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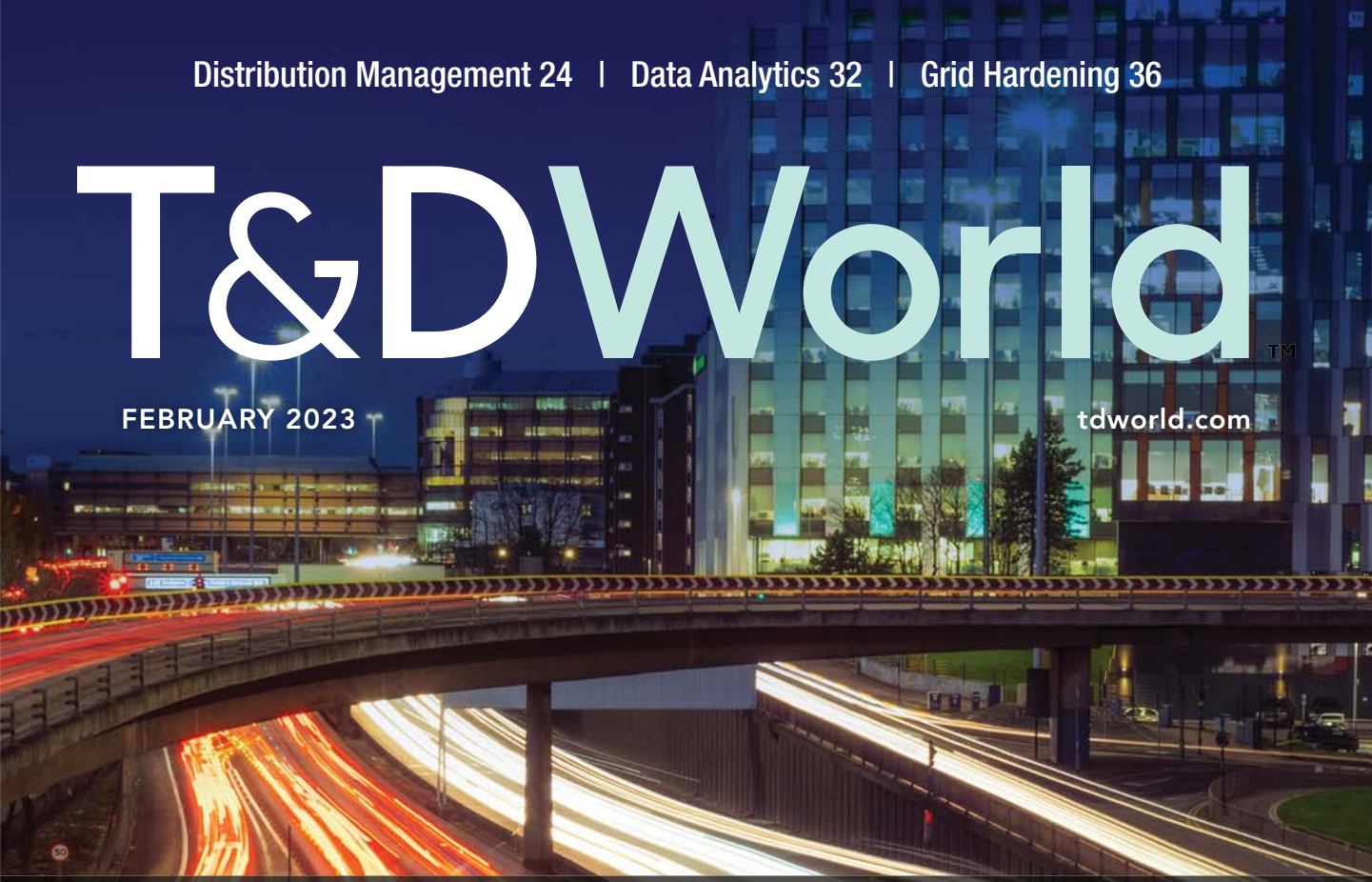

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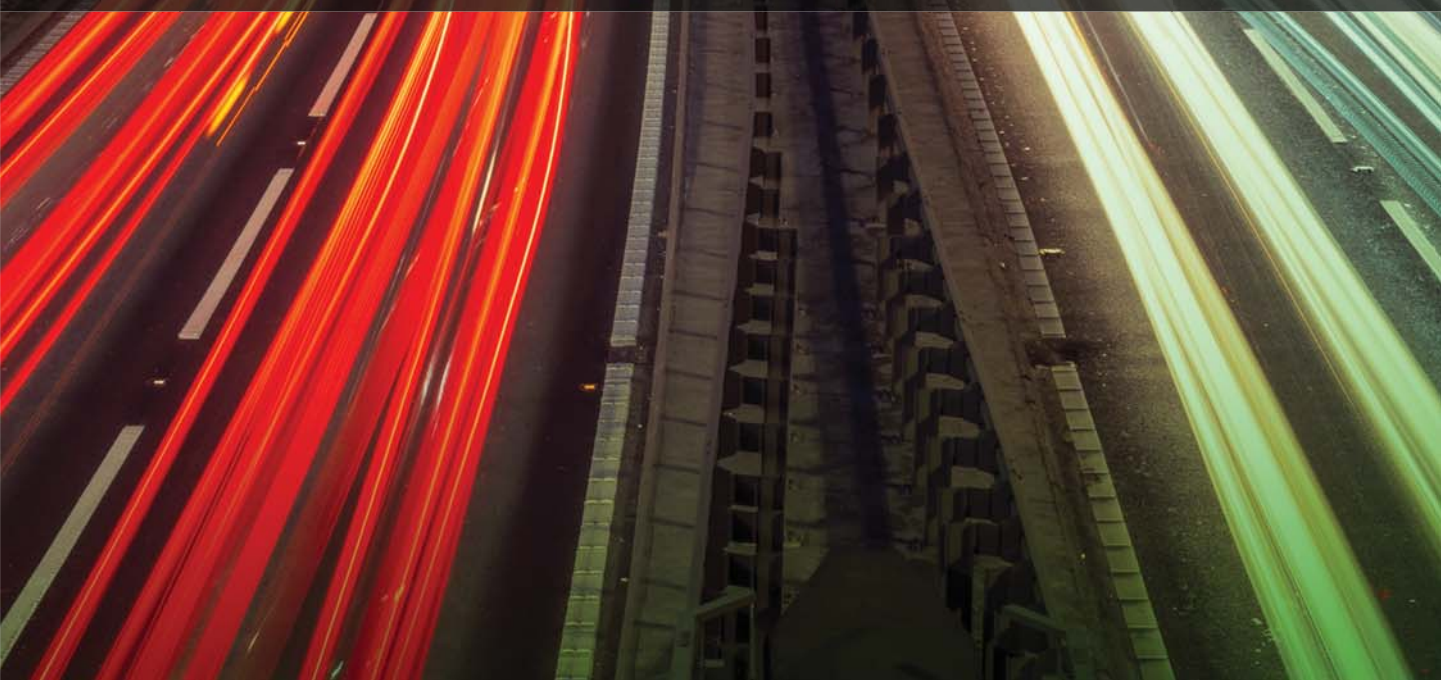

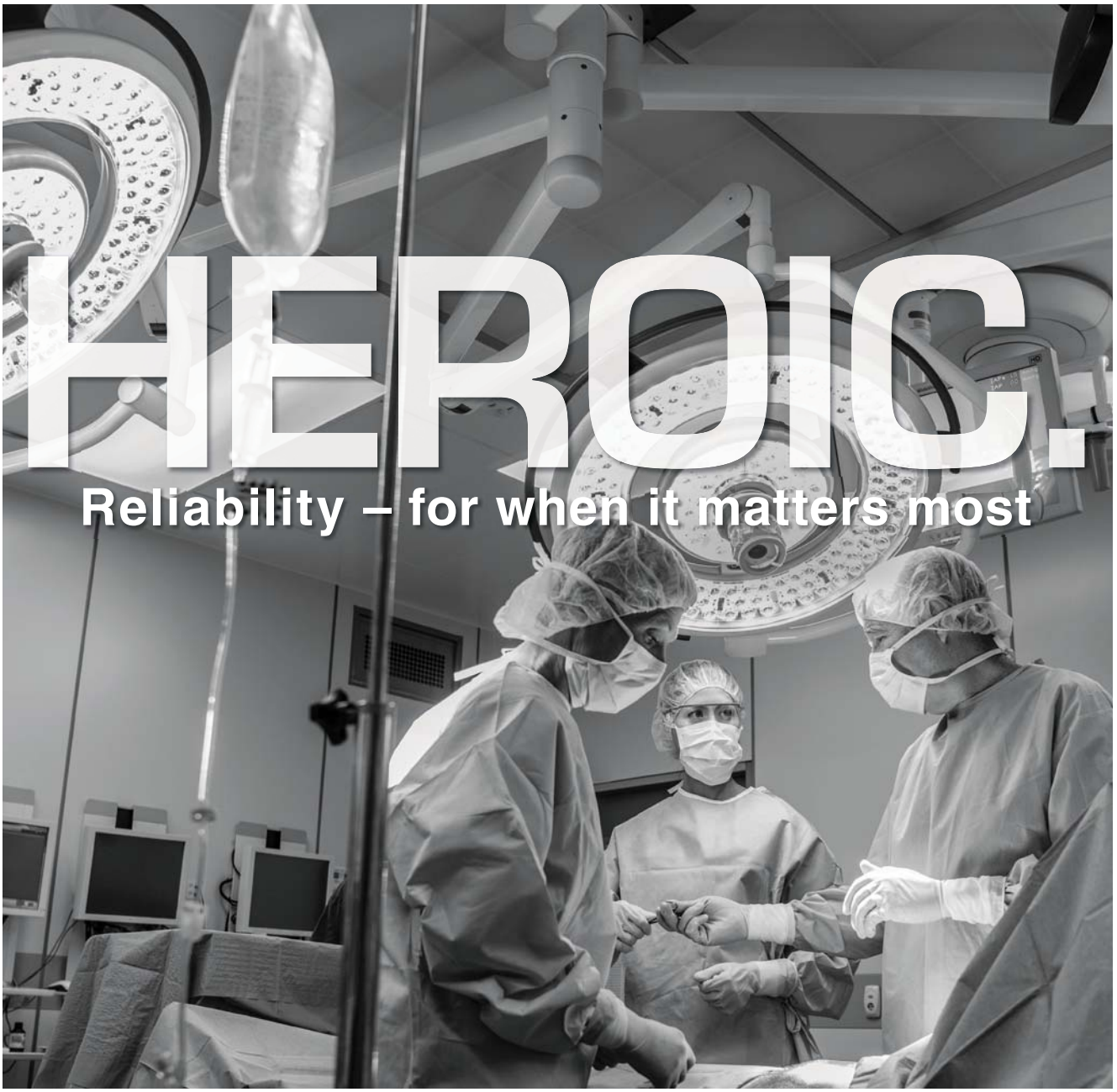


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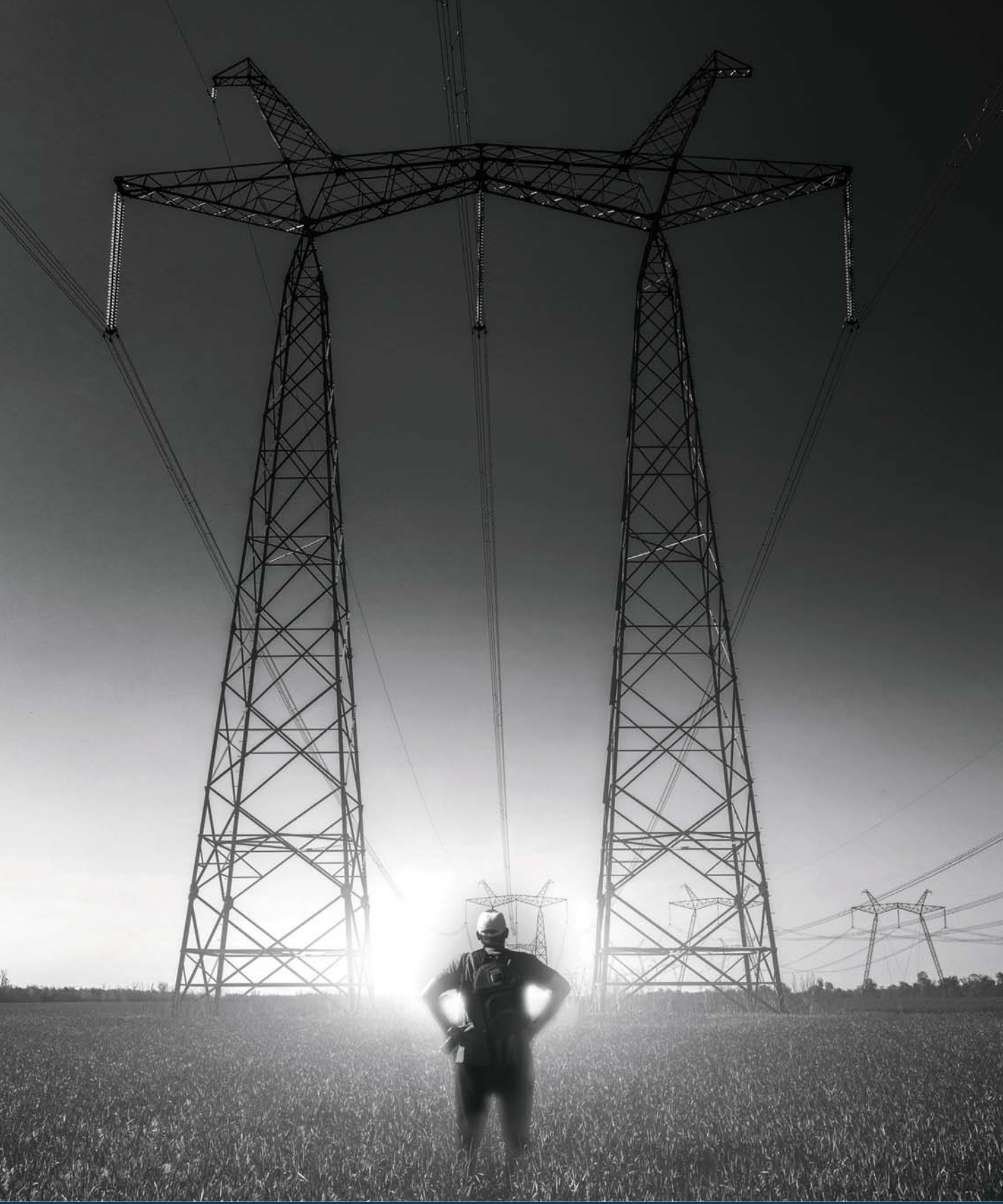

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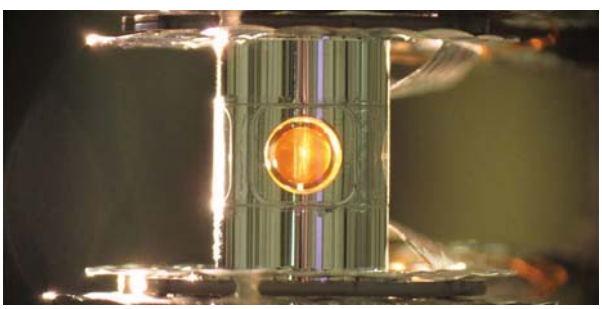
By Jeff Postelwait



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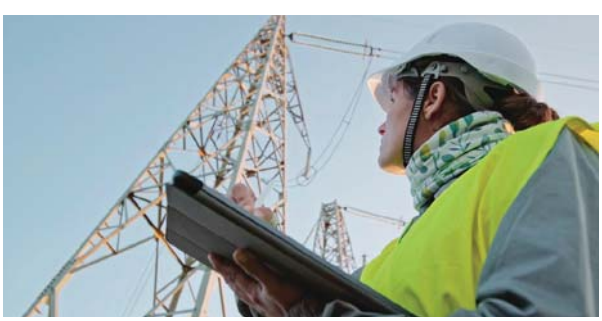

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# Energy Conservation, Customer Programs Must be Priority in Grid Emergencies

"ERCOT and the Texas power grid" was one of the five topics I listed in my January Global Viewpoint column as topics I plan to follow this year. Shortly after I wrote that column, temperatures plummeted in Texas and ERCOT was once again in the news, so it's the first of thos topics I'll cover in 2023. For more than 36 hours, beginning late on Dec. 22, the state's temperatures were nearly as low as they were during Winter Storm Uri in February 2021. I'm sure you remember Uri caused the Texas transmission grid to fail miserably. Since that time, Governor Abbott, state regulators, the legislature, ERCOT, and other state agencies have worked to ensure it doesn't fail again. As I mentioned last month, Texas Public Utility Commission Chairman Peter Lake and ERCOT CEO Pablo Vegas spoke in a press briefing in late November 2022, ensuring Texans that the grid is "prepared" for winter and that the bulk power system has adequate supply to meet the grid's and customers' needs. They, along with Governor Abbot, continued with this messaging until the subfreezing temperatures arrived.

