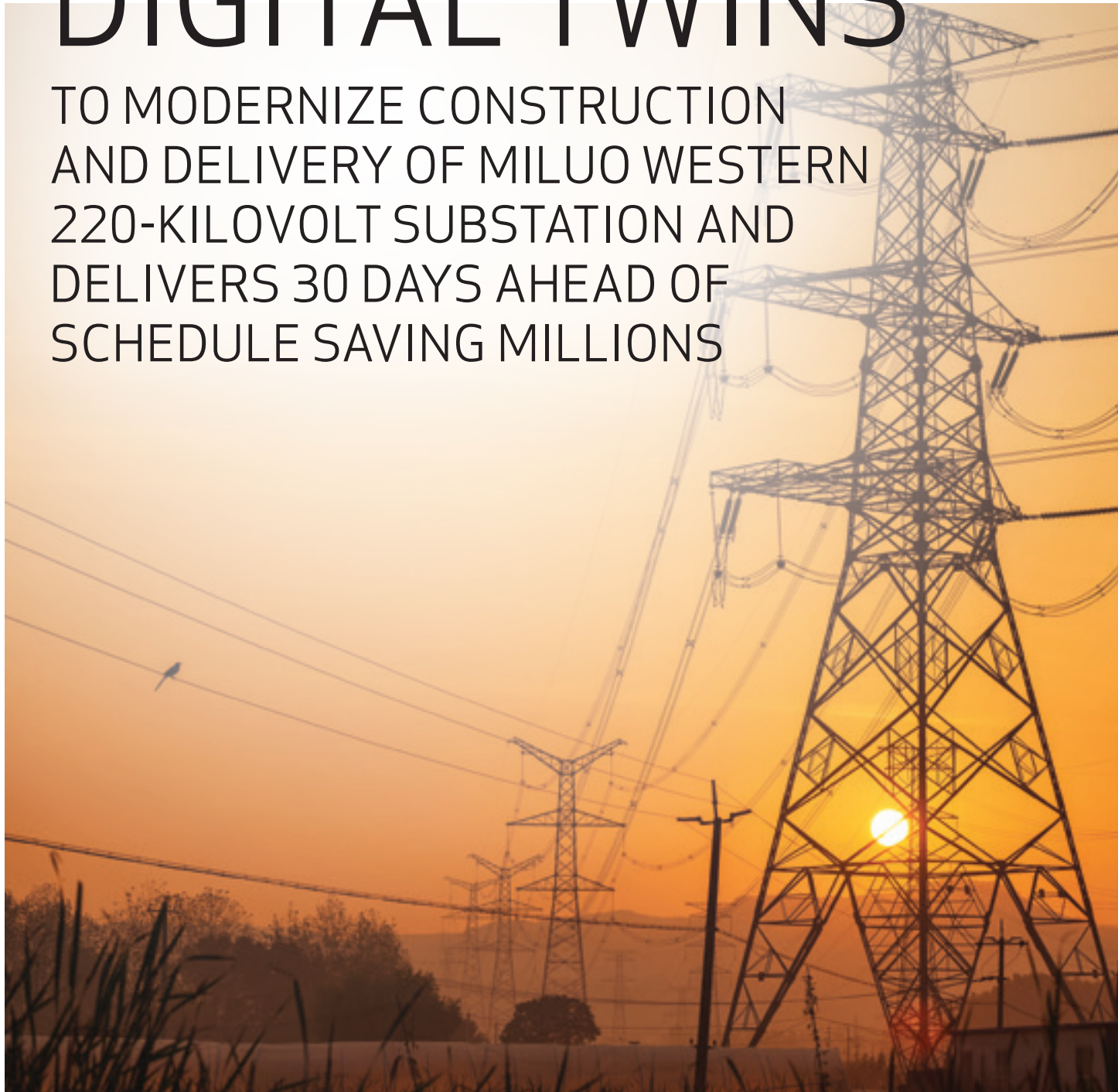
#### ABOUT SHAY BAHRAMIRAD

**Dr. Shay Bahramirad** is the vice president of engineering and smart grid at ComEd, where she serves as a strategic business leader, driving efforts to visualize and implement the 21st century power grid transformation and the new energy economy. She holds executive responsibility for ComEd's vision of the grid of the future as well as communities of the future, developing frameworks for emerging technologies including distributed generation, microgrids, electrification, as well as investment strategies for enabling improved resilience, sustainability and energy equity. Bahramirad is an editorial board member of *Electricity Journal*, an adjunct professor at the Illinois Institute of Technology, and the IEEE PES vice president of new initiatives and outreach, overseeing the organization's engagement with policy makers globally, and developing strategies for next generation of standards and frameworks, including Smart Cities. Bahramirad holds multiple advanced degrees, including a Ph.D. in electrical engineering from the Illinois Institute of Technology. She is also a graduate of Kellogg School of Management at Northwestern Women's Senior Leadership program.



# HEEC PILOTS DIGITAL TWINS

TO MODERNIZE CONSTRUCTION  
AND DELIVERY OF MILUO WESTERN  
220-KILOVOLT SUBSTATION AND  
DELIVERS 30 DAYS AHEAD OF  
SCHEDULE SAVING MILLIONS





## **BRENT JENSEN**

### **Introduction**

The State Grid Corporation of China is developing and promoting 3D design standards to digitalize processes for lifecycle substation management throughout the country. The Miluo western 220-kilovolt substation is the organization's CNY 120 million pilot initiative, and the first substation to use 3D digital modeling throughout construction, operations and maintenance. Located in the Hubei province of China, the substation will significantly improve the grid structure in the Miluo area, covering 16-square kilometers and enhancing the reliability of power supplied to 160,000 residents. POWERCHINA Hubei Electric Engineering Co., Ltd. (HEEC) won the bid as lead designer to implement 3D collaborative modeling in accordance with the State Grid's design standards and to deliver digital twins to the owner.

### **Background**

The project presented numerous site challenges, including a complex surrounding landscape lined with large residential houses that restricted the layout of the substation facility. To accommodate the compressed footprint, the spatial location of each asset type – including underground works, building structures, electrical equipment and cable trenches – required multiple contributing engineering disciplines in close collaboration. Working against an aggressive 10-month schedule to complete construction, HEEC had to effectively coordinate with each construction organization to safely deliver the project on time. Faced with these design and construction difficulties, the team required integrated BIM, reality modeling, and simulation and visualization technology to apply 3D digital standards and achieve full lifecycle digitalization. →





### Creating digital context for immersive visualization

To accurately plan the project, HEEC used oblique photogrammetry, captured using an unmanned aerial vehicle, and 3D reality modeling software to survey the substation site and generate a 3D reality mesh. Using geospatial reality modeling helped establish a digital context for the project, visually capturing landscape, vegetation, rivers, lakes, roads and houses surrounding the project area to support substation site and corridor planning. “The 3D reality modeling software generates high-precision reality models automatically and can visually reflect various information to help make decisions,” said Wei Wang, executive assistant, senior engineering at HEEC.



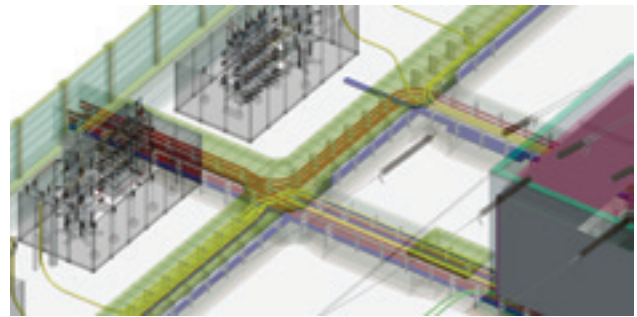
Compared to traditional 2D drawings, using a reality modeling application provided reliable environmental information to rationalize the substation layout amid the constrained site.

HEEC relied on the accuracy of the 3D reality model to visualize and analyze the existing conditions, optimizing the incoming and outgoing corridor lines while also minimizing impact on agricultural land and houses bordering the substation. Using the reality mesh enabled the team to avoid the demolition of six houses and reduce the area occupied by the substation by 22 percent, saving 0.94 hectares when compared to the original design scheme. As a result, HEEC saved CNY 2.5 million through the optimal substation layout and reduced earthworks for bored and cast-in-place piles by 63 cubic meters to save an additional CNY 90,000.

### Collaborating across design teams

The compressed substation layout, while optimal from an environmental and residential perspective, required multiple engineering disciplines to collaborate to avoid collisions in the tight space. To ensure reliable, quality, detailed 3D design, HEEC established an open, connected data environment, and reengineered the design process. The team coordinated designs to integrate electrical, structural and underground modeling works and was able to avoid 30 collisions, saving CNY 800,000.

The electrical and civil engineering groups shared data and information through 3D models in discipline-specific digital applications that were then imported into the comprehensive substation model available within the connected data environment. Structural design and analysis helped refine the architectural model to achieve less than 1 percent deviation in accuracy between the designed and actual steel material, optimizing the steel frame with just 8 tons of steel to save CNY 120,000 in material costs.



A multidisciplinary design environment where structural, electrical and cable and raceway designs are integrated helps to keep all designers working with trusted information to ensure accuracy and speed design.

The interoperability of the design and analysis applications facilitated coordinated digital design to save 65 design days. Establishing collaborative 3D design workflows within the connected data environment, the team created an optimal engineering model, which identified and resolved clashes in advance, resulting in zero changes during underground construction. “Through comprehensive collision inspection of the underground facilities, design errors are found in advance and about 30 construction reworks are reduced,” said Wang. →





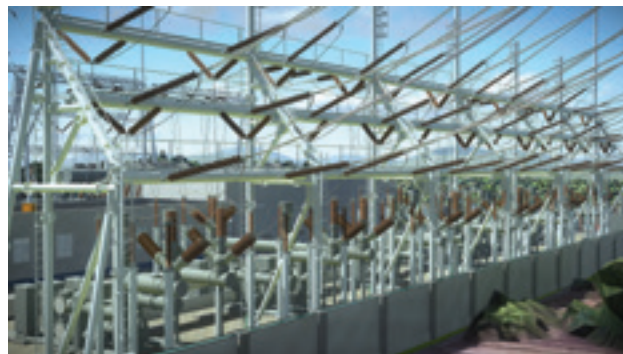
### Streamlining construction management

The engineering design model, combined with the reality model, forms the substation digital twin where construction drawings and material quantities can automatically be extracted. Committed to full lifecycle digitalization for delivery of the substation, HEEC explored various methods to use the 3D design model to digitally guide construction. The team relied on mobile applications to enable on-site construction staff to access and check the substation model and associated drawings. Using iModels and 3D PDF models facilitated integration of various forms of data and dynamic simulation, allowing construction crews to visualize equipment installation and better understand the construction process. Working in a connected data environment with these mobile digital solutions provided on-site workers with convenient access to the 3D design model, improving workflow and communication while effectively guiding construction to save 15 working days.

With dynamic construction simulation, HEEC performed a comparative analysis between the planned construction schedule and actual on-site process to effectively manage changes in real time. “With the technology provider’s digital construction software, we can systematically and comprehensively manage and control the progress of the project, analyzing the progress deviation at all times to control the possible risks,” explained Wang. Introducing mobile technology and the technology partner’s digital construction software, HEEC used the 3D design model to streamline construction management, achieving full construction digitalization to complete the Miluo substation 30 days ahead of schedule.