Texas' transmission grid did not fail, but it came close. ERCOT underestimated the amount of electricity needed to meet customers' usage by nearly 13 GW. It had to ask the Department of Energy to allow the state to exceed normal federal air quality restrictions to keep the transmission grid operating. In other words, the state had to call on fossil fuel plants that it didn't plan to use and exceeded federal emission limits.

During the November press briefing I attended, Vegas was optimistic about the grid's preparedness and the state's power generation supply. For all of the probable winter scenarios, ERCOT expects to have adequate supply to meet the needs of the grid, Vegas said. He explained, however, that Texas has added about 5 GW of load each year for the past three or more years, which is equivalent to adding a city the size of Corpus Christi (350,000 people in 2022) each year. The state's demand is growing faster than reliable capacity is being added. In additionm the amount of thermal generation in the state has remained flat, while most new generation has been solar and wind.

It's important to note that as the transmission system operator, ERCOT has no control over capacity additions or market strategy. It must do its best to keep the grid operating under whatever conditions arise. Because demand has outpaced capacity additions, ERCOT must rely on better grid operation to keep up with load growth, Vegas said. Adding that the agency is taking an aggressive approach to grid management, and reliability is now at the forefront of ERCOTS actions and decisions, but market reform is critical to long-term success.

The Texas PUC unveiled its Phase 2 market redesign proposal near the end of 2022. Energy market reform was high on Texas lawmakers' agenda when they convened on Jan. 10 to begin their biennial legislative session, so they were anxious to review the PUC's proposal. It provides a "performance credit mechanism" that would incentivize power generating companies to provide electricity when power reserves are thinnest. It does not give preference to one type of generation over another. Texas Governor Greg Abbott put forth a different, more controversial proposal that would incentivize developers to build natural gas power plants. Critics say this program would increase consumers' bills without guaranteeing greater reliability because developers would not be required to build new plants even if they pledge to do so. Both plans before the legislature will funnel more money to generation companies, which fared pretty well during Winter Storm Uri when wholesale electricity prices hit nearly $9,000/MWh and averaged just under $1,500/MWh during the three days of subfreezing temperatures. It's likely that either of these plans will increase customers' rates.

Texas needs more generation to keep up with demand, and some of it should be baseload power that can be called on during extreme conditions. I don't understand, however, why demand response, energy efficiency and other conservation programs are not included. It's time for regulators, utilities in Texas, as well as other states, to create programs that incentivize customers to reduce electricity usage, as well as sell the electricity stored in EVs and generated by rooftop solar to their energy providers. In other words, become prosumers. Demand side management and demand response have been around for decades, but in all my years of buying electricity, I've never been offered any such program. These programs and the technologies that support them are commonly discussed within the industry and exist in various places. In many areas of the country, including much of Texas, these programs are used only as a last resort. In fact, Texas PUC Chairman Lake said during the November press briefing, that if necessary, in extreme circumstances, ERCOT "will use conservation alerts, industrial demand response and other similar practices."

It's time for regulators and utilities in Texas, as well as consumers, to see these programs as the first step in improving grid reliability and resiliency rather than the last. Electricity consumers should be educated on not only the benefits of these programs in improving reliability and resiliency, but also the financial benefits of participating.

I don't mean to pick on Texas. I live in Texas and think it is a great place. I can see why it is the second fastest growing state in the U.S. That rapid growth creates challenges, however, one of which is providing affordable, reliable and clean electricity to everyone. Texas is just one of many states facing this challenge. We hear often that the electricity industry is going through the biggest transition in history. It's time to transition to a business model that includes teaching and allowing consumers to be part of the solution. Conservation, customer response and load control programs should not be the strategies of last resort. TDW

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# Playing By Different Rules

The power industry has been inextricably connected to coal combustion for more than 140 years. Among the first central power plants tied to an electric distribution system anywhere, the Pearl Street generating station in New York City began operation in 1882 and ran on coal. Until relatively recently, coal accounted for 50% or more of the fuel used for power generation in the U.S. However, its use for electricity production domestically may end in a few decades if the country stays on its current path. At the same time, India and China are building a new coal plant every week and more than 70% of the power generation in both of those countries is currently supplied from coal. How did we get to this place?

This power plant in China consumes approximately 6,000 metric tons of coal a day.
Photo © William Perry | Dreamstime.com

The Second Industrial Revolution resulted in numerous electrical and mechanical inventions. Thomas Edison put them all together at the Pearl Street Station to supply electricity to households via a DC electric distribution system. The power plant used six coal-fired steam generators each producing 100 kW. With demand for electricity growing rapidly and coal being the favored fuel, coal fired generators were producing 1 to 10 MW by 1900 according to Power Magazine. Over the next 30 years, continuous improvements in turbine technology raised the average generator capacity to 300 MW. By the 1970's, unit ratings of 1,300 MW were achieved.

The 1970s also witnessed a growing environmental movement with the passage of major legislation beginning in 1970 designed to protect human health and the environment. While both stationary and mobile sources contributed to pollution and the failure to meet newly passed air quality standards in some states and cities, power plants were a frequent focus of blame often accused of creating acid rain, causing interstate pollution transport, and more recently contributing to global warming. Most of us grew up hearing all these claims and even though most emissions from major sources like coal fired plants have declined by greater than 95% since the 1970's, power plants are still a favorite target.

In the last 20 years, the green movement is increasingly taking its queues from celebrities and even Congress people who hold extreme views like climate change is an existential threat to civilization and the world will end in 12 years if we do not address it. Worse yet, our kids who cannot distinguish hyperbole from truth are being taught climate change will end humanity.

Even power industry professionals are deferring to popular opinion by not properly fact checking claims such as the risks and damage from hurricanes, wildfires and other extreme weather events are increasing in the U.S. due to climate change.

Instead of just following the crowd, particularly on the issues with such major societal consequences as global warming, more decision makers need to research all viewpoints. There are experts still trying to do a more thorough job of interpreting the data we have been collecting for more than 100 years. Roger Pielke, Jr., a well-known climate science writer from the University of Colorado Boulder told a House Committee: "There is little scientific basis in support of claims that extreme weather events, and specifically hurricanes, floods, drought, and tornadoes, and their economic damage, has increased in recent decades due to the emission of greenhouse gases." He went on to clarify that "there's no evidence to suggest that hurricanes, either in the U.S. or globally are increasing. And the same goes for floods, drought, and tornadoes."

Michael Shellenberger, a long-time member of the environmental movement and author of "Apocalypse Never: Why Environmental Alarmism Hurts Us All" shares a similar view. He points to National Oceanic and Atmospheric data for the period 1900-2021 of hurricanes in general and major landfalling hurricanes (cat 3-5), which shows an actual decline of both over this timeline. He claims popular reporting that show otherwise are cherry picking data or not considering improvements made in detecting hurricane frequency. Further, he argues data reveal there has been no increase in the relative cost of hurricanes once the change in wealth and development density are factored.

Most climate experts agree that reducing greenhouse gas emissions is a valid goal, the disagreement is over whether it is a crisis. Further, while the U.S. and some other countries participating in the IPCC Climate Accords are agreeing to extreme steps that hurt their citizens, they are giving a pass to "developing" nations. Developing countries include China and India, among others, which have some of the highest pollution in the world.

U.S. utilities have some real challenges, including grid modernization, cyber threats, wildfires and managing costs and rates in the current economic environment. Meanwhile, some would argue that due to bad policies, these same entities, their ratepayers, and, in fact, the entire country are getting smoked by global competitors playing by different rules. TDW

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# Better Include Physical Security With Cybersecurity

I had just settled down at my computer to start the February "Charging Ahead" editorial. I had decided on the subject that fit nicely with the topic of my February article. As I entered the topic in my browser, a breaking news headline flashed across the screen diverting my attention. It said some cretins attacked a couple of substations in North Carolina, which resulted in a blackout for the entire county the substations served. What got my attention was the fact it was a planned physical attack, using gunfire.

Burning transformer. Photo by Gene Wolf.

Of course you will be reading this a couple of months from now, and the events will be old history at that point. The news coverage, however, did bring back a flood of memories concerning attacks on substations that I experienced in my substation engineering career. When I was a new substation engineer there wasn't much emphasis on any type of substation security. We installed a ten foot chain-link fence topped with three strands of barbed-wire around the station, put a lock on the gate and called it good. The amazing thing was this approached worked in those days!

## Attractive Nuisance

It wasn't long until I had my first vandalism encounter proving we needed to improve that approach. My utility was hit with large scale copper theft problem. Thieves were breaking into substations to steal copper, but many were being hurt or killed in the process of stealing. They didn't understand clearance issues. That resulted in lawsuits, with large awards to the thieves or their next-of-kin. The juries considered a substation to be an attractive nuisance and a simple fence with barbed-wire wasn't enough deterrent to protect people from themselves.

The one thing I learned as a substation designer, there's no way to keep determined people out of a substation, but there is a lot that can be done to minimize any intrusion. In the case of the copper thieves, the problem had a simple solution. Replace the solid copper cable grounding jumpers with something that had no scrap value. Copper-clad aluminum jumper cables did that. In retrospect that problem seems trivial compared to today's more sinister attacks.

Several years later, I took part in meetings with other utilities and sometimes regulatory groups like NERC (North American Electric Corporation) to discuss the rising numbers of physical attacks on substations. No one wanted to call these happenings a physical attack, but looking back in hindsight that is exactly what they were. There was also an understood policy that members should not talk about the meetings, and it seemed like a good idea at the time. There was a concern that publicity would give people ideas and encourage copycats, but still substation attacks increased.

## What to Do

Then in 2013 there was a major attack on PG&E's Metcalf Substation, and 17 out of 21 power transformers were damaged. NERC was directed to develop a physical security standard to give utilities a guideline to lessen vulnerabilities on critical facilities from physical attacks. That resulted in the CIP-014 standard, which has a great deal of helpful information. Interestingly, CIP-014 requires utilities determine what facilities on their systems are critical.

With something like 55,000 transmission substations and over 450,000 miles of high-voltage transmission lines, that is a hard task. After the North Carolina attack, it's going to be more difficult to adequately define criticality. Criticalness is relative. Maybe another approach would be more appropriate such as treating all facilities as critical and take advantage of state-of-the-art technologies for physical protection.

Getting back to that idea about not talking about vulnerabilities made it hard to find products designed to physically protect substations. Of course there are several varieties of video cameras, intrusion alarms, and perimeter monitoring systems, but what about physical barriers. That is something that usually doesn't come up at the morning coffee break, but there are some manufacturers who specialize in off-the-shelf military grade ballistic resistant barriers that meet UL 752 US Ballistic Standard.

A quick check turned up several manufacturers like ArmorCore and Southern States offering various sized panels and barriers that include eight individual levels of UL Standard 752 approved protection. Panels can be installed within doors, building walls, control cabinets. Detachable barriers can be installed around outdoor equipment and can be removed for maintenance. Hitachi Energy, Siemens Energy, and others offer ballistic protected transformers. It is time to consider our physical-security as thoroughly as we do cyber-security – the technology is available! TDW

# The Brightest Ideas In Vegetation Management Start Here.

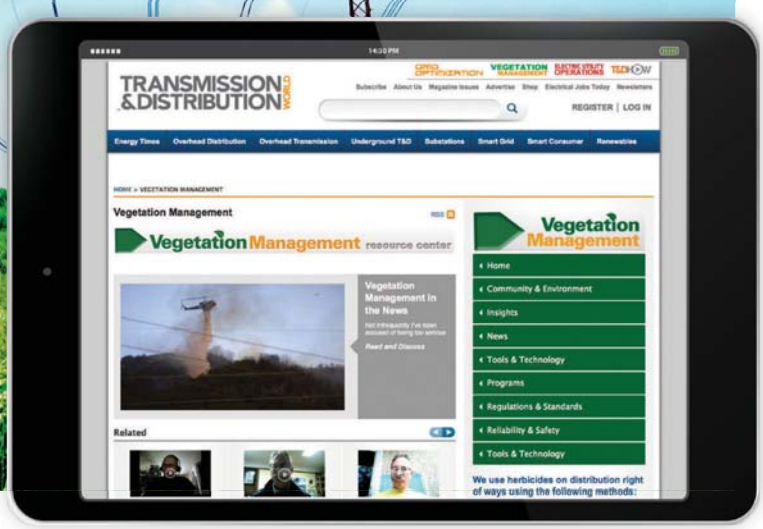


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Photo courtesy of HItachi Energy

# Plugging Into Smarter Grid Technology

## Will the next generation of communications technology push the smart grid into its next transition?

Just what do we mean by saying we have a smart grid? Well, it probably depends on the perspective of the person answering. Surprisingly some experts report a large number of the power industry's stakeholders identify the smart grid as being exclusively smart meters. They are convinced that smart grid technology is solely AMI (automated metering infrastructure), which points out what a good job the suppliers of AMI technology have done for product identification.

They may be missing the point a little, but that's okay. After all AMI has played an important role in getting us plugged into grid smartness. It might help if the industry had some reference points to mark where it has been and where it's going. Maybe AMI would be a good starting point that could be called smart grid 1.0. Case in point, the industrial revolution has benefited from such designations. It currently is at 4.0. Also cellular technology has used designations as a successful marketing tool. We moved to 5G (fifth generation) smart phones a few years ago and 4G phones were cycled into a desk drawer.

### Technological Push

If AMI defines smart grid 1.0 what would the next reference point be? Possibly smart grid 2.0 could be the movement to the digital utility, and 3.0 might be defined by something like digital twin automation. Perhaps some standards organization such as IEEE's "Power and Energy Society" will pick up the challenge. What better way to mark each change from one smart grid era to the next than to identify the transition point. This would be especially helpful as the boundaries between the physical and cyber worlds blur and the industry moves further into virtual and augment reality systems.

What started this contemplating was a series of studies, reports, and white papers speculating that the next generation of the smart grid technology is here, but it's getting harder keeping track of it. The smart grid is all about connectivity and using industrial 5G technology for that connectivity is going to boost the grid's abilities.

This is particularly true with field area network technology. Industrial 5G has more to offer IIoT (Industrial Internet of Things) technology. That is seen as being extremely important when it comes to making the grid smarter, but more on that later. One aspect that stood out in these publications was integrating industrial 5G cellular technology into wireless mesh network (WMN) technologies. But recognize, this is not the familiar AMI meter meshes. Those meshes use low frequency narrowband technology with limited data capacity.

The WMN being discussed is powered by industrial 5G technology, which is designed for the conditions found in industrial ecosystems. The proponents say industrial 5G makes these WMNs more flexible, autonomous, and efficient. Industrial 5G also provides ultra-low latency, a wide selection of frequencies, large bandwidths, and multiple bands, to name a few capabilities.

Simply put, a WMN is a local area network of connected numerous devices via multi-tier communication architectures.

It's a network of nodes that are linked to each other via Wi-Fi, LTE, radio, cellular, etc. They can operate through one path or multiple pathways, it's up to the user, but there is one critical point that demands attention. Like all elements of the smart grid, interoperability is a major consideration. Utilities have to be able to mix and match hardware especially as WMNs grow in use.

Mixing manufacturers doesn't have to a big deal thanks to open standards. Early in the smart grid deployment proprietary systems impeded the wide scale adoption of the technology. WMNs need to be specified using open standards such as TCP/UDP/IP, IEEE 802.11 along with other 802 and IETF standards to name a few. Protocols are important because these systems will be operating with the utility's existing components and elements. It's worthwhile spending some upfront time specifying how the WMN is expected to operate on the utility's network.

Granted, this is an oversimplification, but it gives a starting pointing with some basic fundamentals. It's a complex technology, but it doesn't have to be complicated. There is a lot of help available from manufacturers who supply this equipment such as Cisco, Ericsson, Hitachi Energy, General Electric, Siemens Energy to name a few.

## Power of IIot

There is a growing interest in plugging IIoT technology into the smart grid using these 5G powered WMNs. Ever since OT (operational technology) converged with IT (information technology) it has seemed like IIoT is the logical direction for modernizing the power grid. Keep in mind, there are a lot of older existing devices on both the transmission system and the distribution network that gather some data, but they keep it to themselves.

If that data can be extracted, it brings the IT/OT convergence to the remotest corners of the grid. Combining 5G technology and IIoT can bring about a new era of grid automation, but there are many questions about doing this. "Charging Ahead" contacted Mike Dulaney, Global Head of Wireless Sales at Hitachi Energy, and Tore Gillbrand, vice president of Global Product Management for Hitachi Energy for more insights into this advanced approach to networking.