### Modernizing substation workflows

By creating a digital twin of the substation using reality modeling, BIM, construction simulation, and virtual reality applications reduced total investment of the project by CNY 6.3 million. To realize full lifecycle digitalization of the substation, HEEC used near photorealistic visualization to establish and deliver digital twin models to the owner for more efficient operations and substation maintenance. Moreover, the visual animation technology adds the immersive virtual reality element to the 3D design model for optimal communication and understanding of the substation facility operations.



Robust 3D modeling and visualization tools are used to communicate design prior to construction, but also to support operations and maintenance – making trusted information available whenever and wherever it is needed and understandable by everyone.



#### ROI:

- Created the project's digital context to optimize substation layout, reducing land occupation by 22 percent.
- Performed dynamic construction simulation to enable delivery of the substation project one month ahead of schedule.
- Created digital twins of an integrated 3D solution for collaborative management, saving CNY 6.3 million.
- Optimized collaborative design and resolved 30 collisions, saving CNY 800,000.
- Integrated structural design and analysis to save CNY 120,000 in material costs.

As China's first substation project put into operation using 3D design standards and digital twins during construction, HEEC industrialized substation delivery for future State Grid initiatives. And this integrated workflow optimized the pilot implementation of collaborative lifecycle 3D modeling to deliver digital twin models, improving design productivity and providing strong technical support for construction, operations and maintenance.

**Organization:** POWERCHINA Hubei Electric Engineering Co., Ltd.

**Solution:** Communication and Utilities

**Location:** Miluo City, Hunan, China

#### ABOUT THE AUTHOR:

**Brent Jensen** has worked in a variety of industries, beginning with computer and software design at IBM. Starting in hardware and computer chip design, Jensen moved into software development and sales for IBM's product suite called ITSM (IT Service Management). This involved network, system, application, end user, transaction and other types of system and end user monitoring to help IT shops manage complex system and application environments.

After IBM, he joined an energy storage company involved in large flow batteries (1 MW to 100 MW's) with a 20-year life span, to help utilities smooth renewable energy generated from solar and wind farms. Working with Texas Utilities, Jensen helped show how energy storage paired with renewables can be a cost-effective alternative to other energy generation sources.

Recently joining Bentley Systems as a sales enablement director, Jensen works with Siemens and Bentley on integrated transmission and distribution planning and design products for utilities. He is working with sales teams from both companies, to help show utilities the value of digitizing their complex power systems to greatly reduce the work and automate DER (Distributed Energy Resource) studies adding solar and wind to existing power distribution systems.

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# REINVENTING THE ENERGY AND UTILITY INDUSTRY

## CUSTOMER STRATEGIES AND TECHNOLOGIES

KELLY JAMES

Significant disruptions confront the energy and utilities industry today, with challenges coming from seemingly every direction and at every level. New energy sources, inflexible infrastructure, consumer demands and climate change are just a few of the forces affecting this once stable and most traditional of industries.

Contributing to the urgency is that customer expectations are changing rapidly, driving much of this change from the bottom up. Commercial, industrial and residential energy consumers are demanding a new relationship with their power providers. In this dynamic, the relationship is more consultative, centered around expert advice concerning power usage, or on creative ways to get a better return on investment.

Today's customers have been trained by Amazon, Google, Apple and other online vendors to expect personalized service from service providers and marketers. And, as new generation options enter the market, consumers now expect energy to be delivered the way they want, e.g., from renewable sources that reduce carbon emissions.

Simply put, customers want choice and sustainable energy options.

To respond to these demands, energy suppliers in competitive markets and even utilities in traditional regulated models are responding to the pressure to evolve or face displacement by new players in a potentially very different energy industry. Not only are service and delivery models changing in today's digital world, but leading energy companies are transitioning out of the fossil-fuel based economies that were the bedrock of their revenue models.

"We are at the start of an energy revolution," says Isabelle Kocher, CEO of Engie, who is taking risks and leading the pack in the industry's transition to a zero-carbon energy future.

The fulcrum is about to tip, and the time to act is now. The good news is that the tools are available to create the value-focused relationships that consumers want.

### Enabling customer strategies

The traditional, top-down, "one-way street" relationship with customers is over. The new relationship requires a change in thinking and approach, one based on partnership, as utilities pivot to become trusted advisors on all issues relating to energy and consumption habits.

The industry is well positioned to forge this new customer relationship. Despite oft-cited Accenture statistics about customers only spending 9–11 minutes per year thinking about their utility, utilities in the United States remain the number one entity trusted by consumers to advise on their energy choices. A recent survey by the Smart Energy Consumer Collective (SECC), found that 78 percent of consumers in the U.S. trust their utility and are more likely to participate in a program or purchase a product if their utility endorses it.

Utilities can capitalize on this opportunity in one of two ways. First, they can embrace a consultative role, offering trusted advice regarding all things digital and energy-related to the customer. Second, they can offer the right set of solutions to meet customer needs and sustainability goals. →









Utility companies have a golden opportunity to provide this advice and these solutions. Why? Because they are sitting on a treasure trove of customer data. But they must be smart about how to analyze and leverage this data to give customers more insight and to tailor products and services to their needs and desires. Companies such as Google or Amazon may have considerable data about a business or residential customer's energy use, too – but the utility is still the source of the commodity, usage data and rates. By and large, utilities still have the advantage of data stewardship and customer trust, and the opportunity to use their advantage to benefit the customer, both directly and through strategic (and potentially revenue generating) partnerships.

### **Making the shift possible**

Agile digital technologies are the key to providing a 360-degree view of the customer, transparency into transactions and the means for creating relationships that will allow greater customer choice in a value-driven, multi-dimensional energy market. Digital operations are already driving new investment in data-driven technologies, such as artificial intelligence (AI), machine learning, IoT sensors and agile approaches to improving operational and maintenance efficiencies. All of which, in turn, will continue to reinforce the shift to the new partnership between energy companies and their customers.

Competitive energy markets, out of necessity, are driving innovation in customer digital technologies. The operational efficiency gains, the customer benefits, and the lower risk agile nature of these transformations are highly applicable to utilities in the rapidly evolving regulated energy markets as well. British Gas, the largest energy and home services supplier in the United Kingdom (UK), provides an example of how the digital transformation of business processes benefits a company's bottom line while improving its customer relationships. This UK energy supplier is leveraging digital technology to lower costs, improve business processes and accelerate the time to market for new offerings.

A new strategic technology solution based on technology from a San Francisco-based provider of cloud and mobile software significantly improves a key business process: quotes that previously took three days are now delivered in under three minutes. That's an outcome that "meets the rising expectations of our business customers," according to Ronald Starreveld, Director IS Architecture, Business and Energy for British Gas' parent company, Centrica.

A platform, such as Salesforce's leading cloud-based CRM, can help accelerate this customer-centric shift and provide the technology that underpins the new relationship between customer and the utility industry. Modern cloud platforms fuel customer-centric innovation by providing crucial enterprise-grade security, scalability, performance and availability – while also providing a robust and agile base for complementary applications, processes and technologies. And true platforms also enable industry-specific product offerings. A utility-specific platform in a low or no-code environment can greatly speed innovation for the electricity, gas and water utilities sectors in particular, allowing IT to move at the pace of business and delivering unified, omni-channel customer experiences at a fraction of the price of custom-built or black box offerings (that are, in contrast, closed, code-heavy and general-purpose). The result lays a future-proof foundation for agility, transformation and disruptive innovation without the significant IT and business risks and maintenance that come with custom solutions or major changes to legacy systems.

The customer benefits from a greatly enriched experience as they gain access to a host of energy information and services from their phone, tablet, laptop or other smart devices. Services such as the ability to review current or historic usage patterns, order solar panels or monitor one's carbon footprint, to name but a few examples.

French multinational ENGIE recently set a goal to become the world leader in the zero-carbon transition and began shifting from a utility company to a provider of low-carbon energy and services. ENGIE's ambition is to bring

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**The customer benefits from a greatly enriched experience as they gain access to a host of energy information and services from their phone, tablet, laptop or other smart devices.**

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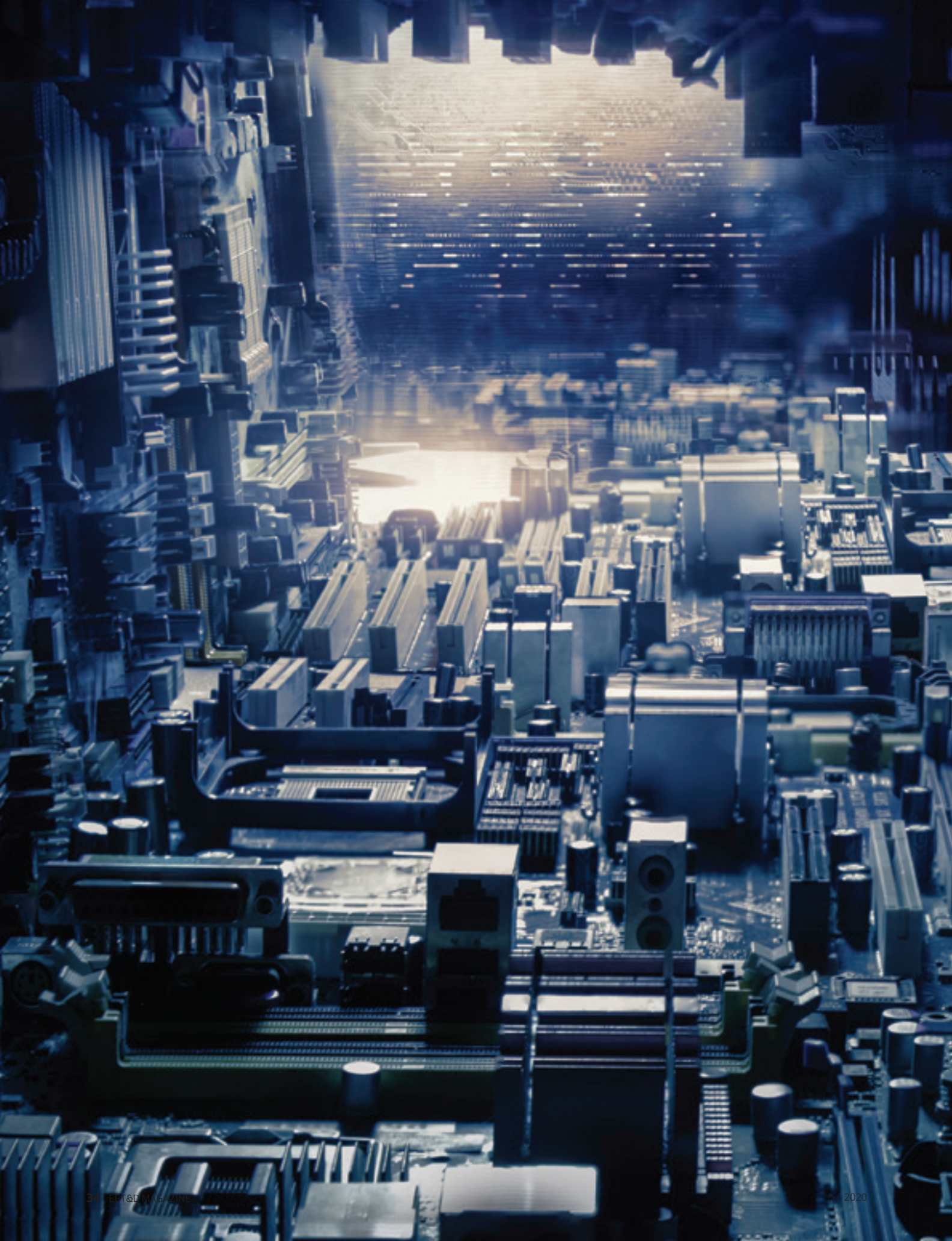
consumers with them on this journey and develop the next generation of employees to deliver this ambitious new service. But even as ENGIE reimagined the ways it engages with customers, like all utility companies, ENGIE is challenged in these efforts by the limitations of legacy systems built for another era. In order to realize the future state it envisioned, ENGIE needed to digitally transform.

To assist it in this digital transformation, ENGIE is partnering with Salesforce, Accenture and the previously-mentioned San Francisco-based provider to deploy a global, unified customer relationship management (CRM) platform. ENGIE replaced a fragmented amalgamation of applications with a single layer offering a common, intelligent view of customers. This heightened visibility allows ENGIE to put its customers at the center of its business while empowering its employees in countries around the world to drive customer success, transitioning together to the zero-carbon energy future they envision. They can more efficiently serve and advise customers on the right products and services to meet customer green-house gas emissions goals and take their companies into a greener future.

Additionally, ENGIE's commitment to a zero-carbon future is attracting a highly skilled workforce that will serve the company well far into the future. "Truly motivated employees rally around their company's business model," says ENGIE Chief Digital Officer Yves Le Gelard. "They are the human link between your company and your customers."

Le Gelard sees employee engagement as critical to customer success and is excited to find potential employees attracted to ENGIE's goals. Since adopting its new value proposition, ENGIE has become known as "the place to be" for prospective employees who care about sustainability, as evidenced by a surge in unsolicited resumes. →





## New and more profitable customer relationships

ENGIE operates in competitive and newly deregulated energy markets across the EU -- markets that, by design and necessity, are now driving investment digitalizing both customer and infrastructure operations. Utilities, particularly in the USA, where deregulation lags behind the EU, are learning that even though they have a mostly captive customer base, their customers are going to continue to demand a new relationship and level of individual personalization. So, the need to support digital transformation is just as important – even if it is more challenging due to the sheer size of the customer base and the need to serve all segments of their individual markets.

The bottom line, however, is that short-term pain is certainly worth the long-term gain for customers and the industry.



In turn, empowered customers will inspire new business models as utility companies learn to quickly adapt to the changing digital energy landscape.



The modern digital ecosystems that will be created will increase transparency and improve performance for utility customers. This will ensure that they will remain loyal and engaged. In turn, empowered customers will inspire new business models as utility companies learn to quickly adapt to the changing digital energy landscape.

An empowered workforce will have the tools they need to provide enhanced customer personalization, responsiveness and knowledge – working faster and more interactively to reinforce customer loyalty. A 2019 study by J.D. Power showed an 80 percent improvement in customer issue resolution when agents were armed with a modern, digitally-enabled 360-degree view of the customer – which also led to a markedly increased level of customer satisfaction, particularly when customers interacted with new applications.

Increasingly, the industry will be shaped by employees who can be proactive because they are informed by data and intelligence surfaced by AI. The same set of underlying digital technologies that will make this possible will be available to customers, too, so those who want more hands-on involvement in their energy choices, will have it. Utilities already have the capability to bring information to customers that they may never have thought possible before. This also has the exciting potential to save them millions of dollars while enabling energy sustainability goals.

The future for the utilities and power industry will be shaped by those who digitalize first and best. Electrical utilities have a great window of opportunity to seize the lead and shape this digital energy future.



### ABOUT THE AUTHOR:

**Kelly James** is vice president and general manager of Vlocity Energy & Utilities. James has spent more than 15 years building and delivering CIS, billing and customer experience solutions to utilities worldwide and has held various leadership roles at Oracle, Opower and Salesforce. In her role with Vlocity, James is responsible for industry strategy and for delivering solutions that delight utility and energy customers and employees, and that positively impact both the utility top-line and bottom-line.

# ADVANCEMENTS IN SUBSTATION AUTOMATION SOLUTIONS TRANSFORM USABILITY FOR FIELD TEAMS

## INTUITIVE INTERFACES AND “ONE-BOX” CONSOLIDATIONS – PART OF A NEW GENERATION OF RTUs

CONRAD OAKLEY

Electric utilities face the challenge of managing aging and unsupported legacy automation and monitoring equipment at their substations and pole-tops. This equipment is critical for accessing data from intelligent electronic devices (IEDs) for measurement and protection, automating key functions and enabling remote users to securely control power-system devices.

Increasingly, outdated legacy technology, such as remote terminal units (RTUs), requires updating to keep up with evolving performance requirements, communication needs and increased security compliance protocols. The need can also be driven by concerns over vendor support, or when there is a major deficiency a vendor is not addressing with the equipment.

When this occurs, utilities often take the opportunity to pilot and deploy new substation automation platforms as part of the upgrade. Given recent advances in automation, new all-in-one solutions effectively reduce the number of hardware components in each substation, improve integration with existing IEDs and RTUs, simplify data access and configuration through integrated, web-based HMI, SCADA and alarm annunciator interfaces and

facilitate cybersecurity compliance to meet NERC CIP requirements.

### A window of opportunity for SRP

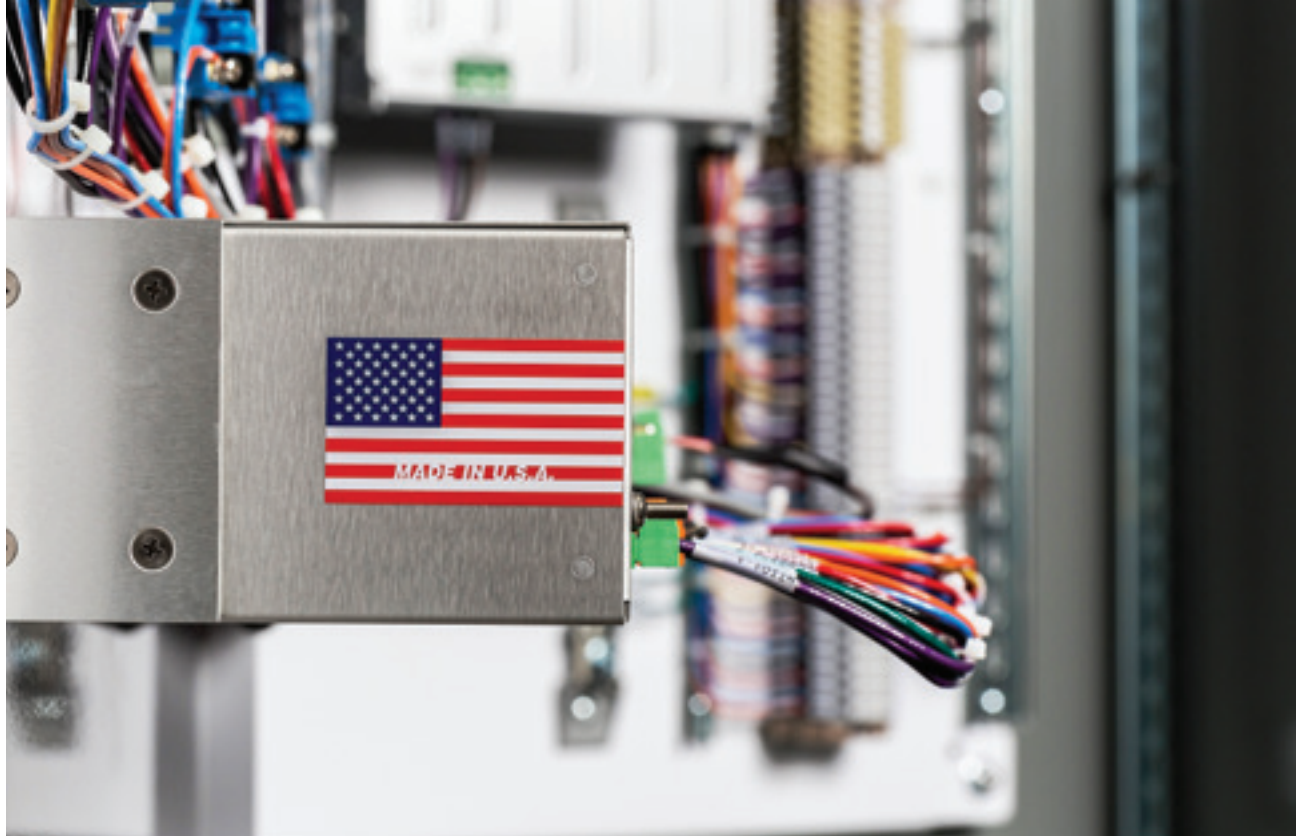
Today, Salt River Project (SRP) is in the process of updating its substation automation platforms. The energy company manages a large field operation of over 300 substations across a 2900 square mile service area in central Arizona in support of over one million customers.

For SRP, the process of exploring upgrade options began more than two years ago when the vendor that supplied its RTUs discontinued support for the product.

“We have been using the primary RTUs in our system since the mid-nineties, and they were simply outdated,” said Josh Manski PE, senior engineer at SRP. “Although we began the project because our vendor discontinued support for the RTU, we really saw it as an opportunity to integrate the next generation of substation automation systems to assist our security compliance efforts and provide greater interoperability with other parts of the system.” →







The substation automation platform can be integrated with any equipment.

After sending out an RFP to the nation's top vendors of RTUs and also communication and automation processors, SRP scheduled demos and conducted a full lab evaluation of all the products involved. SRP ultimately selected a Pennsylvania-based IT services management company as their substation automation provider. The service management company has worked with customers in the electric power transmission and distribution substation market for more than 30 years. The provider's platform is a communication and automation processor that can connect to nearly any substation device in its native protocol, perform advanced math and logic, and securely present the source or calculated data to any number of clients in their own protocol.

The platform can be integrated with any equipment, including competitors', and it is often connected to micro-processor-based relays, meters, event recorders, IEDs and RTUs. It is then connected to an existing enterprise network or SCADA system.

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“  
We kept asking ourselves how we could  
configure the product so it would make our life  
a lot easier going forward.”  
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According to Manski, the provider was selected, in part, based on its willingness to configure features of its platform to meet SRP's specific requirements.

“Our engineering team tried to be forward-thinking as we were implementing these upgrades,” explained Manski. “We kept asking ourselves how we could configure the product so it would make our life a lot easier going forward.”

For SRP, this included ensuring field engineers or technical staff could modify the master configuration files to tailor the system to each site. At SRP's distribution sites, there is greater consistency, and the chosen platform easily supported existing standards and configurations used for decades. However, there was more variability in terms of configuration at each transmission substation, so a templated approach did not work as well.

Using the platform, Manski and his team were able to build a master configuration file that encompassed SRP's base standards but still allowed the field engineer to modify or delete aspects that did not apply to a given site. This also simplified training, an important feature given SRP rotates new engineers through a variety of roles every six months as part of a two-year onboarding program. The training includes learning all the equipment, including the platform, and how to program it.