Dulaney started off the discussion with a quick review of multi-tier communication platforms saying, "Hitachi Energy provides complete high performance communication packages with their Tropos broadband mesh networks. A Tropos network is organized into nodes, gateways, and clients by Tropos device's ability to be configured as an element is needed."

Dulaney continued, "Hitachi Energy's Tropos broadband mesh product portfolio uses broadband, fiber, ethernet, etc. for two way communication links with equipment in the field, and in the fourth quarter of 2022 Hitachi Energy introduced a new cellular router to expand their fifth generation wireless networking capabilities and support IIoT applications for utilities. The Tropos TRO610 was designed for a wider variety of edge computing applications and devices like this are making it happen. It is compatible with 3G, 4G, and 5G cellular networks that are found worldwide. It also provides utilities with an efficient, cost effective method for modernizing older devices."

Gillbrand explained, "The TRO610 provides a means to connect all of a utility's assets even if they were built and installed before today's stronger cybersecurity standards were issued. These are the devices found on the grid's distribution network's such as distribution capacitor controllers, volt/VAR regulators, load breaks, reclosers, etc. that have been in service for 20 years or more. The Tropos operating system is designed to deliver the same security options over the wireless network that is available over the hardwired network."

Gillbrand resumed, "The manufacturers of power grid equipment have a long history of building quality products. These devices are built to last, and many are still in service long after the standards they were manufactured by are out of date. That is why it's important to be able to update these devices without having to replace them. They still have more years of service in them. This is where the TRO610 comes in. The small form factor product has been designed to allow it to be installed wherever there is space for it. In many devices that means mounting it on the door of the control cabinet and poking an antenna through the cabinet. They can also be mounted on the top of a utility pole or any other suitable space – they are very adaptable."

Gillbrand continued, saying, "When combined with the TRO620 cellular mesh router, the utility has a secure connection over public cellular infrastructures like AT&T, Verizon, US Cellular etc. Or they can connect to private cellular infrastructures using CBRS or Anterix like those our utility customers are planning on building for themselves. Many utilities don't want to be faced with a technology obsolescence cycle so common with commercial cellular networks. It usually has a shorter lifecycle than they are comfortable with, and this is an option. Whichever infrastructure the customer selects, this approach provides them a fully distributed mesh network that delivers enhanced capacity, greater resiliency, and state-of-the-art security with improved scalability."

## What Next

WMNs infused with industrial 5G technology make plugging smarter components into the smart grid easier and faster, which is needed as we try to improve physical security of the power grid. In addition, manufacturers are able to convert older devices into smart grid data contributing elements by applying IIoT technology. That in turn makes the power system smarter. The decentralized WMN approach adds to the power system's flexibility and removes data bottlenecks along with single points of failure.

Is this the next transition point for the smart grid? It could be, but whatever develops there is one certainty. Communications technology is playing a key element in making the smart grid smarter. WMNs make good business sense; because of the connectivity, they improve applications like substation automation, management of renewable energy sources, outage management, and a many others. Whatever happens, it's going to be challenging. TDW

# SMUD ANNOUNCES NEW RESIDENTIAL VIRTUAL POWER PLANT INITIATIVE

To help meet its 2030 Zero Carbon Plan to eliminate greenhouse gas emissions from its power supply, Sacramento Municipal Utility District (SMUD), has entered into an agreement with Swell Energy (Swell). Per the agreement, Swell will act as the aggregator for SMUD's new My Energy Optimizer Partner+ program—a residential customer-driven virtual power plant initiative.

The virtual power plant (VPP) program is one of the most advanced initiatives underway in California to aggregate residential solar and battery storage systems, in a centralized manner, to reduce carbon emissions, according to SMUD and Swell. The program will also be used to create a more renewable, resilient, and reliable grid. The My Energy Optimizer Partner+ program enables customers to operate their individual solar and battery storage systems alongside many others to aggregate and dispatch renewable energy sources to benefit their communities. Participating My Energy Optimizer Partner+ customers will receive both upfront and ongoing compensation, or GridRevenue™, based on the capacity of their solar and energy storage systems.

Swell Energy, California Install. Photo by Swell Energy/SMUD

"As more SMUD customers add solar panel systems paired with battery storage solutions, they'll be better able to manage their own energy needs while making meaningful contributions toward reducing their community's carbon footprint," said Lora Anguay, Chief Zero Carbon Officer of SMUD. "We are excited to partner with Swell to make this program a reality in 2023 and continue to deliver on our decarbonization plan, which promises environmental protection, excellence in grid resiliency and reliability, affordable rates, and local economic and workforce growth opportunities that benefit the entire region."

Currently, there are approximately 600 customer-sited energy storage systems in SMUD's service area, with an additional 400 in the interconnection process and thousands more projected over the next several years. The success of programs like the My Energy Optimizer Partner+ is based not only on total enrollment but also on the additional job opportunities created for local installers and on the socially equitable impact of the program. Accordingly, SMUD has committed to funding batteries for low-income customers in the service area through local non-profits such as Grid Alternatives.

"We're honored to work with SMUD towards the achievement of their Carbon Zero 2030 plan through the deployment of a multifaceted virtual power plant across SMUD territory and the overall CAISO grid," said Suleman Khan, CEO of Swell Energy. "Our collaborative virtual power plant will provide real-time energy management and synchronized battery dispatch across SMUD's customer base, enabling large-scale renewable deployment and minimizing the need for conventional power plants in the region. We believe this model is a beacon for how municipal utilities and other publicly owned utilities can achieve scale and value with distributed energy resources."

My Energy Optimizer Partner+ will launch enrollments in Q1 of 2023, with operations planned to start in April 2023. Enrollment will be open to both new and existing solar and storage customers.

As the nation's sixth-largest, community-owned, not-for-profit electric service provider, SMUD has been providing low-cost, reliable electricity to Sacramento County for more than 75 years.

## EARTHQUAKE TRIGGERS POWER OUTAGES IN NORTHERN CALIFORNIA

A 6.4 magnitude earthquake with its epicenter near Fortuna, a small town in California's coastal Humboldt County, has knocked out power to tens of thousands of customers.

The website PowerOutage.us said Tuesday morning that of about 99,000 tracked customers in Humboldt County, about 71,000 of them were without power at about 8:00 a.m. Pacific time.

Pacific Gas & Electric reported that about 50,000 of its customers were without power in Humbolt.

PG&E also said its crews were initiating their emergency relief plans and sending crews to respond to electric and gas hazards while working to address outages.

The county's sheriff's office cautioned people to be on the alert for damage to utility lines and reported "widespread damages" to roads and houses throughout the county. The office also said that despite some weaker aftershocks of around magnitude 4, there was no risk of tsunamis at the time.

According to the U.S. Geological Survey, the earthquake struck at a 10 mile depth at about 2:30 a.m. Pacific time. It struck about 7.5 miles southwest of Ferndale, California. There were about a dozen smaller aftershocks as well.

The sheriff's office reported two people sustained minor injuries. —Jeff Postelwait

SMUD is a recognized industry leader and award winner for its innovative energy efficiency programs, renewable power technologies and for its sustainable solutions for a healthier environment. In 2020, SMUD's power supply was more than 60 percent carbon free and SMUD has a goal to reach zero carbon in its electricity supply by 2030.

In addition, SMUD is the host utility for T&D World Live, which will take place September 12-14, 2023, in Sacramento. "T&D World is excited to be partnering with one of the country's most-forward thinking and innovative utilities. We look forward to working with its management and employees to create a program that includes highlights of some of those innovate programs," said Teresa Hansen, T&D World's vice president of content.

Swell Energy is an energy management and smart grid solutions provider focused on accelerating the mass adoption of distributed clean energy technologies by enabling consumers to take control of their energy use and cost, achieve energy security, and participate in the transactive grid. Swell Energy provides homeowners and businesses with financing and virtual power plant programs while partnering with trusted local solar and solar+storage companies. Swell Energy also delivers resilient VPP networks and grid balancing services to utilities. ■

## NY GOVERNOR ANNOUNCES START OF CONSTRUCTION ON SMART PATH TRANSMISSION LINE

New York Governor Kathy Hochul last in December announced the start of construction on Smart Path Connect, a critical transmission project led by the New York Power Authority and National Grid NY to rebuild and strengthen about 100 miles of transmission in the North Country and the Mohawk Valley. The transmission line upgrades are necessary to meet the clean energy requirements of the state's Climate Leadership and Community Protection Act. Project representatives, including New York Power Authority Interim President and CEO Justin E. Driscoll, and National Grid New York Chief Operating Officer for Electric Brian Gemmell, joined president and CEO of the New York Independent System Operator Rich Dewey to mark the project's construction kick-off and briefed the local community on the project along with state and local leaders at the New York Power Authority's Hawkins Point Visitors Center in Massena, New York.

The Smart Path Connect project will help unbottle existing renewable resources in the region and yield significant production cost savings, emissions reductions, and decreases in transmission congestion. It is estimated to result in more than 1.16 million tons of CO2 emissions avoided annually on a statewide basis and an annual reduction of an estimated 160 tons of NOx emissions. New York Power Authority estimates the project will provide more than $447 million in annual savings in northern New York and create hundreds of clean energy jobs during construction.

The work will involve construction of several new substations as well as refurbishment of several existing substations. ■

# Electric Fleets are Coming, Ready or Not

## Fleet owners and utility professionals are both thinking about what greater adoption of electric vehicles could mean for them.

By **JEFF POSTELWAIT**, Senior Editor

Even with the disruptions of the last two years, electric vehicle sales have been growing. Most of the growth has occurred with electric passenger vehicles. Commercial electric vehicles (CEVs) are still a small portion of vehicle sales. Still, according to the International Energy Agency's Global EV Outlook 2022, electric truck sales in the United States and Europe have begun to rise rapidly in the past few years, driven by an increase in available models in those markets, policy support, rapidly improving technical viability and economic competitiveness of electric trucks in certain applications.

Fleet owners are taking a closer look at purchasing electric vehicles. Operating costs are becoming more important as fleets plan for future vehicle turnover. Higher gas prices, at least for now, are drawing attention to the lower cost of electricity as fuel. Then there is the total cost of ownership (TCO) of CEVs. According to the North American Council for Freight Efficiency (NACFE), early adopters of CEVs are validating an acceptable TCO in urban medium-duty vans and trucks, terminal tractors and short regional haul applications.

An uptick in the adoption of CEVs in the United States is noted in Endeavor's 2022 Commercial Vehicle Adoption Report. Only 8% of fleets reported operating even a single electric truck in 2021. In 2022, that percentage doubled to 16%. The top motivation for fleet owners' consideration of CEVs is in researching future vehicle needs.

Fleet owners do have concerns about purchasing CEVs. Does the TCO (upfront costs and operating expenses) make sense? Will there be sufficient charging infrastructure to handle trip cycles without reducing margins on fleet assets? Are the stranded costs of early replacement of internal combustion engine vehicles acceptable? Utilities will play a role in addressing these questions.

Fleet owners and utilities recognize that transportation electrification will require new and deeper partnerships. While utilities are experienced in building out infrastructure to meet increased electricity demand, utility companies are new to understanding the diverse needs of CEVs. On the other

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*T&D World* deployed a 25-question survey to its utility subscribers to determine where the industry stands on charging infrastructure roll-out for commercial electric vehicles. This article is a summary of the resulting report, which is available at no cost on the *T&D World* website.

With a few exceptions, utilities do not have business units or cross-unit collaborations dedicated to planning and implementation of CEV charging. The roles and titles of respondents of this survey may be reflective of an early state of maturity. Photo by Calvin L. Leake, Dreamstime.

hand, fleets know about refueling internal combustion engine (ICE) vehicles, but not the optimal electric infrastructure for locating charging depots.

## Momentum is Building

According to the International Energy Agency's (IEA) Global EV Outlook 2022, electric truck sales in the U.S. and Europe have begun to rise rapidly in the past few years, driven by an increase in available models in those markets, policy support, rapidly improving technical viability and economic competitiveness of electric trucks in certain applications. EV network service providers – companies that operate charging stations for users for a fee – are becoming more active in servicing fleets.

Local, state and federal governments are adding to the momentum with decarbonization goals and policies. For example in 2020, California adopted an Advanced Clean Truck rule requiring minimum sales targets for zero emission vehicles. Since then, four other states have adopted this rule.

Also of note is a memorandum of understanding (MOU), signed by 17 U.S. states, the District of Columbia and Quebec. The MOU advances the market for electric MHDVs, including large pickup trucks and vans, delivery trucks, box trucks, school and transit buses, and long-haul delivery trucks. Signatory states encourage utilities to act on CEV-focused electric distribution system planning, beneficial rate design and investment in "make-ready" charging infrastructure. Make-ready programs are intended to jump start adoption of CEVs by covering some of the costs of utility- and/or customer-side CEV infrastructure.

In 2021, a group of utilities joined together to form the National Electric Highway Coalition (NEHC). The NEHC is committed to providing EV fast charging infrastructure. Fast charging infrastructure benefits both personal and commercial vehicles. There are currently more than 60 investor-owned

and municipal electric companies and cooperatives that have joined the NEHC.

Then there are collaborative efforts that bring together utilities, automotive original equipment manufacturers (OEMs), EV service companies, EV charging network providers and trade associations. The Alliance for Transportation Electrification (ATE) brings groups together to collaborate on policy and regulatory issues, such as innovative rate design for commercial and industrial rates to "provide transitional relief to station owners and allow the market to develop."

Still, it is early days. There is a lot of regulatory activity related to passenger vehicles. However, policy makers and regulators are just beginning to address CEV adoption. Of importance are incentives that support charging infrastructure deployment, EV-related utility grid investments and rate design. As of February 2021, only 6 states have utilities that are offering best practice incentives for commercial fleet charging.

Utilities and fleet owners are discussing the question of who pays for major infrastructure investments. At issue is whether early adopters of fleet charging depots should bear the cost for utility side infrastructure, while later depot installations on the same feeders will benefit from those grid improvements at lesser cost. Photo by Waihs, Dreamstime.

## Local Fleets Are Coming First

Most utilities have not seen substantial build-out of CEV infrastructure for fleets in their service territories. Utility respondents were asked to give their view on the rate of penetration of CEV by vehicle usage class – local, regional, and long-haul trips, as well as vocational usage (construction, waste hauling, landscaping, agriculture, municipal services).

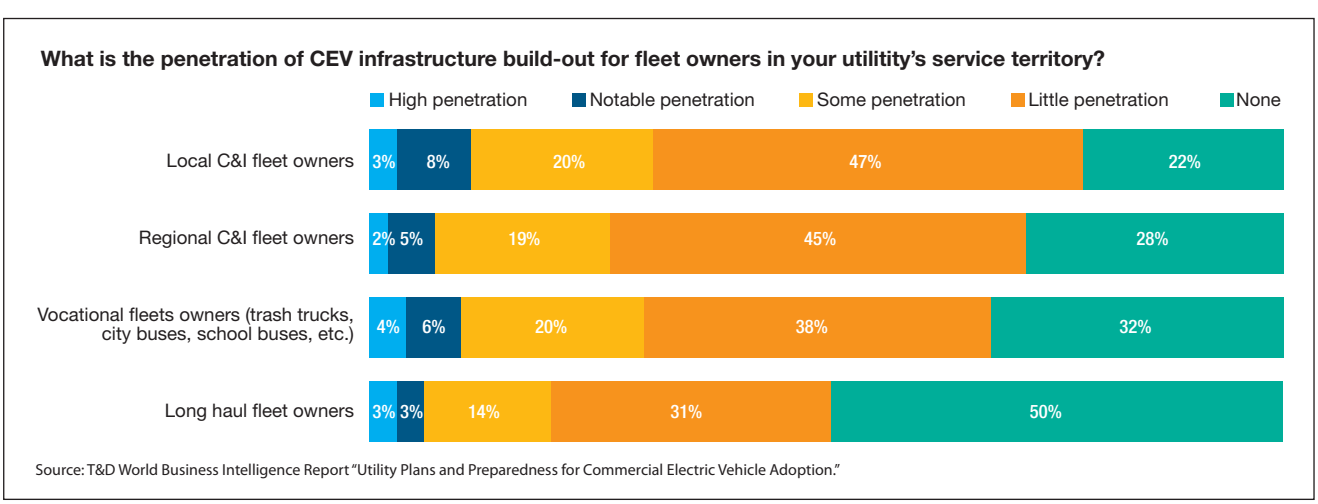
Utility respondents' perceptions are in line with how fleet owners perceive the roll-out. According to the 2022 Commercial Electric Vehicle Adoption Report conducted and compiled by Fleet Owner magazine, "Of those fleets open to CEV adoption in the next one to five years, 79% see them deployed in local service applications and 43% in regional applications. Only 6% expect to launch long haul CEV operations, most likely reflecting the unsuitability of battery-only trucks in that application and the early development stage of fuel cell truck systems."