“Our new and experienced engineers were very impressed by the ease of configuration and intuitiveness of the substation automation platform - so much they stated they preferred working on it over the legacy equipment,” said Manski.

The system also uses open-source web technologies and pre-configured template pages to simplify the building of interactive SCADA and local HMI screens to view data from connected IEDs and RTUs using standard web browsers.

Beyond interface design improvements, the integration of key features, such as an alarm annunciator application, is one of the areas that substation automation platforms have advanced significantly. The alarm annunciator in the platform is managed through the same software and includes pre-configured pages for data archiving/sequence of events recording, alarm annunciation, one-line diagrams, IED faceplates, control screens, alarms, trending and communications diagnostics.

For example, any data point in the database, either obtained from attached IEDs or calculated, can be designated as an alarm point and displayed on the tile annunciator. This can save substantial time when upgrading sites with thousands of alarms.

"It used to take hours for us when we were upgrading a transmission site that had almost a thousand alarms," said Manski.

Two years removed from a successful pilot implementation, SRP this year is upgrading six transmission substations and nine distribution sites, with additional generation and distribution feeder automation planned. The utility anticipates it will ultimately replace more than 300 RTUs and install 500-600 substation automation systems.

## Automation upgrade at Hoosier Energy

In the Midwest, Bloomington Indiana-based Hoosier Energy also had to review its substation automation technologies. The electric cooperative, founded in 1949, provides wholesale power and services to 18 members through a nearly 1700-mile transmission network.

"Our RTU vendor went out of business," explains Lance Simpson, a Hoosier Energy communication engineer. "We needed a vendor that would be a reliable source of maintenance and spare parts."

The energy company used an extensive RFP process before selecting the Pennsylvania-based IT management systems company.

"A large driver for our choice of system was the user interface and how comfortable our technicians felt with it," said Simpson. "It needed to be user-friendly not only from an engineering design perspective but also from the technician's perspective. The ease of building master configuration files using the provider's configuration software makes their work easier."

Hoosier Energy technicians often use the terminal interface to view traffic on the various communications ports. They also move files and save multiple configurations on the same box for the HMI. "With everything organized through the same interface, there is less training to do because the learning curve is not nearly as steep," said Simpson. →



The substation platform easily supports existing standards and configurations used for decades.





The substation automation platform is a communication and automation processor that can connect to nearly any substation device in its native protocol.

The utility finds the simplicity of the interface particularly useful for testing when it will need to pull alarm logs off to view them and trend values over time.

Consolidation of features in a single unit has also saved Hoosier Energy space and money. According to Simpson, "Having an integrated tile annunciator tool has allowed us to install annunciator displays in stations where costs or space previously prohibited us from doing so."

While the utility primarily sources off-the-shelf RTUs and parts such as terminal blocks, field wiring and power supplies from the IT services management company, it also sources integrated distribution enclosures. These are complete cabinets or enclosures designed for distribution SCADA applications in outdoor environments. Due to the challenging environmental conditions, these are larger in scope and require a separate battery charging system and environmental controls.

The combined efficiencies that Hoosier Energy has discovered using integrated technologies have had a significant overall impact. "Based on all the things the automation platform can do, we have certainly seen cost savings and just an overall improvement in ease-of-use," said Simpson.

Since 2012, Hoosier Energy has deployed 10 new large RTUs at its transmission stations and 20 more smaller applications at the distribution level. According to Simpson, the energy company will continue to replace and upgrade its technology at the rate of two-to-five- transmission substations each year.





#### ABOUT THE AUTHOR:

**Conrad Oakey** is the vice president, strategy and communications for NovaTech, a supplier of automation and engineering solutions for electric utilities and process manufacturing industries for over 30 years.

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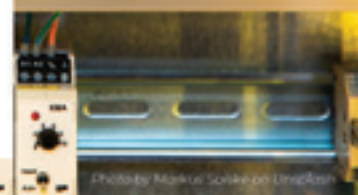
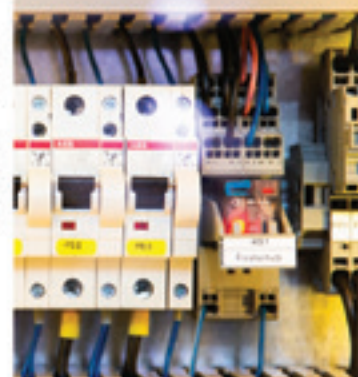
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# FOR A RESILIENT FUTURE GOVERNMENT STAKEHOLDERS NEED TO PLAN FOR A MICROGRID TODAY

BY DON WINGATE

Heat waves and severe storms are becoming increasingly frequent and more damaging, straining the electric grid and causing extensive power outages. Recent examples are many, and each highlights the fragility of our infrastructure and the urgent need for widespread microgrid adoption.

While it's impossible to completely remove the risk of power failure, microgrids are a proven strategy to harden the grid - preventing and reducing the impact of extreme weather on electrical systems. Coupled with their ability to enable the system to "bounce back," microgrids help mitigate power interruptions, increasing both life safety and business continuity.

With climate change front and center, now is the time to consider the resilience and economic benefits provided by microgrid technology.

## The role of microgrids in hardening our electrical infrastructure

At best, grid failure is a short-term inconvenience; at worst, it's a danger to people's lives.

When grid power goes down in the midst of a major weather event, what might have been merely inconvenient, quickly becomes urgent. Streetlights and traffic lights go dark, food spoils, and HVAC stops working.

The critical facilities citizens rely on in emergencies are equally incapacitated by power loss. Hospitals, police and fire stations, and ambulance dispatch can't function effectively without power, further endangering the populace. A microgrid's ability to provide the necessary power to critical facilities during emergency situations is vital to the safety and security of the people who rely on them.

Additionally, grid failure poses a significant threat to business owners. According to a 2016 study by energy consultant E Source, key U.S. market segments, such as manufacturing, financial services, offices, hospitals, government/education, grocery and retail stores, forfeit about \$27 billion per year due to power outages. The report also found that nearly 80 percent of businesses reported that they would, or likely will, invest in reliability improvements in the next few years, including on-site back-up generation.

A microgrid – or a network of distributed energy resources (DER), often made up of renewable resources such as solar or wind, is unique in that it serves a dual role. It can be grid-tied, which provides power to the utility grid and economic advantage to the owner, plus it has the unique capability to island itself from the main grid. In the event of an outage, this enables the microgrid to seamlessly provide the necessary energy in the absence of utility power to increase resilience and minimize the impact those affected. →





While there are other energy alternatives, including diesel generators, solar and wind, none are immune to potential failure. Solar needs the sun; wind turbines only work when the wind blows; and generators rely on fossil fuels, which may not be accessible in the midst of a major storm. This is not to say microgrids are infallible, but they're less prone to failure than other forms of energy because they utilize multiple DERs, including energy storage. If one resource experiences an outage, the microgrid can switch to another.

### Ensuring resilience at the local level

Our national electric infrastructure is outdated and prone to failure, particularly in smaller cities, where utility poles, transformers and substations are above ground and more susceptible to external weather events. In fact, most outages are caused by damage to transmission and distribution lines and equipment, not the generation site itself.

To reduce reliance on the miles of utility lines crossing every city and town, microgrids can be deployed in a localized distribution strategy that places power generation, close to critical facilities such as fire and rescue centers, hospitals, evacuation sites, and government administration buildings. Renewable sources can supply power from shorter distances, making them ideal for a localized microgrid strategy.

A lengthy power outage can create chaos and reduce the ability to provide necessary medical assistance, shelter and communications when needed most. This was the case for the town of Milford, Ct., which lost power for seven days due to Hurricane Sandy in 2012. After a series of named storms battered the coastal town in the following years, each causing lengthy outages, the town decided to build a microgrid to strengthen its infrastructure and ensure critical support during weather and other emergencies.



Overhead view of Montgomery County's Correctional Facility in Maryland.





Solar field at Montgomery County's Correctional Facility.

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Additionally, the microgrid costs less per kilowatt-hour than the utility grid, saving the town about 20 percent on energy costs.  
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The city connected five critical sites on the microgrid, three of which can serve as shelters or evacuation sites, as well as elderly housing and City Hall from which fire, rescue and police can be dispatched. The five sites will be physically connected by underground wires to decrease the odds of downed lines.

The microgrid uses multiple sources of generation, coupled with battery storage to ensure energy availability even in the absence of active generation. With the ability to island from the grid, the microgrid can maintain the power supply to these critical sites in the event of an outage. When connected, microgrid generation can be routed anywhere there is a need to ensure ongoing operations at surrounding facilities, such as hospitals, nursing homes and schools.

### Supporting business continuity at critical facilities

Most microgrid projects are conceived to both harden the grid and offset traditional grid energy, which is typically less green, as part of a broader sustainability initiative. In most cases, the microgrid can also reduce energy use through storage or other energy efficiency strategies. Consider Milford's microgrid example in which the residual heat produced by the microgrid is used to heat the building, thereby reducing electricity use. Additionally, the microgrid costs less per kilowatt-hour than the utility grid, saving the town about 20 percent on energy costs.

Across industries and public entities, there is increasing demand to bolster energy resilience to support business continuity at critical facilities. This was one of the driving goals behind the California Port of Long Beach's (POLB) microgrid project. In 2015, POLB undertook a project to create a more resilient and sustainable infrastructure, support cargo operations, and supply power to vital city services, independent of the grid. →





The project involved the design of a unique microgrid that is both flexible and modular thanks to the use of two separate battery energy storage systems (BESS), one of which is in a 20-foot container on a chassis. The BESS is virtually connected to the control software, but mobile to allow for future use in disaster response situations, caused by extreme weather or wildfires.

In keeping with the Port's mission to make it one of the world's most-sustainable marine facilities, the microgrid also uses several DERs including solar, wind, tide, geothermal and waste heat recovery (CHP). The entire city will benefit from the Port's generation and use of greener and more sustainable energy.

### Microgrid investment – a must for government infrastructure

In November 2018, the US Global Change Research Program issued its Fourth National Climate Assessment (NCA). The report recognizes microgrids for their ability to provide resiliency, reliability and flexibility for both climate adaptation and disaster response.

Citing the increasingly dry climate in regions like California, the report points to the growing threat of widespread wildfire and the ability of microgrids to quickly restore power in fire-damaged areas. But, at the current rate of implementation, the NCA cautions that microgrids and other DER are insufficient to greatly improve preparedness and resilience at the scope and scale required as our world adapts to climate change.

To increase microgrid deployment, government and other stakeholders must find new ways to finance these projects. As is the case across most local governments, limited budgets often impede large capital expenditures. Creative financing solutions are emerging that make microgrid deployments more feasible.

In 2012, following a severe storm that left more than 250,000 residents and 71 county facilities without power for several days, the administration of Montgomery County, Maryland, began investigating options to boost infrastructure resilience. In 2017, the County entered into a public-private agreement with a provider of energy and digital automation solutions and Duke Energy Renewables, a subsidiary of Duke Energy, enabling it to build two microgrids at no cost to taxpayers.

This financing model is structured to allow the customer to purchase the energy and heat generated by the microgrid, which is owned and operated by a private entity. Commonly known as energy-as-a-service, this model has been deployed at 81 percent of all microgrids around the world.

With such financing options making microgrid projects more attainable, there is little standing in the way of widespread deployment other than lack of awareness and planning. State and federal administrators must include microgrid investment in future infrastructure development planning. To ignore this option is to ignore the very real climate challenges – and increasingly violent weather incidents – our country is facing. Microgrid is a proven solution to harden the grid and support a more sustainable future.



#### ABOUT THE AUTHOR:

**Don Wingate** is vice president sales – Utility Solutions for Schneider Electric. Wingate leads the targeted account team focused on electric utilities and grid solutions. He also assisted in the architecture and launch of the Schneider Electric Microgrid Competency Center and is the sales sponsor of microgrid development for regulated utilities and channels to market. Prior to joining Schneider Electric, Wingate held executive and management positions with Logica Inc, Cap Gemini, Oracle and General Electric.

# STORY OF THE NORTH WORKING WITH REMOTE COMMUNITIES, MICROGRIDS POWER THROUGH

BY MAXINE GHAVI

Remote communities have long relied on diesel generators for power, as they are not typically connected to main grids. Diesel generation is loud, costly, produces greenhouse gasses and is prone to interruption. This can impact not only simple daily activities, like cooking and charging cell-phones, but also the functioning of essential services such as healthcare, education, food storage, transportation and communication. There is also a strong desire to transition to renewable sources of energy to reduce carbon footprint and negative impacts on the local environment.

But this isn't a simple endeavor. According to a report by Intelligent Energy Systems prepared for the Alaska Energy Authority, "Over the last 10 years, considerable investments have been made in hybrid wind-diesel systems for such villages in Alaska – many of which have proven to be marginally economical. This is primarily because the renewable contributions and associated fuel displacements are restricted by the inability to fully deactivate the diesel engine generators. Integrating renewables like wind and solar into remote diesel-based power systems presents unique challenges requiring the maximization of renewable penetration while ensuring stable and cost-effective electrical power service."

Navigant Research, in its annual global Microgrid Deployment Tracker for 2019, estimates nearly 20 GW of capacity is now managed on microgrids. While major utilities account for 40 percent of new capacity, remote microgrids contribute a whopping 34 percent.

Why the surge in adoption? In fact, remote communities around the world have long operated independent power systems – they simply weren't called microgrids until more recently. Traditionally powered with dirty, high-cost diesel generation, today's microgrids typically seek to operate with high contributions of economically-viable and clean renewable generation. And remote communities have led the way toward a low-carbon solution because of the disproportionately high impacts of fossil-fuel based generation to their way of life.

One example is Deering, Alaska, located on the Kotzebue Sound just south of the Arctic Circle. At this high latitude, daylight levels vary dramatically from season to season. In June or early July, the sun does not set, and in December, daylight may last less than four hours. Winter storms are common, and with temps as low as -50F, this tough Arctic community does not shut down even for such weather. →



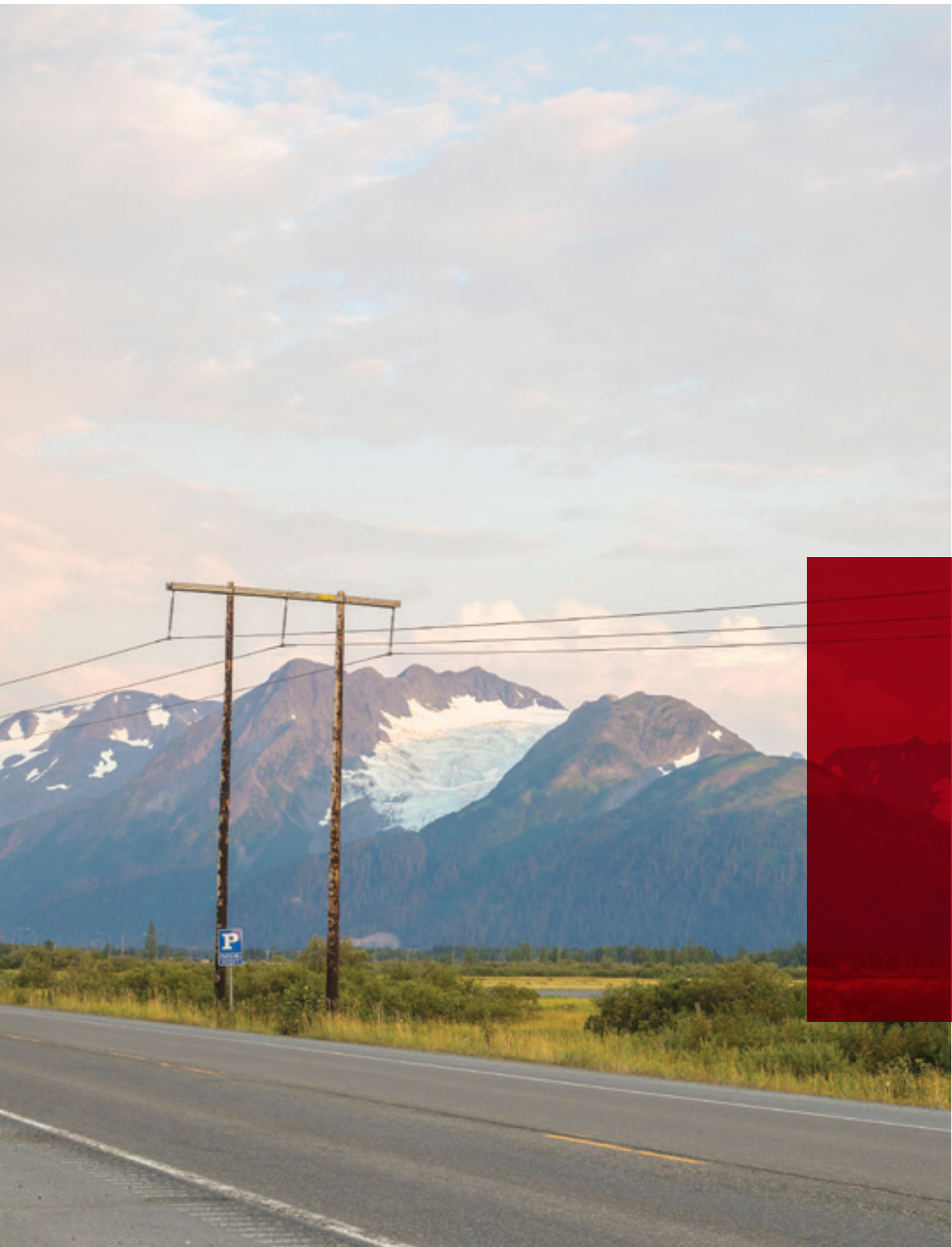




Photo credit: Chris Arend

Situated on a flat sand and gravel spit 300 feet wide and a three-quarters of a mile long, the 163 people living in Deering rely on barge service to provide consumer goods during the summer between July and mid-October. The ocean and waterways are frozen and covered in ice the remaining nine months of the year, and any goods must be delivered via air service, including food and fuel, increasing costs significantly. Primarily a subsistence community relying on the surrounding natural resources, the economy of Deering employs only 54 people, mostly in education, health care and public administration. Combined with the high cost of living, residents typically have limited discretionary income.

Living in rural Alaska is expensive. Grocery items cost nearly 1.5 times as much as similar items in Seattle. Fresh milk is not always available and boxed milk may cost more than \$6 a half gallon. Potato chips cost as much as \$9 a bag, laundry detergent nearly \$50 a jug and a quart of motor oil exceeds \$25.

This also translates to more expensive energy costs. With no road transport, fuel can easily be more than \$6 a gallon. Delivery via air transport will add another \$2 to the cost of each gallon. With the daily wellbeing of Deering residents dependent on the ability to generate electricity and heat from continuously operated diesel engines and burners, the cost of

fuel influences the cost of living disproportionately and electricity rates are more than \$0.70/kWh without subsidies.

These compounded economic restraints have motivated Deering to incorporate renewable resources to offset the high cost of conventional diesel generation. With 100kW of wind generation installed in 2016 and then another 50kW of solar added in 2019, Deering's renewable generation resources regularly exceed their average load. Such high penetrations of renewable generation can introduce system instabilities resulting in poor power quality or unplanned outages and can minimize or largely erode the economic benefits of renewables.

In order to fully reap the benefits of these environmentally-friendly resources, the community of Deering created one of the most advanced microgrids in the world, utilizing an Energy Management System (EMS). The highly configurable EMS microgrid control system, which was developed by a Switzerland-based technology provider, now manages the economic dispatch and sophisticated automation of Deering's hybrid power system while ensuring secure power with optimal renewable contribution. Combined with the grid-forming energy storage system, this cutting edge microgrid operates with up to 100 percent renewables by automatically turning the diesels off when the conditions are right.





Photo credit: Chris Arend

By operating up to 30 percent of the year in diesel-off mode, the community of Deering expects to see significant savings on their electric bills. Combined with similar efforts in nearby communities of Kotzebue and Buckland, the region estimates they'll reduce carbon emissions by as much as 305 metric tons annually.

For Chris Moto, Deering's power plant operator, there's a new-found pride in his job. He can now give plant tours of the diesel powerhouse without hearing protection because it's no longer needed when operating with 100 percent renewable energy. Big and small utilities from around the world are learning from Chris' experience how they can achieve their local Renewable Portfolio Standards. And he's already strategizing on how to add even more renewables to his power system.

Among younger members of the community, it's hard to remember a time when the diesel engines weren't running in the background. Just one of the four diesel engines generates as much noise as big city traffic, or about 85 decibels. And the few times they do remember the silence of the generators being off, the lights in the community were off too because there was no power. But today, the pristine Arctic landscape of Deering can be enjoyed without sacrificing either the serenity of the sounds of the nearby ocean or the need for reliable power. Now, when the diesels are off, the lights in Deering are still on.

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Now, when the diesels are off, the lights  
in Deering are still on.”  
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Key advantages of microgrid deployment for remote communities:

- Ensures reliable, uninterrupted and quality power availability
- Maximizes fuel savings through the highest possible renewable integration
- Optimized cost by reducing fossil fuel consumption
- High power quality by stabilizing the power systems against fluctuations in voltage and frequency
- Achieves a secure and sustainable energy mix, together with energy optimization and management
- Fast and safe installation and commissioning

As a pioneer in energy management and optimization, the previously mentioned Swiss company's grid edge solutions are leading energy innovation and transition around the world, from utilities and service providers who want to effectively manage their increased portfolio of renewables and distributed energy resources, to islands and remote communities seeking energy autonomy, as well as commercial and industrial sites who want to unlock new economic opportunities. The company's grid edge solutions' global installed base covers more than 470 MW and 170 reference sites.



#### ABOUT THE AUTHOR:

Group Senior Vice President and Head of Grid Edge Solutions Product Group at ABB, **Maxine Ghavi** has more than 25 years of experience, holding various leadership roles in program and project management, business and market development, product management, business operations and marketing and sales. Her deep domain knowledge spans the breadth of the power industry including grid edge technologies, microgrids, storage, renewables, software and semiconductors. Prior to working with ABB, she was head of business management at Oerlikon Solar, VP of sales at Voyan Technology and senior product manager at KLA-Tencor. Ghavi received her bachelor's degree in physics from San Jose State University in California.