It is not surprising that utilities think that the grid is readier for local fleets than other usage types, although penetration rates are low for all. Eleven percent of utility respondents reported that local fleets have notable and high penetration rates in their service territories. Local usage vehicles, like delivery trucks, can charge overnight or at publicly available at direct current fast charging (DCFC) stations during the day. Similarly, 10% of utilities report that vocational trucks have notable and high penetration charging build-out.

Long haul charging infrastructure build-out is extremely low. Eighty one percent of long haul fleets have little or no infrastructure. Miles per charge is still low and charging time too long to make economic sense for long haul trucks. The jury is still out on whether electric batteries or fuel cell electric vehicles will emerge as the leading technology for this class. Respondents were evenly split on whether hydrogen/fuel cells will become the better source of clean fuel for vehicles in the future.

## Utilities are Receptive to CEV Build-Out

The utility industry has more experience with public, home and workplace charging than with fleet charging. Survey results




Source: T&D World Business Intelligence Report "Utility Plans and Preparedness for Commercial Electric Vehicle Adoption."


DAF CF Hybrid and Electric trucks. DAF Trucks is a division of Paccar and has its headquarters in Eindhoven, The Netherlands. Photo by VanderWolfImages, Dreamstime.

reveal that 44% of utilities have built charging infrastructure in their service territories but not necessarily for CEVs. EV infrastructure has largely been at the distribution level with minimal investments in distribution lines and transformers.

Fleet charging is relatively new, although utilities do have practice with electrifying their own fleets. Since 2020, over a dozen IOUs have announced plans to electrify their fleets, motivated by lower TCO and emission reductions. CEVs may not be ideal for all vehicle classes. Utility fleets are diverse, including emergency vehicles that depend on being charged during outages, service trucks that make local runs, and bucket trucks that require electricity to operate machinery. Advances in technology may address these issues in the future.

Most of the survey respondents are receptive to enabling CEV vehicles in their service territories. Utilities have a positive view of the reliability benefits of CEVs and believe that CEV growth will not disrupt utility operations.

There is not general agreement about what role utilities should play, however. While 47% of respondents believe that utilities should collaborate with fleet owners to develop infrastructure, 37% believe utilities should be responsive to EV charging infrastructure needs, but not a collaborator involved in the EV transition decision.

Beyond collaboration, 29% of respondents believe that utilities should promote the transition to EVs by providing financial incentives to fleet owners. The Large group is more interested in providing incentives than smaller utilities. In addition to the make-ready programs mentioned above, utilities may provide rebates for Level 2 (L2) and DCFC chargers.

There is also a role for utilities as trusted advisors. Technical assistance programs have been established by utilities such as DTE Energy, Consumers Energy, National Grid, Southern California Edison, Pacific Gas & Electric, Eversource, Oncor, and Pacific Power. Typically, utility fleet technical assistance programs provide no-cost advice that helps fleet owners understand the costs and benefits of fleet charging.

## Funding for Required Infrastructure is the Most Critical

Required infrastructure (57%) and who will fund it (54%) are the most critical challenges utilities expect to face when building

out CEV infrastructure. However, not all of the resources utilities are pursuing will cover CEV infrastructure.

Utilities are seeking funding from government sources, utility customers, and bond initiatives. Funding is also being used to help cover upfront costs for fleet owners, either directly through incentive payments for chargers and other equipment, or indirectly through bill credits.

Local, state and federal programs are the most sought-after source of funding. Forty-two percent of utilities are looking to government resources to fund EV infrastructure. Governments offer tax credits, grants, rebates, and/or loans for chargers and EV infrastructure. According to the American Council for an Energy Efficient Economy (ACEEE), 17 states offer incentives for L2 and DCFC chargers. While these funds may not move from utilities to fleet owners, CEV technical assistance programs run by utilities can be instrumental in helping fleet owners/operators identify state or federal incentives for L2 or DCFC chargers and related equipment.

Utilities likely will not obtain Federal Infrastructure Investment and Jobs Act funds to cover private fleets. Twenty-two percent of respondents indicated that they will be pursuing this funding. The act provides an estimated $5 billion for EV infrastructure over 5 years. However, the lion's share of the funding is allocated to charging that is accessible to the public.

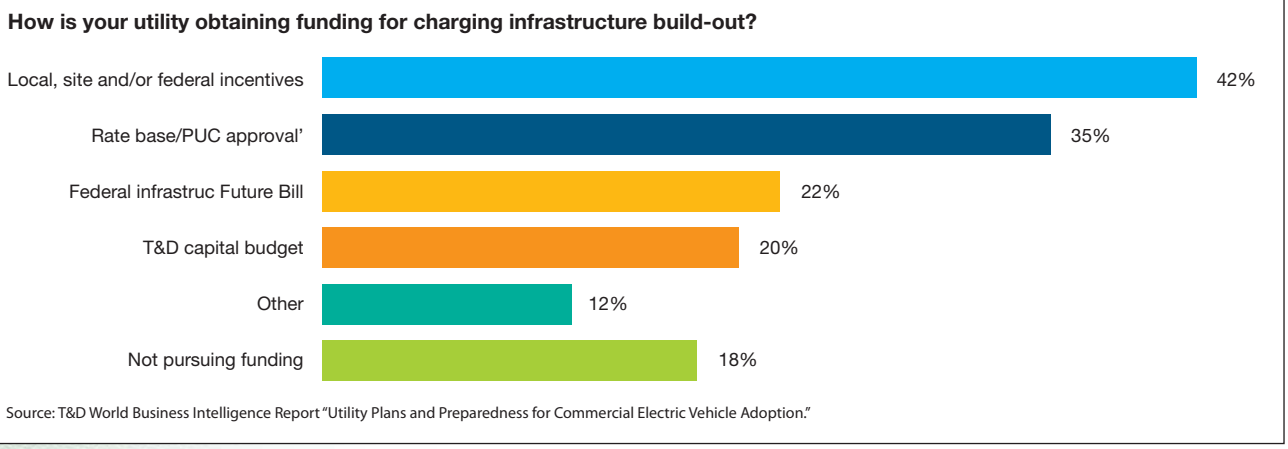
## Charging Pattern Information

In planning for CEVs, fleet owners will need to be prepared for questions from utilities. Utilities use this information, along with grid data, to assess where the existing lines may need upgrades to serve EV charging load. Take the example of a company proposing to build a warehouse that has a charging depot for medium duty electric trucks. Ten medium-duty trucks charging overnight would require 70 kW. To charge those same trucks in nine minutes with DCFCs would take 1.75 MW and the need for an upgrade.

Utilities are most interested in fleet charging patterns – when will vehicles charge, will charging happen at centralized depots, how many vehicles will be charging, what are the best locations for charging along CEV routes.

The time of day vehicles will charge is the most critical information. Over half of utility respondents (53%) said that time of charge is very or extremely important; 28% found that data to be important. Utilities need this information to assess whether the existing capacity of distribution is sufficient to accommodate EV charging when there is major other load on lines feeding the area.

Only 12% of respondents think that obtaining information from fleet owners about the best locations for charging along CEV travel routes is critical. At the same time, almost half of utilities report difficulty in seeking optimal locations for CEV charging. Forward-looking utilities want to collaborate with fleet owners to develop data on in-route and depot charging patterns. Expect to see more emphasis on travel patterns in the future, including miles between charges, where and how long vehicles "dwell" to charge.




## Fleet Planning

Charging patterns are critical for fleet owners to understand as well. This information will help fleet owners evaluate the TCO and return on investment. In addition to the capital expense (vehicle purchase, the charging infrastructure in front and/or behind the meter), there are operating costs, which are particularly sensitive to energy price.

Commercial billing rates typically include demand charges. Demand charges are calculated based on the highest level of electricity used in a period of time. Utility demand charges are often assessed at different rates depending on the time of day and/or season in which electricity is used. For example, a medium duty charging depot serving a dozen vehicles could have demand charges of over $2,500 per month in some jurisdictions. It will be important for fleet owners to understand the impact of demand charges on operating expenses.

Depot charging – where vehicles return to the station to charge at the end of the workday – is an area where managed charging makes sense. Iterative charging vehicles are programmed to charge at different times, which can reduce charging peaks.

The more CEVs that charge at the depot, the higher the annual energy charge. Some utilities offer time-of-use (TOU) rates for energy consumption to encourage charging at times of the day when there is excess electricity supply, such as wind

and solar. There are also managed charging programs that allow the utility to control charging in return for lower rates or other incentives.

## Ramp-Up Will Require More Outreach

Over three quarters of utilities are involved in activities to promote build-out of CEV infrastructure. A majority of utilities have at least started conversations with fleet owners in their service territory.

Surprisingly, less than a quarter of utility respondents report that C&I customers have contacted their company to discuss electrifying their fleets. It may be that respondents to the survey were unaware that C&I customers have attempted to find out more about electrification. At early stages of any program, it is possible that account representatives have been contacted by C&I customers about a topic, but systems are not in place to record and report those contacts.

With a few exceptions, utilities do not have business units or cross-unit collaborations dedicated to planning and implementation of CEV charging. The roles and tiles of respondents of this survey may be reflective of an early state of maturity. Eighty-four percent of respondents are individual contributors or manager/supervisor level. Engineering and design personnel make up the largest group of utility respondents.

## Looking Toward the Future

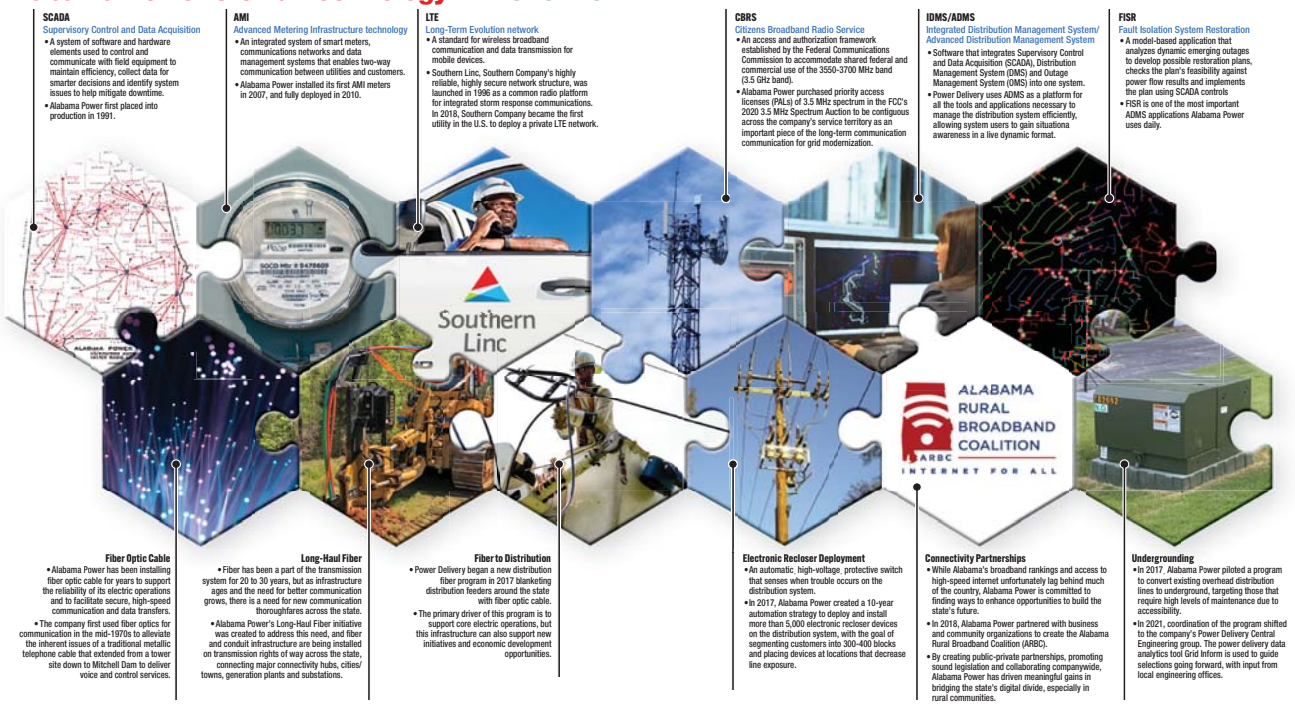
Utilities and fleet owners, along with EV network service providers have a better chance of understanding the potential impact of fleet charging when they collaborate, especially if fleet owners are considering deploying clusters of depots or using publicly available DCFC charging stations in the utility service territory. The good news is that 36% of respondents say that their utility is already coordinating with other entities that plan to install charging stations.

In preparing for the future, forward looking utilities and fleet owners are discussing the question of who pays for major infrastructure investments. At issue is whether early adopters of fleet charging depots should bear the cost for utility side infrastructure, while later depot installations on the same feeders will benefit from those grid improvements at lesser cost. From the utility perspective, it would be less expensive to build capacity that accurately anticipates increased demand on feeders, rather than having to incur additional costs associated with capacity expansion on the same feeder at a later date. From the early fleet owner adopters' perspective, it would be better to share the cost of infrastructure with fleet owners who, in the future, wish to develop depot charging that is connected to the grid in that location.

**Editor's Note:** This article is a summary of an Endeavor Business Intelligence Report titled "Utility Plans and Preparedness for Commercial Electric Vehicle Adoption." *T&D World* deployed a 25-question survey to only its utility subscribers to determine where the industry stands on charging infrastructure roll-out for commercial electric vehicles. The full report, including graphs and charts, is available at no cost to qualified readers at *https://tdworld.com/21257787*. TDW

A comprehensive puzzle

## Alabama Power's Grid Technology: An Overview




# Dynamic Data, Technology Drives Grid Improvements

Alabama Power uses a complex mix of technology, infrastructure and data to operate a smarter, more resilient electric grid.

By **JESSICA NISSENBAUM**, Alabama Power

With 116 years of experience providing affordable, reliable electricity, Alabama Power, a unit of Southern Co., has a history of leveraging technology to improve its operations. Since the 1980s, the utility has added to its mix of technologies and existing infrastructure — supervisory control and data acquisition (SCADA), long-term evolution (LTE) network, fiber, system automation, remote control, integrated distribution management system/advanced distribution management system (IDMS/ADMS), fault isolation and service restoration (FISR) — by using them in tandem to operate an advanced, efficient and reliable distribution system.

As Alabama Power works to strengthen its grid, manage the distribution system efficiently and cut restoration times, it relies on dynamic data. The utility uses ADMS software, which integrates the SCADA, distribution management system (DMS) and outage management system (OMS). This provides a platform for all the tools and applications necessary to enable system users to gain situational awareness in a live, dynamic format.

One of the most important aspects of ADMS is FISR, a model-based application that analyzes emerging outages to develop restoration plans, checks plan feasibility against power flow results and implements the plan using SCADA. Since its inception at Alabama Power in 2018, FISR has been a catalyst for improving restoration efforts. It has helped to significantly reduce the customer minutes of interruption (CMI) and system average interruption duration index (SAIDI). With FISR, the utility has avoided more than 237 million CMI and improved SAIDI in 2021 by almost 12%.

## Power Delivery Data Analytics

In 2019, Alabama Power established a power delivery data analytics (PDDA) team to serve as a support organization. This team uses data to create actionable insights that drive innovation, promote improved system performance and increase customer satisfaction, while responding to shifting landscapes in the industry and inputs from end users and customers.

"We're combing through real-time system data and analyzing it to identify assets that are the least reliable for our customers and have the most operations and maintenance costs, and then addressing those areas with smarter capital deployment strategies," said Shane Powell, manager of data analytics and connectivity at Alabama Power. "It's a major win for our customers, our employees and our system."

By leveraging rich data sets from ADMS, advanced metering infrastructure (AMI), FISR, geographic information systems, accounting systems and fiber systems, the PDDA team ingests, analyzes and visualizes data to produce insightful and actionable analytics for the overall system.

One such use case was creating a methodology to predict reliability performance and operational costs at a granular level across the system for both present and future states. These insights are used to suggest targeted deployment of capital investments on the lowest-performing assets, allowing improvements in reliability and reducing operation and maintenance costs.

Alabama Power has developed new initiatives on its transmission system to further the fiber footprint throughout Alabama. Photo by Daniel Chetroni, Dreamstime.

## SCADA Development

Alabama Power began developing a distribution SCADA system in the mid-1980s, primarily supporting substation equipment. After two pilot programs, a system (now owned by General Electric) was placed into production in 1991 and the project was expanded to automate line devices in addition to the distribution substations.