# UTILITIES REMAIN A RESOURCE FOR CONSUMERS CONCERNED ABOUT THE CLIMATE CRISIS





### **JEFF HAMEL**

Consumers are increasingly prioritizing smart home features as they become more conscious of the climate crisis and their own energy consumption. In turn, utilities are adapting their business models to drive smart home technology adoption and provide more customers with devices that support energy savings. By lowering adoption barriers for smart home products across demographics, utilities are positioning themselves as champions of the smart home and climate movements. To continue to meet rising technology demands while supporting consumers and environmental goals, utilities must continue to educate their customers about available rebates and the benefits of owning smart devices. →





### The climate crisis is impacting consumer priorities

Utilities have been supplying power to peoples' homes affordably, safely and reliably since the early 20th century, and consumers are now starting to ask for their energy providers to be climate-conscious and support their own energy-conscious lifestyles. According to a SmartGrid Consumer Collaborative study, more than 25 percent of Millennials would be willing to pay as much as \$3-4 more per month just to get their energy from renewable sources. Utilities' consistent role in the daily lives of consumers puts them in the position to transform how they deliver power to meet these modern-day requirements for innovation, emission reductions, customer engagement and environmental responsibility.

### Utilities are driving smart home transformation

Leading utilities are embracing consumers' demand for cleaner energy systems and energy-saving resources by driving greater access to smart devices. More utilities are starting to offer online marketplaces that make it easy for consumers to add device rebates at the time of purchase, reducing friction and meeting modern online shopping expectations. These devices, in turn, help to facilitate energy and cost savings for customers and utilities alike. For example, smart thermostats can make it easier for customers to participate in demand response (DR) programs and encourage customers to reduce their energy use. Smart Electric Power Alliance's (SEPA) recent 2019 Utility Demand Response Market Snapshot found that utilities reported a DR enrolled capacity of 20.8 GW in 2018. The report provides another proof point that DR is an important tool for balancing the grid, and it demonstrates how new technologies are making DR programs more robust.

Energy providers are also taking note as devices like smart speakers -- now the fastest-growing consumer technology since the smartphone -- and voice-controlled devices are gaining in popularity. Similar to smart thermostats, these devices can simplify consumer lifestyle choices to help them be more sustainable. As one example, Xcel Energy has offered smart device services since 2015 and is now offering Google Assistant Actions with bill pay commands.

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**These devices, in turn, help to facilitate energy and cost savings for customers and utilities alike.**

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### All customers can be a part of the smart home journey

Utilities are working to put these energy-saving technologies into the hands of those who need it most. Initiatives like the Power Project are delivering smart thermostats to low-income households, a segment that's historically been hard to reach. Seniors represent another customer group that is not known to be tech-savvy or easily accessible but stands to benefit greatly from the connected home. Parks Associates reported that 13 percent of seniors 65+ and 30 percent of caregivers consider voice control a must-have feature for an independent living system. The adoption of smart home technology will enable utilities to better address the specific needs of these underrepresented groups, as well as react to watershed moments in history, such as the climate crisis.



**The adoption of smart home technology will enable utilities to better address the specific needs of these underrepresented groups, as well as react to watershed moments in history, such as the climate crisis.**



### What's next

It is encouraging to see the broadening scope of utility smart device programs, but there must be an ongoing effort to ensure that consumers are aware of these offerings. Parks Associates recently indicated that 67 percent of consumers who are planning a smart device purchase prefer to do so through a retailer, and that a vast majority of those surveyed intend to self-install. These findings are both good and bad for the trajectory of increasing the accessibility of smart devices: positive, because it shows that consumers aren't intimidated by the prospect of installing a smart thermostat. Less positive because it also indicates that consumers may not be aware of the cost-saving opportunities of purchasing a device with a rebate through their utility provider. As online marketplaces start to become more common, consumers will recognize that it is just as easy to purchase a device through their utility as it is through their retailer with the added benefit of an immediate rebate.

Utilities must continue to show leadership in driving adoption of energy-saving technologies to address a myriad of challenges and changes resulting from the climate crisis. They're reaching users beyond the early adopters through rebate programs and other initiatives, and expanding offerings to include smart speakers and voice-controlled devices in order to increase their customers' energy-saving capabilities. Looking ahead, utilities must ensure that all customers are aware of available smart device rebates and programs so they can continue to lead the smart home transformation and support climate goals.

#### ABOUT THE AUTHOR:

**Jeff Hamel** is the director of industry partnerships at Google. He previously served as 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. Additionally, he earned an MBA from Santa Clara University.

# WITH THE MARCH OF RENEWABLES, ELECTRICITY SECTOR LATEST INDUSTRY TO UNDERGO TRANSFORMATION





### **DAVE LELIGDON, JEREMY KLINGEL AND DEAN SIEGRIST**

Renewable energy and applications altering how energy is used are rattling the conventional power industry, hastening its transformation even as headwinds – things like rigorous regulations and consumer expectations of reliability – may make it feel like a bridge too far.

As with many major evolutions, the process is plodding but pressing on. And utilities should take note of just how quickly, using this generation as the latest example, that business models changed the moment that technology created disruption. In all of those moments, industries that accepted such challenges as opportunity prevailed.

And now more than ever, utilities must embrace consumer and user experiences as their true north, just as so many industries that have undergone renaissances have taken to heart. →



Wall Street – once defined by shouting and hand-signaling traders in cramped pits known as “The Floor” – now is open to trading by anyone, with merely a keyboard and an internet portal. Ridesharing services such as Uber and Lyft have dawned the age of the gigeconomy and the “uberpreneur” – ordinary people making cash on the side by using their cars as cabs. Television has been transformed by rapidly shifting consumer preferences and viewing behaviors made more complex and competitive by streaming devices, platforms and services. And legal streaming services – Spotify, Pandora, Tidal and the like – define a music scene once dominated by vinyl and compact discs.

Now roughly 130 years old, the electric industry is facing its time to evolve. Surveys show that many stakeholders believe a “utility death spiral” is fanned by advancements in distributed energy resources (DER) – things such as microgrids, rooftop solar units and electric vehicles – and consumer demands for cleaner, cost-effective energy. That’s if the industry doesn’t adopt alternative energy solutions, or if regulations fail to allow flexibility. Or both.

Environmental and climate concerns are grabbing more global attention, blunting debate about whether renewables are going to be the cornerstone of tomorrow’s power generation. It’s in that vein that the electricity sector and businesses need to show they’re serious about clean power and collaborate on energy solutions for increasingly urbanized societies, rendering discussions about “off-the-grid” approaches less relevant.

### Solar power grabs widening spotlight

Renewables globally are outgaining fossil fuel and nuclear capacity combined, accounting for one-third of the world’s installed capacity, the Renewable Energy Policy Network for the 21st Century recently revealed in its yearly look at the market.

Down the road, the Energy Information Administration (EIA) expects generation of renewable energy to spike to nearly half of global electricity generation in the next three decades, with solar growing fastest among renewables. In the coming 30 years, Forbes recently reported, \$10 trillion to more than \$15 trillion will be funneled into solar and wind energy, depending on the percentage of incremental power that these renewables supply. Energy storage – key to fully harnessing intermittent power generation – is predicted to become a \$20 billion annual market.

Electric utilities and commercial and industrial (C&I) stakeholders are taking note. In a recent survey of hundreds of energy consumers, slightly more than one-quarter of them (27 percent) expect distributed energy and renewables to dominate utility service offerings in the next five years. That number spikes to 45 percent on a 10-year horizon and 55 percent when forecasting 15 years out.

### How much do you agree or disagree with each of the following statements relative to the future of distributed energy resources (DER)?

(Select one response per row).

Source: Black & Veatch

#### DER will dominate utility service offerings in the next five years



#### DER will dominate utility service offerings in the next ten years



#### DER will dominate utility service offerings in the next 15 years



■ Agree ■ Neither agree nor disagree ■ Disagree

Driving that surge are policies increasingly favoring renewables, regional load growth and declining costs of technology ranging from the photovoltaic panels to the high-capacity batteries that store that energy.

That begs the question: In this dynamic moment in power supply, are the keepers of the grid responding? Put another way, are utilities committing to upgrade a dated system to accommodate renewables and two-way energy flows that come with them?

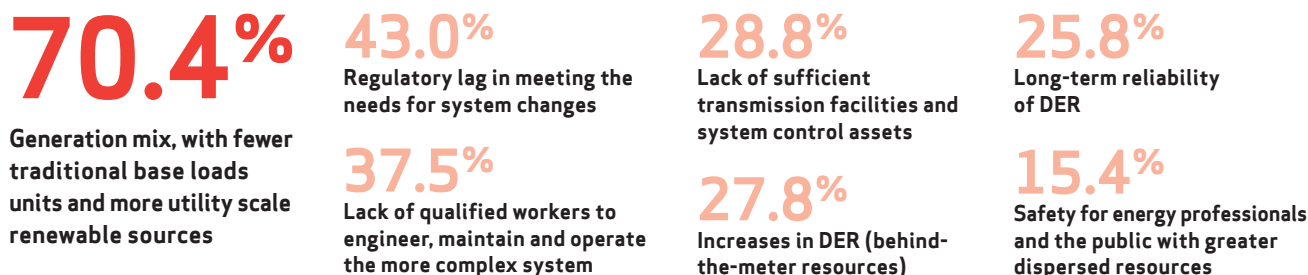
When asked recently for their biggest concern for tomorrow’s grid development, electric industry respondents to the survey overwhelmingly – 70 percent of roughly 900 respondents – cited a generation mix with fewer traditional baseload units and more utility-scale renewable sources. Respondents, by a lesser margin, also pointed to regulatory lags in addressing needed system changes and the lack of qualified workers to architect and run the more complex system.

Separately, three-quarters of respondents see adoption of alternative behind-the-meter energy options as a threat to the utility business model, either if regulatory models preclude market flexibility or if utilities fail to implement their own alternative energy solutions.

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**With the growing complexity of the grid, its operation and maintenance, what are the three biggest concerns for future grid development? (Select up to three choices).**

Source: Black & Veatch



### Businesses rethinking energy options

As renewables gain a widening footprint and reach price parity with power from the local utility, the changing energy landscape is pressing businesses to rethink how they use and manage electricity. For utilities that don't notice or react, bad news is defined by a single word: defections.

Companies mindful of sustainability are migrating toward the cheapest form of renewables or a basket of green energy options that gets them a reasonable cost of power. The catalyst is that businesses have a deeper menu of ways to satisfy their appetite for power, and they may see renewable energy — chiefly solar — aligned with their sustainability goals.

Some large companies have said they'd power some of their operations with renewable energy. Many others are going all in, reflected in a "RE100" listing by The Climate Group that shows more than 120 multi-national companies — many in the C&I sectors — plan for their power to come entirely from renewables as part of a global corporate leadership initiative.

Many of these companies are generating their own energy and buying renewable-based power from off-site, grid-connected generators. Beyond the environmental benefits of switching to renewable energy, they insist the business case for green energy is strong. But progress is slow, very little renewable generation is on-site or localized, and the pressure to see an economic return is beginning to build.

So what does that mean for utilities? Lacking agility in making changes that align with growing clean energy and decarbonization mandates could drive away sizable commercial and power-craving industrial clients who have the financial means to turn to renewables or distributed generation on their own. Such defections from the grid inadvertently would make the system more expensive by spreading its fixed costs among fewer ratepayers and adding to the network's complexity.

Utilities can make their investments more valuable by using monitoring, control and automation technologies to unlock the potential of grid assets for greater reliability, efficiency and security. This includes renewables and two-way communication on the grid, giving utilities and consumers more control and insight into everything from power generation options to bill management.

### Renewables gain growing favor among regulators

As coal-fired generation continues to fall out of favor, new plants powered by cleaner-burning natural gas are drawing growing scrutiny in favor of renewables.

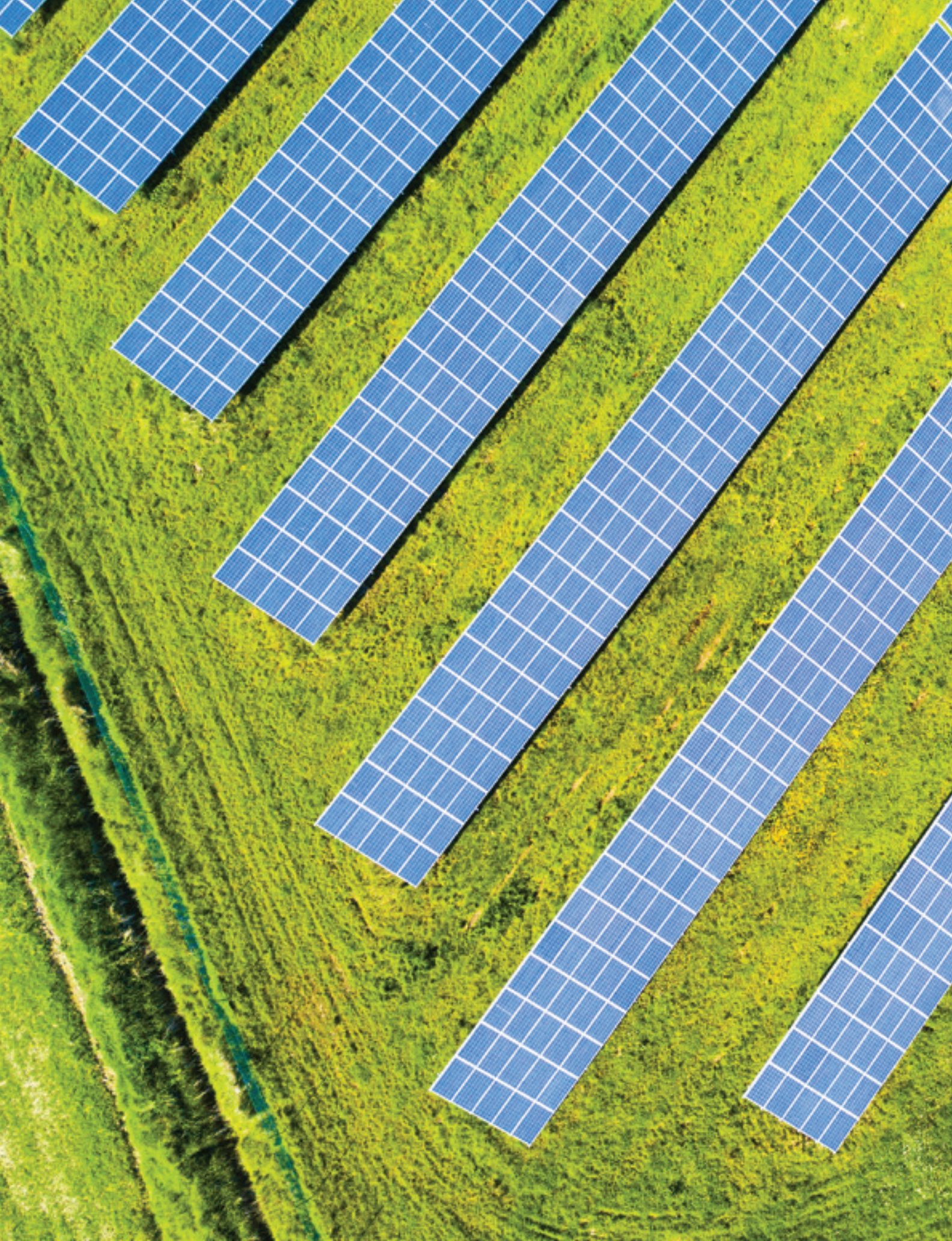
In early 2019, Indiana regulators unanimously rejected a proposal by electric and natural gas utility CenterPoint Energy division Vectren to replace three coal plants with an 850-megawatt (MW) gas facility. Regulators concluded the new site could become a stranded, uneconomic asset as customer demand changes, energy storage matures, and the cost of renewables fall.

CenterPoint's Lynnae Wilson said in a statement that while "the case was filed at a time of significant changes in generation technology," regulators have directed the utility "to increase our focus on the benefits of a more diverse resource mix."

"As we demonstrated in our case, economic and reliability factors are driving a transition from coal-based generation, and the selection of replacement resources will continue to be our focus," wrote Wilson, CenterPoint's chief business officer for its Indiana electric utility business.

In the Southwest, the Arizona Corporation Commission in 2019 extended its ban on building new natural gas plants generating at least 150 MWs in the state. That comes as Arizona weighs a grid modernization plan calling for 80 percent of the state's electricity to come from zero-carbon sources — renewables — and coal by mid-century, along with a target of 3,000 MWs of energy storage by 2030. →







## Onus on utilities to get current with renewables

Consumers, equipped with increasingly sophisticated technology and no longer content with arms-length relationships, are demanding real-time, transparent engagements with their utility. And along with a growing number of businesses, they're demanding power in cleaner, greener ways.

The onus of being nimble is thrust onto electricity providers, who admit flexibility to adapt to what's coming is atop their wish list. More than half of the survey respondents said that when it comes to identifying the most essential things for tomorrow's invariably more complex grid, 55 percent pointed to innovations that are more malleable in configurations to handle changes, ostensibly those linked to renewables. That's followed by better modeling and forecasting, and more real-time telemetry and control devices.

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### What tools or resources are most essential for the planning, engineering, construction, operation and maintenance of a more complex grid?

(Select up to three choices).

Source: Black & Veatch

**55.1%**

**Innovative system designs that allow for more flexibility in system configurations**

**53.2%**

**Better modeling and forecasting data and programs**

**45.7%**

**More real time telemetry and control devices (SCADA)**

**42.8%**

**Staff training and development in new systems**

**36.7%**

**Risk identification tools and mitigation options**

**14.7%**

**Access to consultants who have experience with an ever-changing, complex grid**

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The opportunity for power producers rests in adopting technologically sophisticated, cost-competitive and bankable engineering, procurement and construction (EPC) solutions focusing on integrating the complex grid, modernizing the vast infrastructure and putting reliability at a premium. Persistent regulatory questions will remain, requiring the industry to work collaboratively with their government overseers, among other things, to minimize rate impacts.

The push and pull of cost and consumer choice that reshaped the music, television and investment sectors is taking aim at power generation and delivery. What's needed now is the deep understanding that time waits for no one.

### ABOUT THE AUTHORS:

**Dave Leligdon** is a senior vice president and Global Renewable Energy business line leader for Black & Veatch's power business. Leligdon has led the renewables business since September 2018 and has more than 30 years of experience with energy, water and wastewater facilities in multiple regions around the globe.

**Jeremy Klingel** is the Global Distributed Energy business line leader for Black & Veatch's power business. Klingel has more than 23 years of experience, including the past four years with Black & Veatch's management consulting business. He has led more than two dozen smart grid development projects and has driven the operational roadmap behind advanced distribution management and end-user experience.

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# FOR MISSION- CRITICAL DATA AND CONTROL, PRIVATE STANDARDS ARE THE KEY TO LONGEVITY FIX



### **KATHY NELSON**

5G is all the buzz in telecommunications and even everyday life these days. People are wondering when it will be available, and the telecommunications providers market it as the answer to everyone's communications problems. At the same time, mission-critical industries such as utilities, oil & gas, rail and others have been forced to operate with limited amounts of radio frequency (RF) spectrum or purchase larger amounts in the secondary market from spectrum speculators. Some have had to move to commercial networks, whether they be 3G, 4G, or possibly 5G, depending on the area in which they operate.

While 5G's marketing materials promise previously unheard of wireless speeds and connectivity, the reality is that those connectivity speeds will be available only in urban areas and in areas that are quite close to their access point or base station. 5G, at least in the United States, is based on millimeter wave technology at extremely high frequencies, which means the radio waves do not propagate very far, and range is limited. 5G is currently intended to be deployed as base stations or access points installed on distribution power poles or light poles within urban environments. (See **Figure 1**). →



**Figure 1**





**While security breaches are common and unfortunate, people's financial data is accessed, or their devices or networks are hacked into, the risk for the electric grid is much more significant.**



For many years, mission-critical industries have been reluctant to use commercial wireless networks for mission-critical data and control. Commercial networks do not provide the levels of availability, reliability, low latency and security that are required for these very mission-critical applications. 5G does nothing to solve these issues, and for most of these issues, it actually makes them worse.

To begin with, 5G will have lower availability. Currently, commercial networks typically install their base stations or access points on tower sites. These tower sites have buildings or larger concrete pads in some cases, and most have battery banks that will provide at least four to eight hours of backup power in the case of a power outage. With 5G access points being installed on a light pole or distribution power pole, there is no place, nor is it cost-effective, to install a battery plant. When there is a power outage, those access points will go off-line, and 5G will be unavailable in that area.

Reliability will also be lower as 5G will not be ubiquitous and will take a long time to deploy. As previously mentioned, coverage from each access point will be much smaller than 4G and 3G coverage, due to the high frequencies used. Additionally, the base stations installed on poles will require fiber going to them to provide backhaul connectivity to the network. This is a costly and time-consuming endeavor, and only the most populated locations will have 5G coverage initially. After decades of commercial cellular deployment, some places in the United States have only 4G, 3G, or no coverage at all. 5G will not be coming to those areas, at least not for a long time. It is just not cost-effective, nor is 5G in the business plans for commercial carriers.

Lower-latency has been touted as improving significantly with 5G deployments. Providers are reporting overall latencies of 30 ms with air latencies as low as 8 to 12 ms. 4G networks have latencies around 50 ms, so the

improvement is significant if those reports are accurate. While latency that low is definitely an improvement and may be able to provide the latency required for many control applications, it is still not low enough for many transmission teleprotection applications. However, this is one area that 5G, if reality does meet promises, has made significant gains.

Security is a great concern and a grave danger to networks that are used for such critical communications as serving the electrical grid. By using a commercial network that is accessible using the same technology that literally everyone in the world has access to, electric utilities open themselves to great risk of a security breach. While security breaches are common and unfortunate, people's financial data is accessed, or their devices or networks are hacked into, the risk for the electric grid is much more significant. Because the electric grid is tied together into three major grids (the eastern grid, the western grid and the Texas grid), the risk of wide-spread blackouts is great if an intruder – whether that be a nation-state actor, a disgruntled employee, a hacker or a teenager playing around – breaks in. Commercial providers will tell you that they are secure because the technology is so wide-spread that their level of security is quite high. Still, networks will be compromised with wide-spread technology, and that is a threat to mission-critical industries, particularly electric utilities, cannot risk.

5G does not present any further risks than using existing commercial networks, but it also doesn't alleviate any more risks than existing commercial networks. So, what do electric utilities do? Electric utilities need to continue to use private, licensed, wireless networks as they have done successfully for many decades. This does not mean that all electric utility data needs to go over a private, licensed, wireless network. Private wireless networks have limited bandwidth, and only a utility's most critical data and control points need to be on a private network. Utilities have much greater data needs that require more bandwidth, but many of these larger data requirements are not as critical and can use commercial networks to augment the increasing demands.