The initial SCADA deployment gave real-time visibility into the grid and enabled remote operation of devices traditionally operated manually. In 2017, Alabama Power began upgrading

The utility's power delivery organization began a program in 2017 to blanket distribution feeders around the state with fiber-optic cable. The primary driver of this program is to support core electric operations, but this infrastructure also can support new initiatives and economic development opportunities. Photo by Alabama Power.

its SCADA communications to long-term evolution (LTE) over Southern Linc, Southern Co.'s wireless, push-to-talk communications network. This upgrade moved SCADA to a more secure protocol on a private network, where it could take advantage of Southern Linc's reliability.

Today, Alabama Power has nearly 800 automated distribution substations and 9000 distribution line devices online.

## AMI Technology

After many years of testing and large proofs of concept, Alabama Power selected Sensus Flexnet as its AMI technology in 2006. Flexnet is a two-way, fixed-base AMI network that uses licensed spectrum and purpose-driven protocols for electric, gas and water metering. Deployment of Alabama Power's 1.5 million electric AMI meters started in 2007 and was completed in 2010. Since deployment, the utility has used its AMI technology to fundamentally change the way it bills customers, forecasts revenues, monitors the distribution system and restores power.

A meter is more than just a device to register power; it is intelligence equipment that provides customers with smart insights, a distribution sensor that has awareness of all distribution anomalies that could impact reliability and a revenue meter that provides customers the ultimate flexibility on when and how they use energy.

With this strategy, Alabama Power aims to change how the industry thinks about AMI meters and establish what is possible for the future, gathering functional requirements for the next generation of AMI.

"We continue to find opportunities to use AMI data to enrich our existing business processes and analytics efforts," said Brandon Lundy, AMI management systems manager at Alabama Power. "In many ways, AMI data symbolizes our customer; it is the demarcation between our distribution system and our customers' experience."

## Undergrounding Strategy

Beyond using dynamic data to improve restoration efforts, Alabama Power is making significant strides to improve service and reliability in communities across the state of Alabama by replacing overhead power lines and equipment with underground lines, where appropriate and feasible.

In 2017, Alabama Power piloted a program to convert certain existing overhead distribution lines to underground, targeting those that required high levels of maintenance because of difficult accessibility. In 2021, coordination of the program shifted to the utility's power delivery central engineering group. The team uses a data analytics tool, called Grid Inform, to guide selections with input from local engineering offices.

With two primary types of projects now in line — rear-lot residential and single-phase, high-vegetation management radial lines — the goal is to improve reliability and cost savings.

## Increased Automation

In conjunction with a robust undergrounding strategy, Alabama Power is increasing the number of protective devices on a given distribution feeder, reducing the number of customers between protective devices and, ultimately, the number of customers impacted by an outage.

Automation has been on Alabama Power's distribution system since the 1990s. Since then, the utility has continued to increase the amount of automation through different initiatives and programs, such as the Smart Grid Investment Grant (SGIG). In 2017, the utility created a 10-year automation strategy to deploy and install more than 5000 additional electronic recloser devices on its distribution system.

The goal is to segment customers into blocks of 300 to 400 and place devices at locations with decreased line exposure. Increasing

the number of electronic reclosers will give system operators and FISR more options to keep customers protected from sustained outages.

Another piece of this automation strategy involves dropout reclosers. By installing these types of devices in place of fused cutouts, permanent outages caused by temporary faults can be mitigated, leading to improved reliability and cost savings.

## Improving Connectivity

Alabama Power first used fiber optics for communication in the mid-1970s to alleviate inherent issues of traditional metallic telephone cable that extended from a tower to Mitchell Dam.


In 1985, the utility entered the first of several joint-venture fiber-optic projects with commercial telecommunications carriers. Photo by Alabama Power.

In 1985, the utility entered the first of several joint-venture fiber-optic projects with commercial telecommunications carriers. These projects used the then-state-of-the-art technology of optical ground wire (OPGW) cable, replacing shield wire on electric transmission lines with a metallic conductor containing optical fibers in a central tube. The communication systems operating over these fibers provided enterprise voice and data communications between Alabama Power, its regional offices and Southern Co. affiliates, delivering enterprise and control communications to electric generating facilities located within reasonable proximity to the fiber routes.

"Alabama Power has been installing fiber-optic cable for years to support the reliability of its electric operations and to facilitate secure, high-speed communication and data transfers," said Suzanne Hoffman, Southern Co. Services telecommunications engineer.

## Two-Way Communications

Alabama Power's advanced grid requires two-way communications that enable dynamic customer engagement with resources distributed across the T&D grid.

Southern Co.'s LTE network evolved from a decades-old communications challenge — how to meet the mobile needs of the company across a large territory. Over the years, Southern Co.'s subsidiaries tried to meet this challenge by using individual two-way radio systems with varying technologies. While useful when meeting a specific utility need, there was no interoperability when operating companies worked together as a team. In 1993, Southern Communications was formed, launching the Southern Linc network in 1996. Following a tremendous amount of work by telecommunications professionals across the enterprise, in 2018, Southern Co. became the first utility in the U.S. to deploy a private LTE network.

In addition, Alabama Power purchased priority access licenses (PALs) of 3.5-MHz spectrum in the U.S. Federal Communications Commission's 2020 3.5-MHz spectrum auction to be contiguous across the utility's service territory as an important piece of the long-term communication strategy for grid modernization.

"Data demands on Alabama Power's grid are predicted to increase by eight times by 2030 due to longer-term communication needs," said Meredith Morgan, Alabama Power's data analytics and innovation engineer. "We're continuing to modernize how we meet these needs and provide energy to customers by deploying telecommunications infrastructure to support the grid."

## Long-Haul Fiber Initiative

Fiber has been part of the transmission system for 20 years to 30 years, mainly as OPGW. Alabama Power has developed new initiatives on its transmission system to further the fiber footprint throughout Alabama.

The utility's long-haul fiber initiative was created to address this need. Conduit, fiber and colocation infrastructure are being installed on transmission rights-of-way across the state.

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Long-haul communication thoroughfares connect major hubs, cities, towns, generation plants and substations. These new underground routes are in addition to existing and new OPGW projects on the transmission system, and they will eventually cover much of the state. Photo by Alabama Power.

Long-haul communication thoroughfares connect major hubs, cities, towns, generation plants and substations. These new underground routes are in addition to existing and new OPGW projects on the transmission system, and they will eventually cover much of the state, providing both critical communication routes for operational needs.

## Fiber to Distribution Program

In addition to fiber initiatives on Alabama Power's transmission system, the utility's power delivery organization began a program in 2017 to blanket distribution feeders around the state with fiber-optic cable. The primary driver of this program is to support core electric operations, but this infrastructure also can support new initiatives and economic development opportunities.

When it comes to supporting the distribution electrical system through traditional methods, only a finite number of devices can be installed on a given feeder and properly coordinated. Trip timing and coordination are no longer limiting factors when using high-density coordination (HDC) and fiber-optic connectivity.

"Not only is it important for Alabama Power's grid devices to have reliable, secure and resilient communications, it's just as important for control centers, engineering offices and facilities to have this same quality of communication," said Tommy House, Alabama Power's connectivity supervisor. "Whenever possible, Alabama Power makes an effort to get these locations on company-owned and -maintained fiber."

## Healing the Digital Divide

Alabama Power identified a problem it wanted to help its customers with: Alabama's broadband rankings and access to high-speed internet lag behind much of the U.S.

By creating public-private partnerships, promoting sound legislation and collaborating companywide, Alabama Power has driven gains in bridging the state's digital divide. By strategically using fiber deployments planned for the electric grid, the utility has identified an opportunity to serve as an infrastructure solution for telecommunications companies, specifically in rural areas.

While telecommunications companies often build in high-density areas that provide better financial returns, the electric utility business model focuses on delivering reliable service to all customers. Utilities have existing telecommunications infrastructure — including spectrum and fiber — that can be used to serve customers in rural, suburban and urban areas alike.

"Alabama Power's fiber strategy makes its grid smarter, more reliable and resilient for customers, while providing an asset to help facilitate the expansion of broadband services to our service

territory," said R.B. Walker, Alabama Power's director of legal affairs. "Much like every corner of Alabama benefited from the expansion of electricity, connectivity can create the same opportunity and accelerate the foundation electricity built."

However, transformational change cannot be made alone. Alabama Power actively sought internal and external partners to help lay the proper groundwork and develop policies to facilitate this change. Externally, a 30-member coalition worked to help pass state legislation to bring more companies on board to connect Alabamians.

Each fiber deployment builds surplus capacity, providing an extra asset that can be crucial to bringing high-speed internet to the "middle mile." Alabama Power recognized it could play an important role by partnering to use its middle-mile infrastructure as the backbone network for telecommunications providers' service builds. These broadband partnerships cover the costs of grid enhancements, providing customers more reliable service without additional charges.

Beyond broadband expansion, Alabama Power continues to leverage partnerships to improve the customer experience and help communities and businesses across the state to live and work smarter. These include weather camera installations with the Barron Weather Institute, leveraging the existing AMI network for metering solutions and the development of outage alerts to provide real-time outage information to customers.

To meet customers' needs now and for generations to come, Alabama Power constantly enhances and modernizes its electric grid, investing in grid technology and improving resiliency.

"This comprehensive puzzle of engineering, technology, innovation and implementation…is something we've worked to develop for decades and are continuously working to enhance as we make smart investments for the homes, schools, businesses and industries who rely on us," said Grant Rogers, Alabama Power's connectivity supervisor

The grid is evolving rapidly with new technologies, new forms of generation and increasing customer demands on utilities. Innovation is critical to maintaining a reliable, resilient and secure electrical grid.

**Editor's note:** For more information on Alabama Power's grid resiliency efforts, visit *www.alabamapower.com/smart-energy/sustainability/resiliency.html.* TDW

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**JESSICA NISSENBAUM** is a senior communications specialist in Alabama Power's PR organization, specializing in internal and executive communications. She provides public relations and strategic counsel to internal stakeholders, including human resources, diversity, equity and inclusion, innovation, power delivery and crisis communications. She supports the management of the company's employee communications platform. Jessica has more than 14 years of professional PR experience, and has held positions in the energy, nonprofit, healthcare and franchising industries in both Atlanta and Birmingham.

Modern GIS software enables utilities to manage many aspects of their assets in a contextual, visual and map-based database. Instead of the static columns and rows associated with a traditional spreadsheet, information can be tied to a photo or visual image that links to associated media. Photo by Scott Prokop, Dreamstime.

# How to Leverage GIS Data

Web-based geographic information system software enables utilities to manage aspects of their assets in a contextual, visual and map-based database.

By **SARA LACEY**, Pepco, and **JAMES PARKER** and **DAVID TAYLOR**, Dewberry

Web-based geographic information systems are powerful tools, offering vital information for asset management and new capital projects. Today, utilities can access these data-rich resources for specific and evolving needs. Utilities of all sizes can benefit from purchasing rapid turnaround mapping solutions that provide exactly the data interpretation and analysis they need, for exactly the amount of time they need it.

Many consultants now build and host geographic information system (GIS) applications in a secure cloud environment for users such as utilities and municipalities. These agencies and organizations can access the geospatial and technology expertise they need to manage data and dashboards without the burden of system ownership, which saves time and money and keeps staff focused on operations. These web-based solutions can aid in documenting inspections, tracking maintenance schedules, managing outages and emergency response activities, and overseeing improvement and expansion projects.

## BYOD: Bring Your Own Data

Utilities own and manage a broad array of horizontal and vertical assets that require the doHOcumentation and tracking of large amounts of data, including asset type, location, size and age as well as important details about maintenance schedules and life-cycle status. A bring-your-own-data model enables utilities to upload or integrate their data into a GIS platform that is ready to go.

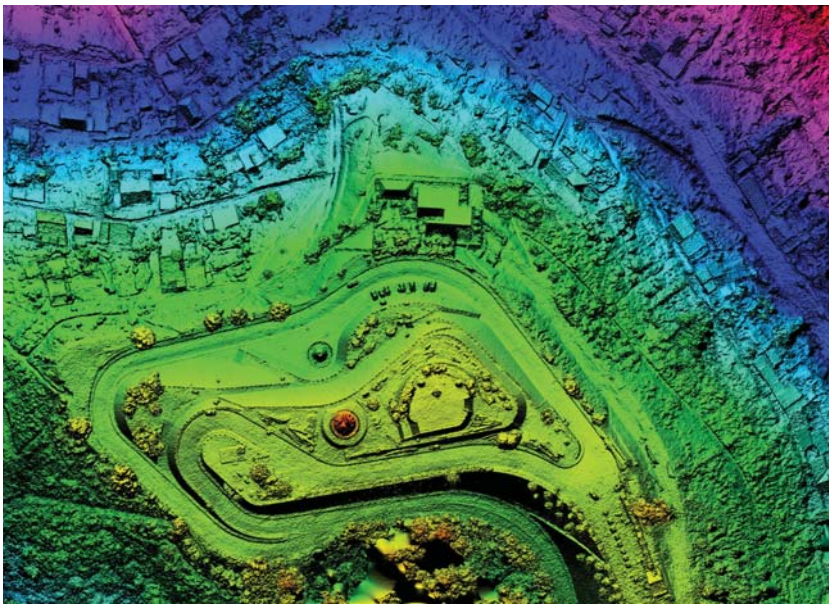
Within a few minutes, data can be loaded, visualized, analyzed and interpreted all inside a web browser. Behind the scenes, data can be encrypted, secured and backed up by the hosting cloud infrastructure. With web-based GIS, personnel will not lose time installing software, configuring licenses or waiting for the service desk to fulfill requests. In this way, utilities can leverage historical and unique data sets to gain context around these disparate variables.

Utilities can harness data in real time from today's vast ecosystem of mobile devices, interactive websites and open data systems with conversion tools that quickly and efficiently pull information into the application. While just a few years ago this step

might have required a significant investment of time to digitize or convert data, the process is much more streamlined today — automating data input from sources and formats such as computer-aided designs, imagery, as-built drawings and sensors.

Modern GIS software enables utilities to manage many aspects of their assets in a contextual, visual and map-based database. Instead of the static columns and rows associated with a traditional spreadsheet, information can be tied to a photo or visual image that links to maps, charts, statistics, associated media and reports. Information can range from large, multilayered data sets for enterprise asset management to project-specific data — for example, creating an inventory of substations to review best practices for stormwater management or planning for a distribution line extension to support new development.

A color-coding system can aid in ongoing system maintenance, enabling users to review schedules for a particular type of asset. For example, green map features might indicate substations are up and running, yellow might indicate maintenance is due within a certain time frame and red might point to the need for immediate attention. This digitized heat map can be instrumental in prioritizing schedules and allocating resources.



A digital rendering of Quito, Equador. Utilities can harness data in real time from today's vast ecosystem of mobile devices, interactive websites and open data systems with conversion tools that quickly and efficiently pull information into the application. Photo by Ammit, Dreamstime.

## One-Click Custom Reporting

A key feature of web-based GIS infrastructure is the ability to pull on-demand status reports. Single-click report generation can enable users to download formatted reports in seconds to Excel or a PDF. These reports can aggregate statistics across entire data sets or present preselected records. Dashboards

Heavy equipment delivers new distribution poles to workers performing outage restoration. Having a centralized tool with standardized processes for each project team to contribute to and work from helps create a clear picture of project progress and allows issues to be elevated efficiently and in a timely manner. Photo by William Morgan, Dreamstime.

can be shared with stakeholders in the office or the field.

Generated in a map-based context, reports can be customized to address specific information with predefined questions ahead of time. For example, the reports might help to track the staging and progress of a major capital project, such as the installation of a multi-jurisdictional transmission line involving numerous land parcels. With a single click, a user can pull up a dialog box to reveal the status of landowner negotiations and right-of-way acquisitions, permitting status, construction crew mobilization details, construction status and so forth. Layers of information, with pie charts, graphs and other details, can be assessed in multiple ways and help to monitor a project from the earliest conceptual phases to asset management once complete.

For large-scale capital projects, like planning, designing and installing transmission and distribution lines, there are often many moving parts and a robust level of coordination. Having a centralized tool with standardized processes for each project team to contribute to and work from helps create a clear picture of project progress and allows issues to be elevated efficiently and in a timely manner. Further, this allows the utility provider to see everything in one place, like data from contractors, consultants, and those representing the end-user, eliminating the need for individual reports from each stakeholder. Consistent and seamless data results in appropriate resource allocation, focused outreach efforts, and informed decision making.

## More Than A Map

Web-based GIS solutions serve many functions for utilities, from scheduling maintenance and facilitating field inspections to setting up automated construction status reports. The platform enables the management of multiple forms of media, including photos and video. Linear assets, such as overhead and underground transmission lines, can be reviewed in the context of associated development, such as roads, buildings, light poles, guardrails and so forth.

With GIS mapping, users can view assets in sections. Here again, a color-coded system can be helpful to represent current or planned maintenance or construction activities. The information can show where crews are or will be in upcoming weeks — important information to assist utilities in planning their community outreach and public notifications.

## Log In And Go

Utilities have demanding responsibilities, including keeping up with day-to-day operations, ongoing maintenance needs and capital projects. Whether organizations have limited in-house GIS capabilities or robust systems in place, the use of as-needed, web-based geospatial services can be a solution to keep projects moving along with information coded and customized to specific requirements. Once created, organizations can bring the database in-house as appropriate and export it for use by vendors, contractors and other stakeholders.

Because many projects occur over a multi-year period, sometimes as many as 10, it's critical to memorialize the project at each phase, allowing for new staff to have a clear understanding and visuals of the project's history. As staff turnover continues to occur for utility companies, contractors, and consultants, consistency in the data is key to seamlessly moving a project forward.

The power of web-based GIS lies in the ability to integrate the use of the platform with day-to-day operations and capital project planning. Energy providers and utilities can access the information on a 24/7 basis. Knowing their data sets are secure, reliable and easy to navigate, users can simply log in and go. TDW

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**SARA LACEY** is a senior manager, Smart Grid & Innovation, with Pepco Holdings (PHI), where she leads a team responsible for executing smart grid projects and programs, builds relationships with external stakeholders, and fosters a culture of innovation to implement cutting-edge, community-focused solutions.

**JAMES PARKER** is an associate and senior project manager with the consulting firm of Dewberry. He is a technologist with a passion for location analytics and spatial information management, and has served clients in energy and resources, power and utilities, and many other verticals.

**DAVID TAYLOR** is a vice president with Dewberry. He is the Commercial Utilities-Energy and Renewables lead and works directly with clients in all aspects of entitlements, acquisition, routing, planning, and engineering for power, gas, renewable projects.

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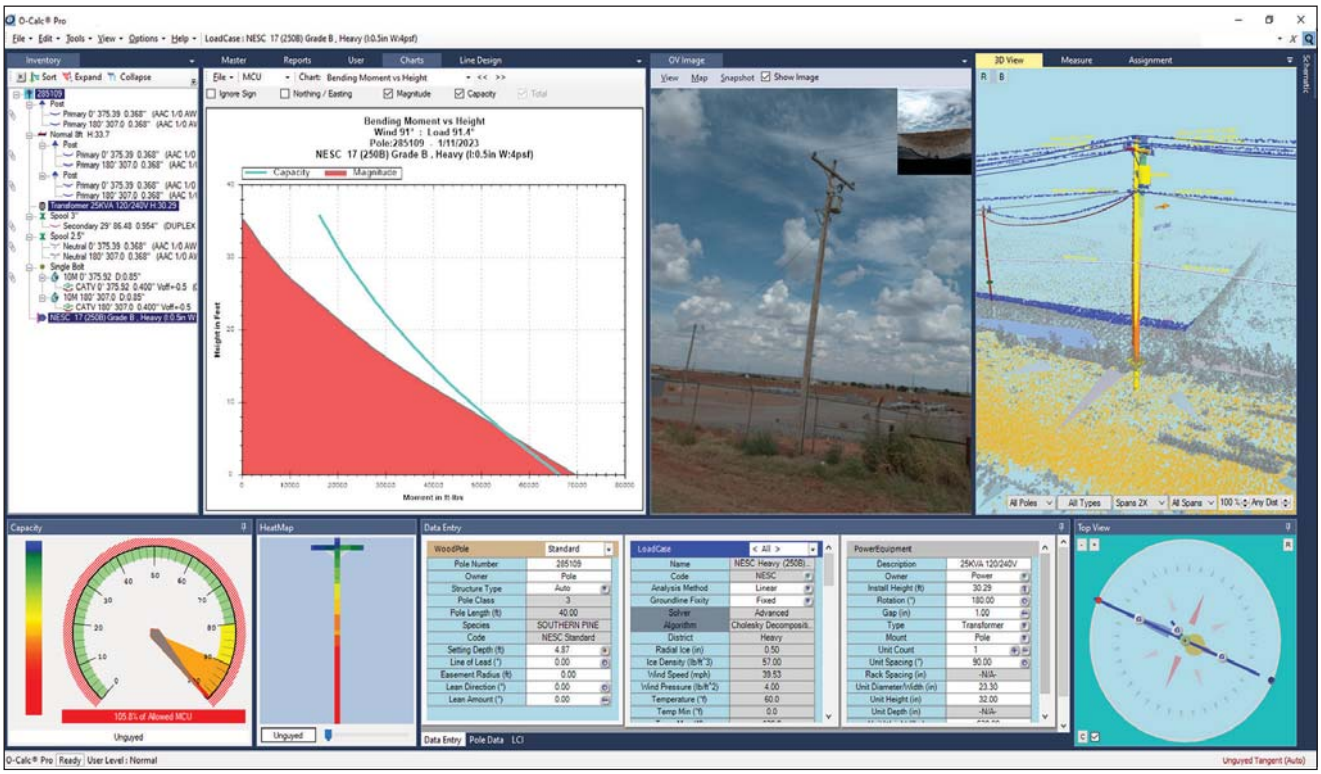



Screen shot of O-Calc Pro software used to conduct the pole loading analysis after data is collected in the field. Photo by Osmose.

# Building New Resilience In the Sooner State

Oklahoma Gas & Electric follows a four-step process to maximize value in making overhead lines more structurally resilient for its customers.

By **BOBBY SHAFFER**, OG&E

It is not so much when wind comes sweeping down the plains that is problematic for Oklahoma Gas and Electric Company (OG&E), but rather it is ice. An October 2020 ice storm that knocked out power to more than 300,000 customers was the kind of event that changed the way the electric company's asset management team looks at resiliency. The Sooner State experiences a significant ice event every decade or so, but this storm was unlike any the region had seen in a long, long time.

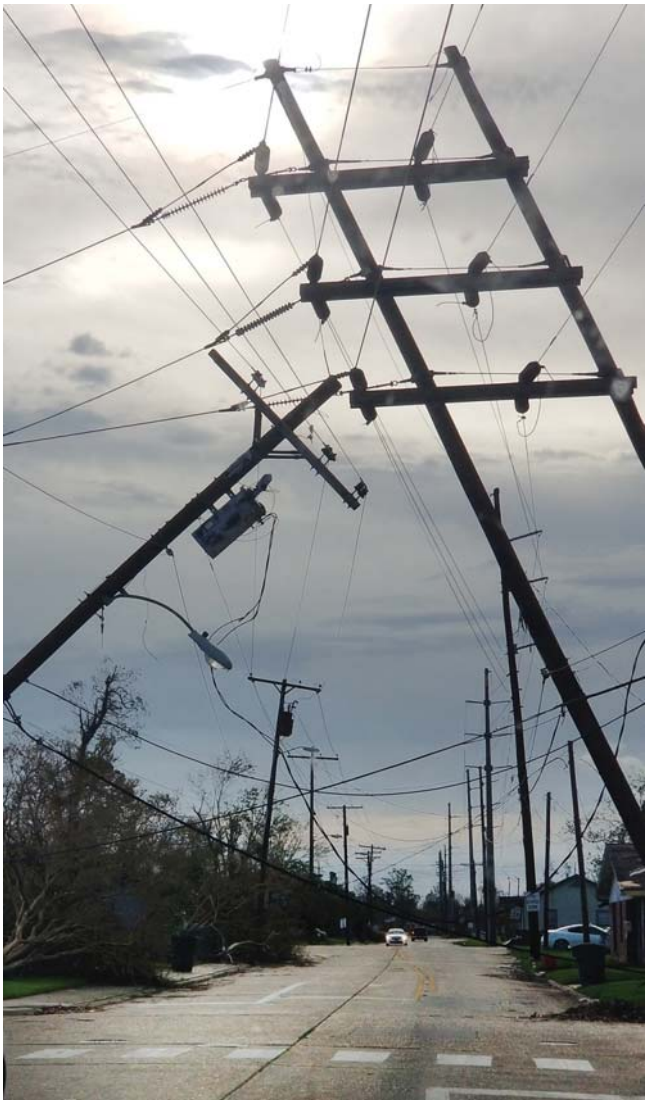
The University of Oklahoma warned students at its sprawling Norman campus to beware of "lightning-infested sleet and freezing rainstorms." A thick glaze of ice started to accumulate on roads, buildings, trees and power lines on Monday, Oct. 26, and continued to fall for two days. Gusty winds pulled down ice-covered power lines and trees, many of which were still fully in leaf because of the storm's early-season arrival.

The media reported on "tree carnage," with limbs falling incessantly over the course of several days. Forestry crews rushed to Oklahoma City National Memorial Park to prop up the ice-weighted limbs of the Survivor Tree, a memorial American elm that honors the lives lost in the domestic terrorist bombing at the Alfred P. Murrah federal building. Nonetheless, a major limb was lost on the beloved tree.

High-power lines came down across interstates, snarling traffic and cross-country shipping lanes across the heartland. Many surface roads remained impassable for weeks. It took OG&E four weeks to bring the last of its customers back on-line. Oklahoma ranks as one of the top states in the country for weather events and having more than one-half of OG&E's customers in the dark at one single time was completely unacceptable.

The areas where the company had replaced poles during prior storms saw several failures again in October 2020. OG&E had expected its newer infrastructure to be more resilient to the severe weather. In the months that followed, the company formed a team to examine the root causes of its grid challenges and answer the

Osmose crews installing a Tough Truss Extra to restore and strengthen a pole as part of a resiliency program Photo by Osmose.



Wood pole storm damage image taken by an Osmose employee. Photo by Osmose.

questions: What can be done to help customers have confidence their lights will remain on in major weather events? And if the power does go off, how could OG&E get it back on quicker?

## Customer Focus

The OG&E team wanted real resilience for the grid. The members needed to understand what changes could be made to reduce the severity of future events and shorten the duration of outages. The team thought it had all the necessary data: geographic information system data, span links information and loading analysis. The damage was assessed, numbers were crunched and results were reviewed. However, a complete load analysis of each pole appeared insurmountable.

In the end, the group committed to a deeper understanding of the grid, reassessing what it had been designed to withstand and what practical improvements could be made to improve its weather resilience.

The team sought to have customer-focused situational awareness of the system. It took inspiration from some of the Gulf Coast utilities that have been proactive, investigating and understanding the pole strength and structural loading of each asset in the field and what they can withstand.

With the ever-increasing frequency and intensity of hurricanes in its service area over the last decade, one major Gulf Coast utility shared how it had created a new model of grid resilience for its customers. Working closely with Osmose, this utility had performed an in-depth analysis of the weaknesses in its grid and invested in hardening its pole plant for the long run, building out a system to sustain winds up to 150 mph (241 kmph).

OG&E had experience working with Osmose itself. The company had been performing ground line reviews of transmission structures for several decades. OG&E then contracted with the company on a pilot project of distribution ground line inspections in 2019. Impressed with the company's technical expertise and diligence, OG&E engaged Osmose to support a more targeted approach to grid hardening.

Even with the many weather challenges in its territory, OG&E customers enjoy some of the lowest electric utility rates in the U.S. That is the result of an adamant focus by OG&E on finding and delivering value for customers. OG&E realized it could deliver the best value for customers by taking a more prioritized, data-driven approach to make the grid truly weather resilient.

Storms and severe weather are the No. 1 cause of downed power lines and power outages. Photo by iStock.

## Four-Step Process

After an onboarding process to understand OG&E's specific needs, Osmose rolled out a four-step process to maximize value in making overhead lines more structurally resilient for customers.

The first step involved detailed field data collection using OsmoVision, an Osmose-developed combination of field collection methods and integrated data-processing automation that enables efficient and accurate utility structure modeling. Using a combination of vehicles outfitted with GPS, light detection and ranging (LiDAR), and high-resolution imaging cameras and backpack tools for walkout inspections, Osmose technicians collected highly accurate and automated data for the territory. They went beyond the standard aerial shots and drive-bys. By adding a walkout format with advanced image and LiDAR capture tools in a package technicians could carry into Oklahoma's diverse terrain, they were able to capture data that exceeds the limitations of vehicle- or aerial-only information gathering. The advanced technology eliminated the need for more traditional and subjective measurement tool sets.

The second step included automated classification and image processing. Using the LiDAR data and imagery collected in step one, Osmose technicians were able to measure heights and distances between poles precisely, identify attachments and create a georeferenced database for all attached objects. Osmose's proprietary image-recognition tools created valuable automated information that fed pole models in Osmose's structural analysis engine, O-Calc Pro. This step was key to creating a complete picture of OG&E's existing grid and understanding where the accumulation of

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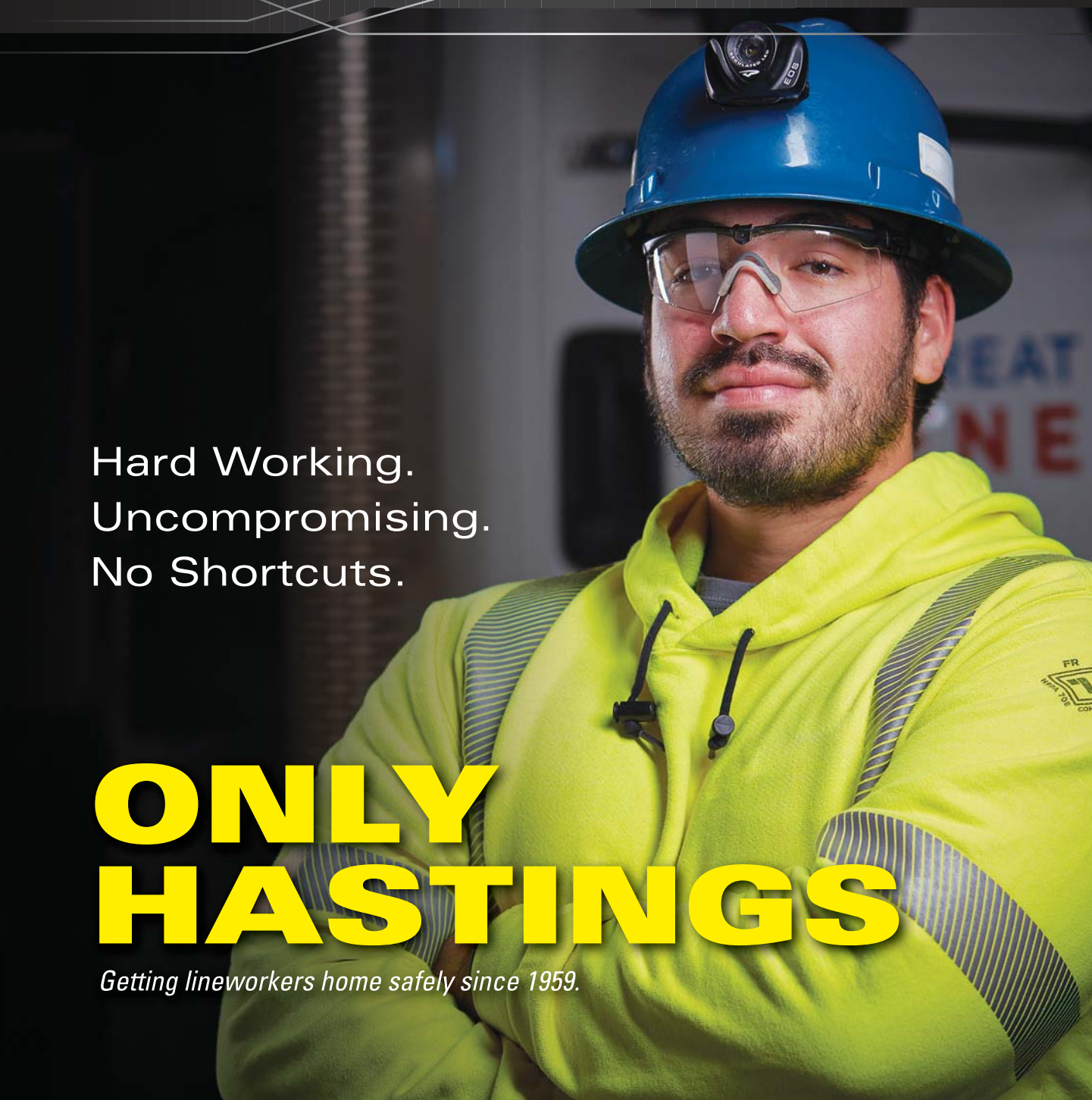

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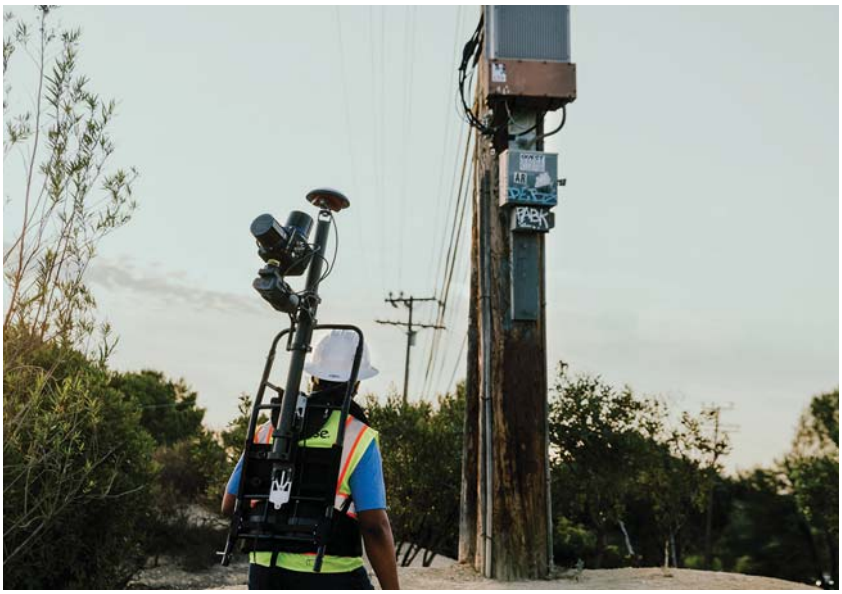
attachments on poles over the years could lead to overload.