Data that is not mission-critical can use commercial networks, as long as the utility understands the commercial carriers' availability, reliability, latency and security risks. This is application-specific. It is important to separate a utility's corporate network from its control network, keep accessibility to a utility's control network separate from its corporate network, and to keep its control network separate from public, commercial networks. As long as these considerations are taken into account and are adequate for the applications the utility is providing, a commercial network can be a good tool in a utility telecommunications network designer's toolbox.

For mission-critical data and control, private, licensed wireless networks are still needed. However, there are challenges with that. Utilities typically have access to only narrow channel licenses or slightly wider channel licenses on the secondary market, but not to channel sizes needed to deploy networks that can use common communications standards such as LTE and IEEE 802.16. This puts utilities into a quandary because they are forced to install proprietary networks which inherently puts their networks at risk. Manufacturers go out of business or discontinue support of product lines, and these narrow channel networks are a small market for many manufacturers. If a manufacturer discontinues support or goes out of business, the utility is left either self-supporting or self-maintaining their network if possible, or forklift upgrading their network to another proprietary solution, which is costly and service disrupting.

LTE's minimum channel size is 1.4 MHz, and IEEE 802.16's minimum channel size is 1.25 MHz. Neither of these standard's smallest channel sizes was usable in spectrum utilities typically have access to. For this reason, a grassroots effort, started by electric utilities in 2015, began work on a revision to IEEE 802.16 to develop a standard that could be used in channel sizes utilities and accessed by other mission-critical industries. At that time, the focus was on spectrum, which could be acquired on the secondary market and, with the technology available at the time, was focused on spectrum down to 100 kHz. In the fall of 2017, IEEE 802.16s was ratified and published by IEEE, and utilities had a usable standard for channel sizes down to 100 kHz. While this was an improvement and was great for utilities that had purchased spectrum on the secondary market, there were many utilities with underutilized or unused private land mobile radio (PLMR) channels or multiple address system (MAS) channels that could be purchased from the FCC for a much lower cost than purchasing spectrum on the secondary market, which may have cost a utility millions of dollars. For this reason, an effort was started in 2019 to create another revision to the IEEE 802.16 standard.

IEEE 802.16t is a new standard revision to the IEEE 802.16 suite of standards whose Project Authorization Request (PAR) was recently approved by the IEEE 802 executive committee. This means a new revision to the IEEE 802.16 standard will be starting in January 2020. The intent of IEEE 802.16t is to go down to narrower channel sizes – as low as 12.5 kHz or less. Additionally, it is intended as part of the standard revision for those small channels to be able to be aggregated together even if they are not adjacent. While that is the initial scope of the standard revision at its outset, now that the standard is open, additional requirements can be brought up by end-users, manufacturers, or anyone else that participates in the IEEE 802.16 standardization process, which is open to anyone.

By using standard technology that is still unknown to the widely connected consumer market, there is an inherent layer of security. Hackers and nation-state actors will be less likely to access a utility's mission-critical SCADA network. Additionally, security using AES encryption is built into the IEEE 802.16 standard as it currently exists, and as IEEE 802.16t is developed, additional security can be added if required.

While consumers look forward to the coming of 5G networks, electric utilities continue to keep the lights on, which requires networks that do provide the availability, reliability, low latency and security required for their mission-critical applications. IEEE 802.16t is the standard that can deliver. Not only is it important to be aware of the standard, but by actively participating as the standard is being revised, your companies' requirements can be heard and included.

#### ABOUT THE AUTHOR:

**Kathy Nelson** is the director of technical product marketing and industry relations at Ondas Networks, 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 has a B.S. in electrical engineering from North Dakota State University and is a registered professional engineering in Minnesota, Wisconsin and North Dakota.

# DR. BECCA JONES-ALBERTUS



For this issue's "Powerful Forces" section, we had the privilege of interviewing Dr. Becca Jones-Albertus, who is the Solar Energy Technologies office director within the Office of Energy Efficiency and Renewable Energy

As a high school student, Dr. Becca Jones-Albertus was fascinated with solar energy, but not many people in her orbit knew what solar power was. She pursued her passion, earning a B.S.E. from Princeton University, followed by a Ph.D. in materials science and engineering from U.C., Berkeley. She even went to Tibet to explore how remote communities could install and repair existing solar panels to meet their lighting needs.

After finishing her doctorate, she joined Solar Junction, a startup company that developed new technology for high-efficiency solar cells. There, Jones-Albertus was part of a team that set two world records for the most efficient solar cells in the world and broke technology barriers for the material the company developed. As gratifying as the experience was, Jones-Albertus found herself wanting a stronger connection to "the bigger picture." So, after five years with Solar Junction, she left her position for the U.S. Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy Solar Energy Technologies Office (SETO), to become the photovoltaics R&D program manager.

It didn't take long for Jones-Albertus to feel like she had found the perfect landing place. Not only was she able to focus more on a big-picture mission; she saw her work as an opportunity to have an impact while also leveraging her technical expertise. Within three years of joining DOE, Jones-Albertus was promoted to SETO's deputy director. Now, six years later, Jones-Albertus has taken on her third role with DOE, recently being appointed SETO's director.

Today, Jones-Albertus oversees teams that support early-stage research and development projects in photovoltaics, concentrating solar-thermal power, and systems integration technologies, as well as soft (non-hardware) costs and moving technology to market. Of the 400 projects underway across the country, some could have market impact within a couple of years, while others remain 10 to 20 years out.

Jones-Albertus also spends time updating Congressional staff and DOE's political leadership about SETO's work, and she engages with a broad array of other stakeholders. "It's important that we talk with industry partners and other relevant stakeholders to understand their needs," she says. "We need to make sure the research we're funding is as relevant and impactful as possible. As solar becomes more of a mainstream technology, it becomes even more important to look at the interactions it has with other technologies to ensure all pieces are working together effectively to support the grid."

Asked what Jones-Albertus finds the most compelling about her work, she points to the industry's transformation. "We've seen such dramatic decline in solar energy costs," she says. "The cost of solar modules themselves has fallen by a factor of nearly 10 over the past decade. It takes many separate pieces of innovation to achieve these kinds of cost reductions; improvements in efficiency are one important example of that innovation."





While solar today is very affordable in many parts of the United States, more than half of Americans don't own a home or have a rooftop that is suitable for solar.



A flexible all-perovskite tandem solar cell.  
Photo by Dennis Schroeder / NREL.

While more consumers are considering solar as a viable energy source, Jones-Albertus says the industry continues to face challenges. “We need to figure out ways to couple solar with storage and other technologies to enable its supply of electricity to be better aligned with when we need power, but also, solar needs to utilize its ability to support the reliability of the grid.” To that end, SETO funds projects focused on innovations in power electronics and other communication technologies. SETO also collaborates with other DOE offices, including the Office of Electricity, to develop capabilities for solar inverters to restart segments of the grid in the event of a power outage.

Further, Jones-Albertus explains, “As technological advances make it cheaper to buy solar power, there are new markets for solar, which have their own challenges. For example, there are issues with siting solar plants where communities are concerned about what solar might do to the character of the land”

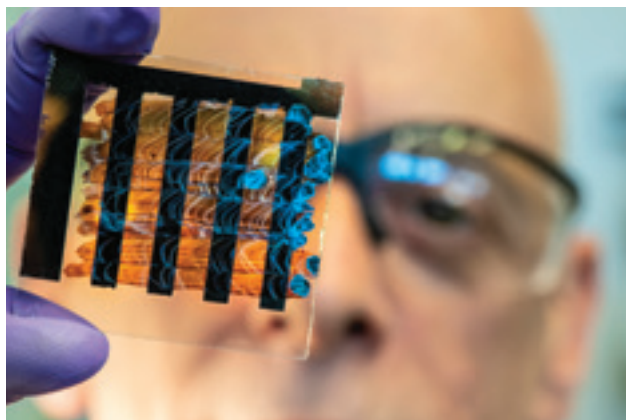
Additionally, Jones-Albertus says there are issues around the lack of access to solar power. “While solar today is very affordable in many parts of the United States, more than half of Americans don't own a home or have a rooftop that is suitable for solar,” she says. “And for solar to be affordable, you have to have affordable financing mechanisms, such as drawing on your own savings or low-interest loans. These options are not accessible to large shares of Americans.”

To address these types of challenges, DOE created the National Community Solar Partnership (NCSP), a coalition of community solar stakeholders working on expanding access to affordable solar power. With the NCSP, DOE is looking at new models for community solar that would allow participants to enjoy the benefits of solar energy as if they have solar panels installed on their homes, even though it is being generated by a large solar plant.

For those interested in emerging trends in the solar space, Jones-Albertus says they can keep their eye on perovskite technology. This solar cell technology has climbed in efficiency faster than any solar technology she has seen to date. Although perovskite solar cells have the potential to create low-cost solar power, they must undergo significant additional research to improve their lifetime and reliability. In the meantime, perovskite cells show promise that they can be integrated with existing solar technology in a tandem solar cell, which is made of two materials that each absorb different parts of sunlight to extract energy more efficiently than a standard, single-junction solar cell.

When solar energy first piqued Jones-Albertus' curiosity, solar power was less than one one-hundredth of a percent of the energy supply in the United States. Today, with solar making up 10 percent of the energy supply in several states, and nearly 20 percent of the energy supply in California, Jones-Albertus can talk about her work without having to explain solar power.

“  
It’s just amazing to be part of this rapid, rapid  
change, and I know we are far from the end of it.  
”



NREL researcher David Moore holds a perovskite ink painted cell. NREL researchers have developed an interdigitated back contact solar cell design in which the metals and transport materials are solution-processed by either inkjet or spray coating. Photo by Dennis Schroeder / NREL.

“I no longer have to tell anybody what solar means,” says Jones-Albertus. “Today, we’re looking at the possibility that solar energy could make up a large share of our electricity generation – it could change the way we use electricity, and it could change the way consumers interact with their own electricity supply.”

What started as a fascination with solar power when Jones-Albertus was a teenager has evolved into rewarding work with the U.S. government agency that focuses on energy generation and distribution. Describing her career up to this point, Jones-Albertus says, “This has been an incredibly inspiring experience. It’s just amazing to be part of this rapid, rapid change, and I know we are far from the end of it.”

#### ABOUT BECCA JONES-ALBERTUS:

**Dr. Becca Jones-Albertus** is the Solar Energy Technologies Office Director within the Office of Energy Efficiency and Renewable Energy, where she leads a team that supports early-stage research and development in the technology areas of photovoltaics, concentrating solar-thermal power and systems integration with the goal of improving the affordability, reliability, and performance of solar technologies on the grid.

Jones-Albertus has spent her career advancing solar technology, from fundamental research and development to manufacturing. Prior to joining the Department of Energy, she was at Solar Junction, where she led efforts developing the company’s two-time world record solar cells and transitioning the technology to manufacturing.

Jones-Albertus graduated magna cum laude from Princeton University with a B.S. in electrical engineering. She also holds an M.S. and Ph.D. in materials science and engineering from the University of California, Berkeley. She has more than 10 patents and 40 technical publications.

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