In the third step, the O-Calc Pro tool was used to create a complete digital model of OG&E's pole network, including a comprehensive structural load analysis. The model enabled Osmose to prescribe effective solutions for any found conditions throughout the network and offer efficient remediation options. The model is stored in a secure pole loading database that can offer solutions for future work.

The fourth step provided a pole-by-pole recommendation, considering the remaining strength estimation performed during the evaluation and life-extension treatment process as well as the pole load analysis results. The resulting recommendations included poles that already exceeded the strength required for OG&E's design loads, poles that should be strengthened using engineered trussing systems and poles that require a stronger replacement. For each pole that failed OG&E's weather-hardening design criteria, Osmose provided a detailed prescription of the truss system and size required for strengthening the asset or which replacement size was recommended.



Osmose crew member using backpack OsmoVision technology to capture pole data that will be used in the pole loading analysis. Photo by Osmose.

## Savings And Safety

Even before the 2020 ice storm, OG&E's grid already met National Electrical Safety Code (NESC) standards for the region. However, to achieve the kind of resilience Oklahoma's evolving climate reality requires, the electric company must exceed those standards and provide value to its customers.

Although much of this work is ongoing, Osmose estimates it will analyze and harden more than 1200 line-miles (1931 line-km) for this initial effort, encompassing 38 circuits and roughly 49,000 poles. Of those, over a quarter are projected to require strengthening to exceed OG&E's new loading standards designed to improve resiliency. With Tough Truss installations on over 9000 of these structures, Osmose is estimating a cost savings of up to 65% percent, vs. replacing every identified pole. The pole replacement rate required to bring true weather resiliency to OG&E's customers is less than 5% of all poles evaluated.

Using the OsmoVision-collected and -processed data, Osmose pinpointed — even on newly constructed lines — which poles would need to be strengthened and prescribed solutions to exceed the prior OG&E pole loading standards, so the assets could better withstand the next major weather event.

Above the savings, safety is central to all OG&E efforts. It has the top safety rating in the Southeastern Electric Exchange and lets that drive its decisions. This applies to everything from how linemen are trained to the material choices for poles. OG&E is currently exploring composite T&D poles to avoid conductive metal infrastructure. As part of building greater grid resiliency, Osmose performed its standard ground-line strength evaluation of poles, which provided added reassurance for OG&E linemen in the field.

## Intelligent Approach

Beyond the improved resilience of its grid, OG&E has benefited by strengthening its customer-focused situational awareness of the system to continue providing reliable, life-sustaining, life-enhancing energy solutions. Initially when the team looked at the system, they thought everything looked good and wondered what was missing. After the review with Osmose, they could see what was needed where. Per weather hardening requirements, evaluations are showing that the system can be overstressed by extreme weather events.

The pole-by-pole digital model generated by Osmose using its OsmoVision tool set, O-Calc Pro engineering software and talented pole modeling technicians has given OG&E a deeper understanding of its grid and provided a road map for how to create its own model of resilience, not for tropical hurricanes but for Oklahoma ice storms.

The electric company is making adjustments and progress. Its new resiliency effort is confirming with data and analytics what it suspected, and it is leveraging all the information it has and the expertise of Osmose to make sure it is on the right path.

Based on this intelligent approach, OG&E has become an industry steward in future proofing its grid infrastructure, anticipating and building additional capacity, upgrading its assets for harsher conditions beyond basic code requirements, and preparing to scale to meet the needs of shifting customer demands and climate conditions. TDW

**BOBBY SHAFFER** (*shafferd@oge.com*) is the manager of Asset Management at OG&E. He has served in this position for the last four years. Prior to this he was the distribution reliability engineer responsible for asset lifecycle and reliability for the distribution system. His team designed and built the grid modernization and enhancement programs, business case analyses and benefits reporting as well as establishing rigorous methods for inspecting, tracking and determining system strength and resilience.

### For More Information

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# ELECTRIC UTILITY OPERATIONS

FEBRUARY 2023

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## Rapid Restoration After Nicole

# CONGRATULATIONS
## TO OUR FEBRUARY FEATURED LINEWORKER
# Kris Onda
## CORE Electric Cooperative

- Born in Silver City, New Mexico.
- Married to his wife, Marcia, and has a three-year-old son, Kyle.
- Enjoys hunting, being outdoors and going fast in hot rods like Mustangs. He also enjoys showing his son the world and giving him new experiences.
- Tools I can't live without: his hooks and the extendo hot stick.
- Competed at the International Lineman's Rodeo.
- Is the first one in his family to work in the trade.

Kris Onda says one of the best attributes of his job is being there for the cooperative's members and supplying them with electricity.

### Early Years

As I was finishing my bachelor's degree in criminal justice and policing, I worked maintenance on conveyor belts for Freeport McMoRan in Morenci, Arizona. At that point in time, I wasn't sure whether I wanted to go into law enforcement or stay working on the belt lines. I learned about line work from a journeyman lineman I met at a get-together with friends. He told me that while it's not an easy job, if you like climbing high, working hard and feeling accomplishment at the end of the day, it's the job for you. With some prior experience, I was able to land an entry position on the line crew. The adrenaline from climbing a 110-ft pole, being 200 ft up in the air over a benched high wall in the pit of the mine working on power lines or hauling poles around the giant haul trucks in the mine was so intense.

### Day in the Life

I am a second-step apprentice for CORE in Conifer, Colorado, and I am responsible for getting parts stocked up on the trucks, icing up the coolers and keeping equipment and vehicles cleaned up and ready to roll. On a typical day, we set new poles, hang transformers or respond to outages. We are also upgrading our system with wildlife and fire mitigation equipment and replacing old equipment, hardware and insulating wire to try and keep everything as reliable and safe as possible.

### Challenges and Rewards

The major challenges of my job consist mostly of terrain and weather. In our service territory, some houses are built on the steep mountains, and mixed with 75 mph winds, trees, snow, ice, and the public, you never know what might happen. The rewards always come through when you can get the members' power back on. I remember one time we had a big storm hit and had a couple thousand people out of power. We responded to a single outage down this dirt road in the forest. When we started clearing the trees from the service wire and respliced the broken phase, an older gentleman came out to say thank you. His oxygen would have run out had the power been off any longer. It felt good to know we really helped him out.

### Safety Lesson

Job-site safety has always been important to me and my coworkers, but it wasn't something that really hit home until I had my son. The importance of him growing up with a dad and being able to be there for him every step of the way has really shaped my safety culture now. I want to be the best dad I can be and getting home every day to him is where it starts. I always try to think about the outcome of every move, and I am not afraid to ask for help or stop a job if I feel it is unsafe.

### Memorable Storm

My most memorable storm memory was when 18 in. of snow fell in Colorado, and we worked all night to get the power back on. A tree fell on top of a power line, and I had to tread through the snow into the fast-moving shallow river to cut the tree out of the line. Fuses were blowing all over the place due to the snow load, and trees were falling on lines and snapping poles. Our office plus linemen from three districts worked together to get our members back on as soon as possible.

### Plans for the Future

I look back and think about if I had only gone into the power industry sooner. When I was graduating from high school, everyone was so set on pushing kids into college and getting a degree. I never heard about trade schools, and if I would have gone straight into line work, I would be a lot further in my career. I hope to one day go into management and learn the other side of the operations, but that's many years down the road. I have had many great mentors, and this trade is filled with so many good people who only want you to succeed. The camaraderie and relationships you build will last a lifetime. This field isn't easy and having the support from everyone makes a huge difference. TDW

**Editor's Note:** If you are interested in being profiled in our monthly Lifeline department or know of a journeyman lineman who would be a good candidate, email *T&D World* Field Editor Amy Fischbach at *amyfischbach@gmail.com*. To thank linemen for their dedication to the line trade, Milwaukee Tool sends each profiled lineman a tool package.

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# Line Crews Unite to Rapidly Restore Power After Nicole

## Duke Energy Florida minimizes the hurricane's impact through proactive planning, teamwork and technology.

By **AMY FISCHBACH**, Field Editor

Hurricane Ian roared into Florida as a Category 4 storm in late September. Just a few weeks later, at around 3 a.m. on Nov. 10, Nicole made landfall as a Category 1 hurricane on Florida's east coast. It then moved through the state as a strong tropical storm.

While Nicole inflicted less damage to Duke Energy Florida's infrastructure than Ian, the storm still impacted a large portion of the utility's service territory. As the first hurricane to make landfall in Florida in November since 1985, Nicole brought damaging rain and heavy winds to Duke Energy's service territory.

Line crews from Duke Energy's Wildwood Operations Center in north-central Florida work to restore power to a neighborhood in Sumter County, Florida.

"Every storm is different with the damage it brings," said Barry Anderson, Duke Energy Florida's senior vice president of customer delivery. "After Nicole, we saw downed power lines due to trees and some broken poles."

In the aftermath of Nicole, crews rapidly responded and restored nearly 300,000 of the impacted customers within 12 hours. To get the lights back on swiftly and safely, it required year-round planning and training combined with sustained investments in a stronger, smarter, more storm-resilient energy grid.

"While we did not anticipate a hurricane so late in the season, our team didn't hesitate to respond and support our customers," said Anderson. "Nicole impacted a large portion of our territory, and the incredible team effort helped us restore 98% of our impacted customers within 12 hours of Nicole leaving our service territory."

### Planning Ahead

To take a proactive approach to storms like Nicole, Duke Energy Florida focuses on preparedness year-round. In turn, the utility can minimize the impact of storms and ensure the safety of its customers, communities and crews.

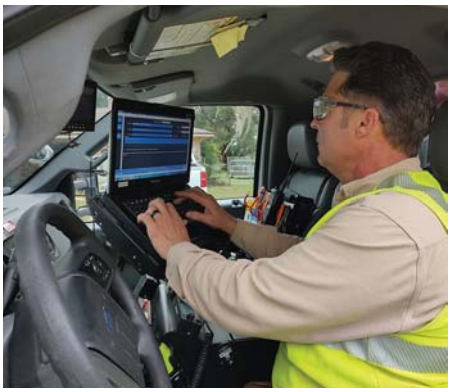
Duke Energy has a comprehensive storm response plan built upon decades of experience and improvement. Advanced forecasting and damage modeling processes help the company strategically place crews, support resources and equipment ahead of the storm to respond quickly as outages occur.

For example, a team of meteorologists track weather conditions and models resource needs to ensure the utility is prepared to react quickly when the power goes out. Prior to every storm, the company also ensures that equipment, supplies and inventories in all areas that could be impacted are readily available to make necessary repairs and restore power outages.

For Hurricane Nicole, Duke Energy Florida's logistics team supported placement of workers across the state to respond quickly and safely

once the storm passed. These crews came from Duke Energy's Ohio, Kentucky and Carolinas operations — as well as workers from other utility companies based in Arkansas, Georgia, Louisiana, Missouri, Tennessee and Virginia, among other states.

"Our team was well-prepared and poised to respond to Hurricane Nicole with more than 5,000 workers — power line technicians, damage assessors, vegetation workers and support personnel — across the state ready to respond to power outages," he said. "Many of those workers came from as far as the Midwest, Louisiana and the eastern portion of the country to answer the call to assist Duke Energy Florida in getting the lights back on for the customers."



A Duke Energy trouble technician uses technology to update the outage management system and get his next assignment.

During every storm, the utility's first priority is to restore power to the greatest number of customers as safely, quickly and efficiently as possible. For Hurricane Nicole, Florida-based crews, along with the reinforcements, helped speed restoration. "With significant progress made during the first day the storm made landfall, the company was able to place a greater concentration of crews in areas where the impacts from the storm were still being felt," Anderson said. "Along with additional crews, the company was helped by its recent improvements to the grid, minimizing outages and restoration times."

## Expediting Restoration

After every storm, safety is the utility's primary concern. Restoration cannot begin until the storm has passed and the workers can safely access impacted communities. For Hurricane Nicole, strong winds posed a particular challenge. For employee safety, crews didn't perform elevated work in bucket trucks when winds were above 30 miles per hour. "As the storm made its way through our service area and weather conditions improved, crews began damage assessments and repairs right away," Anderson said.

The company's damage and resource modeling enabled Duke Energy Florida to stage crews near areas that would likely be affected by this system. "This allowed for the quickest and safest response after the storm passed through our service territory," Anderson said.

Damage assessment, which is the first step of storm restoration, not only involves ground crews, but also aerial surveillance helicopters and drones in hardest-hit areas. That assessment determines where the company will deploy its workers, equipment and other resources to begin

From left to right: Trouble technicians David Hines and Mike Haworth from Duke Energy's Ocala Operations Center in Florida check a fuse in a local neighborhood while restoring power following Hurricane Nicole.

More than 800 trucks mobilized at the Villages in Sumter County, one of many staging sites across Florida used to house crews from Duke Energy and other utilities. These sites served as critical resource centers to move crews and equipment to areas hit hardest after Hurricane Nicole's impact.

the complex job of power restoration once the storm passes.

After a storm, previous technology forced crews to physically inspect miles of power lines to ensure that everyone's power was restored, which was time consuming, Anderson said. Today, Duke Energy Florida crews can use a technology called Ping-it to remotely confirm an outage in seconds. Ping-it sends a signal to each smart meter to ensure that repairs successfully restore electricity to everyone, without ever rolling a bucket truck. In Florida, Duke Energy has installed nearly 2 million smart meters that enable this technology.

Additionally, the company continues to invest in enhancements such as self-healing grid technology, utility pole and power line upgrades and targeted undergrounding of power lines to reduce power outage frequency and duration during extreme weather events and to enhance overall reliability.

## Investing in Technology

Duke Energy Florida is making strategic improvements across the state to strengthen the grid against outages from severe weather. In addition, the utility is striving to improve resiliency to restore power faster when outages occur.

"Grid strengthening work further enhances Duke Energy Florida's storm response," Anderson said. "The company installs stronger poles and upgrades wires, places outage-prone lines underground, trims vegetation near power lines and installs self-healing technology that can automatically detect power outages and reroute power to other lines to restore power faster."

Much like a GPS can reroute traffic during an accident, self-healing technology can automatically detect power outages and quickly reroute power to restore service faster or avoid the outage altogether. The technology provides a smart tool to assist field crews with restoration after a storm like Nicole, helping reduce outage impacts and freeing up resources to help restore power in other locations.

"Over the years, Duke Energy's smart, self-healing technology has provided tremendous benefit to Florida customers," Anderson said. "Duke Energy currently serves nearly 60% of customers in Florida with self-healing capabilities on its main power distribution lines, with a goal of serving around 80% over the next few years."

Case in point: during Hurricane Nicole, the technology automatically restored around 55,000 customer outages, saving 13.4 million minutes of total outage time. During Hurricane Ian, the technology automatically restored more than 160,000 customer outages and saved nearly 200 million minutes of total lost outage time.

Prior to that in 2021, self-healing technology helped avoid nearly 285,000 extended customer outages in Florida, saving around 17.1 million minutes of total lost outage time.

Additionally, Duke Energy Florida has reduced the average amount of time a customer experiences an outage by about 20% over the last five years, according to the System Average Interruption Duration Index (SAIDI), which indicates the amount of time the average customer experiences a sustained outage.

## Focusing on the Future

Another key to Duke Energy's ability to streamline and expedite restoration is partnering with peer utilities, which provide additional resources to shorten response times and get communities back on their feet faster.

To build a smarter energy future for its customers and plan ahead for storms like Hurricanes Ian and Nicole, Duke Energy Florida is focusing on investing in innovative technology, hardening or undergrounding critical grid infrastructure and continuing to perform vegetation management activities throughout the year.

"The back-to-back storms we experienced this season serve as strong reminders of the importance of grid hardening and storm preparedness to help keep the lights on for our customers," Anderson said. TDW

**AMY FISCHBACH** (*amyfischbach@gmail.com*) is the field editor for T&D World magazine.

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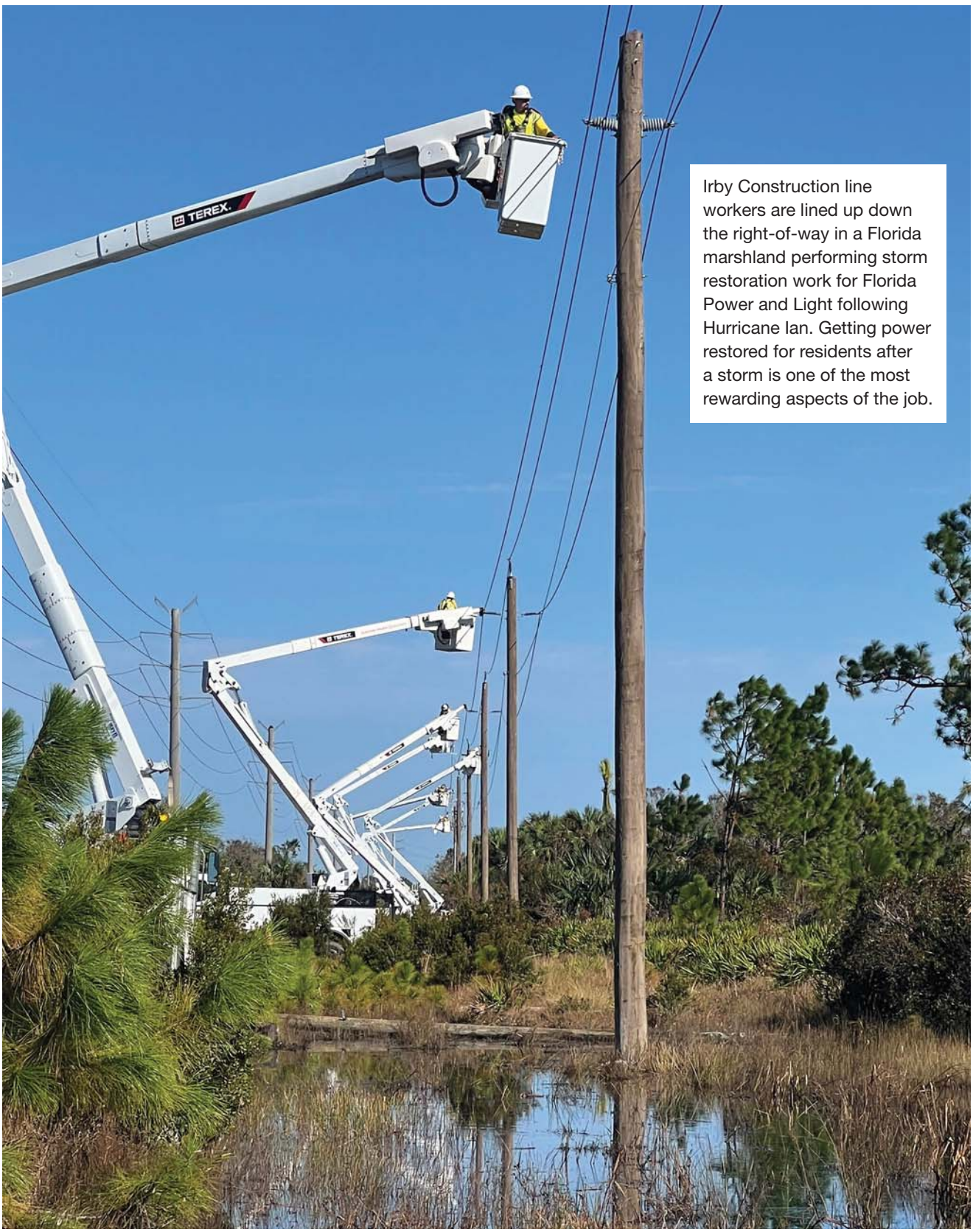
Photo by **GLEN REGISTER**, Florida Power and Light




Irby Construction line workers are lined up down the right-of-way in a Florida marshland performing storm restoration work for Florida Power and Light following Hurricane Ian. Getting power restored for residents after a storm is one of the most rewarding aspects of the job.

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400 kV Tower prototype test arrangement in factory of Confidence Steel Ltd. based in Narayangang, Bangladesh. Photos by Power Grid Co. of Bangladesh Ltd.

# Bangladesh Builds 400-kV Transmission System

The government's strategic plan includes establishing several power hubs in the southern part of the country.

By **MD. SHAFIQUE RAHMAN**, Power Grid Co. of Bangladesh Ltd.

The fast socioeconomic development in Bangladesh during the last decade has accelerated the demand for energy, leading to the need for substantial investment in the country's power generation and transmission systems. The power system master plan published in 2016 forecasted an average gross domestic product of 6% for the next 25 years, through 2041. To satisfy this forecast and taking into consideration the demand diversity factor, the estimated system maximum demand will be approximately 72,000 MW, requiring a net generation capacity of at least 79,000 MW by 2041.

As Bangladesh is currently facing a long-term gas crisis, the government is constructing coal-fired power plants to meet the increasing demand for energy. The government's strategic plan includes establishing several power hubs in the southern part of the country, the first of which was constructed in the vast landscape of Payra. Built by the Bangladesh-China Power Co. Ltd. (BCPCL), the Payra power hub consists of a 1320-MW power plant with two 660-MW generators, located in a village in the Patuakhali district.

The Power Grid Co. of Bangladesh Ltd. (PGCB), the country's national power transmission utility, had to overcome numerous challenges to complete and commission the Payra hub, including the right-of-way, line route, seasons and extreme weather, topography, supply chain and contractor cash flow.

## The First Phase

The first phase of PGCB's development plan for the Payra hub's high-voltage transmission system was the need to construct a 400-kV double-circuit transmission line from Patuakhali to Gopalganj.

Following a competitive bidding process, PGCB awarded the contract for construction and commissioning of the 400-kV, 164-km (102-mile) long, double-circuit Patuakhali-Gopalganj

transmission line project to GS Engineering & Construction Corp. The designated construction period was 24 months, and the value of the contract was equivalent to US$118 million.

## Conductor Selection

To satisfy the specified load-transfer capacity for the 400-kV transmission line, the design team considered a conductor with high-temperature, low-sag (HTLS) characteristics to be critical. From the new generation of overhead line conductors now commercially available, an aluminum composite core conductor (ACCC) was selected.

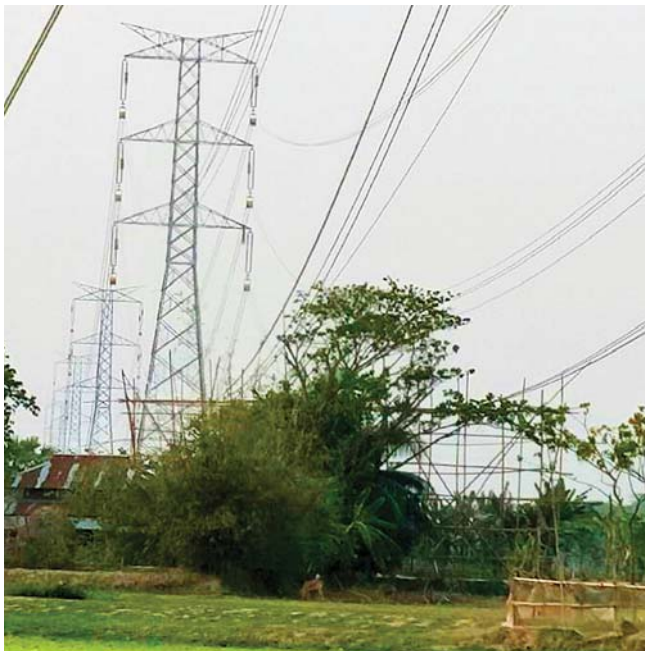
ACCC can carry up to twice the current of a conventional conductor without causing the excessive line sag that occurs when conventional conductors heat up under increased electrical load conditions. An economic performance analysis confirmed the increased upfront capital cost of using ACCC would be more than offset by the overall project economics over the transmission line's life cycle.

The ACCC was strung in a quad-bundle configuration (four conductors per phase), with each conductor having a cross-sectional area of 795 sq mm (1.23 sq inch). The current transmission capacity of the double-circuit transmission line is around 1500 MW, somewhat less than the thermal capacity of the circuit, to comply with the transmission system stability limits.

Conductor stringing works near Gopalganj substation.

## Challenges During Construction

As is common with major capital projects, PGCB had to overcome numerous challenges in constructing the 400-kV Patuakhali-Gopalganj transmission line:



Large 400-kV terminal tower in Payra.

- ***Right-of-way*** — Securing the right-of-way for construction of the transmission line was the biggest challenge in the project. Local communities and landowners were in opposition to construction work on their land because the compensation offered for the crop, tree and pond damage — in accordance with the prevailing laws — was considerably less than the actual market value. Their higher demands had to be negotiated and fulfilled, sometimes requiring the intervention of local administration and law enforcement agencies, leading to disputes being settled in district courts.
- ***Changes to the line route*** — In some of the worst cases, landowners deliberately denied access to their land, requiring route changes to sections of the line route. Rerouting of line resulted in more new activities, including the need for surveying, preparing plans and profiles for the new sections, and seeking approval of the same from the design department of PGCB.

Cyclonic Storm Bulbul halted project activities for a few weeks.

- ***Seasonal time frame*** — In Bangladesh, civil construction works are mostly completed during the dry season — typically from October through March. So, the effective working period was only six months per year. To make the most of this time, about 60 local subcontractors were engaged to undertake foundation works simultaneously.
- ***Construction activities in shallow, marshy land*** — The dry season is the perfect time for construction activities, but the most difficult task was the transportation of construction materials to tower locations across the vast marshy landscape that stretched along some sections of the transmission line route. Carrying materials was practically impossible as laborers were unable to move on the clay and mud. Even engine-driven boats could not be used, as they grounded to a halt frequently in the shallow water and mud. An alternative method was adopted involving a medium-sized metallic boat that was loaded with materials and dragged manually by an iron rope over the shallow, marshy ground conditions. This tedious method proved very time consuming, causing delays in construction.
- ***Weak supply chain management*** — Vendors supplying the civil construction materials, cement, sand and stone chips failed to honor their agreements, resulting in delays in construction. Therefore, more additional local suppliers had to be engaged to meet the daily needs of the construction works. A few of these vendors were solely dependent on rental transport, which led to material supply scheduling issues. Improved field management of the material supply chain issues was introduced, resulting in a substantial improvement midway through the project.
- ***Contractor cash-flow problem*** — The main contractor required to make progress payments to many of the local suppliers and daily laborers experienced cash-flow problems, which led them to seek financial support from PGCB. The subsequent financial agreement between both parties had to be resolved quickly in view of the large financial impact of delays on the project, in terms of capital expenditure overruns and loss of revenue from the delay in commercial operation of the project.
- ***Impact of floods*** — This 400-kV transmission line crosses four rivers. Therefore, the eight river-crossing towers were planned to be positioned on dry land, based on morphological studies. However, tower erection activities had to be delayed for a few weeks because of flooding and landslides, resulting in the need for additional backfill work that was necessary in the affected areas.
- ***Cyclonic storm*** — Bulbul, a severe cyclonic storm, crossed Bangladesh during the construction period and lasted four days, causing severe damage and the flooding of village roads and culverts. The open yards used by the contractor to store heavy-duty machines (for example, conductor pullers and cranes) were flooded, resulting in a two-week delay in all project activities.
- ***Time constraint*** — The construction period for the project was only 24 months, which ultimately proved to

View of 400-kV tower from Gopalganj substation.

be insufficient to complete the huge volume of tasks:

- Undertake the route survey and complete the plans and profiling
- Construct 461 pile foundations for 400-kV towers, including the foundation for eight large river-crossing towers comprising piles 1000 mm (39.4 inches) in diameter and 55 m (180 ft) in length for each tower
- Construct 50 pile foundations for 132-kV towers
- Complete the erection of the towers having an average height of 60 m (197 ft) and the stringing of conductors on 164-km (102-mile) long transmission line with average span lengths of 350 m (1148 ft)
- Perform testing and commissioning of the 400-kV overhead line circuit.

After overcoming these many challenges, the project team's reward was the successful completion and commissioning of the

400-kV transmission line, with only a seven-month delay in the originally specified timeline.

## Lessons Learned

The dedication, sincerity and professionalism of the engineers and staff members of the main contractor and PGCB's project management unit (PMU) ensured the success of this major project.

Additionally, the proactiveness of PMU in having quick approval of drawings and designs, running test reports and obtaining swift disbursement of funds from the finance department were instrumental in reducing the implementation time.

Mitigation of the challenges and proactive strategies adopted by PMU have been well documented and were reflected in the project completion report (PCR) to assist future project teams. In addition, the Bangladesh government amended its 19th century Electricity Act because of PGCB's initiative and continuous efforts by the Line Ministry. As a result of the amended act, it is now easier to secure rights-of-way for the construction of high-voltage overhead transmission lines.

Finally, PGCB acknowledges the full benefit of the Payra power hub will not be achieved until the second section of the 400-kV Payra-Gopalganj-Aminbazar transmission line, namely the 80-km (50-mile) length between Gopalganj and Aminbazar, is commissioned. Construction of this final section of the 400-kV circuit is 95% complete. The largest challenge on this section has been the tower foundation construction for the towers erected in the Padma riverbed.

The termination of this 400-kV circuit is the Aminbazar 400/230-kV substation, equipped with three 520-MVA transformers that will supply the nearby capital city of Dakar, which will then be connected to the Bangladesh high-voltage transmission system. TDW

## Acknowledgments

The operational support obtained from the different departments in PGCB — including the grid maintenance divisions, testing and commissioning department, national load dispatch center and many more — were instrumental in the successful implementation of the Patuakhali-Gopalganj transmission line. The author also would like to acknowledge the support and guidance given by the Line Ministry, managing directors and executive director (planning and development) of PGCB in resolving some technical issues and settling numerous contractual disputes.

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**SHAFIQUE RAHMAN** (*ononnoshafique@gmail.com*) received his bachelor's degree in electrical and electronics engineering from the Bangladesh University of Engineering and Technology and his MBA degree from the Bangladesh Open University. Rahman started his career with the Bangladesh Power Development Board as an operation and maintenance engineer in power stations before joining the Dubai Electricity and Water Authority (DEWA) as a power project engineer, where he was awarded for being a distinguished team member of the Dubai government's excellence program. His career resumed with the Power Grid Co. of Bangladesh Ltd., where he successfully completed numerous transmission line projects prior to being appointed to the position of chief engineer. Currently, Rahman is CEO and director of Green Infrastructure Services Ltd. Based in Dhaka, he is engaged in consultancy projects on infrastructure development in the power sector.

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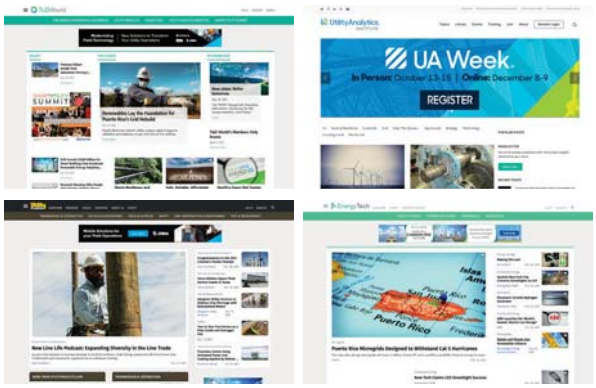


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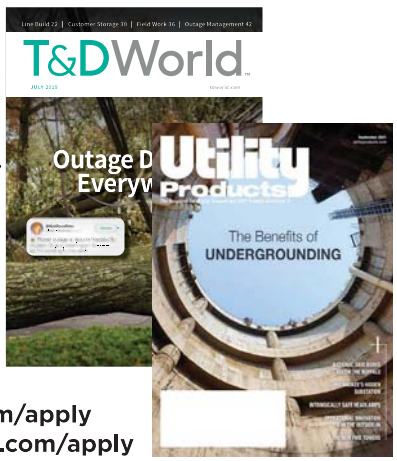


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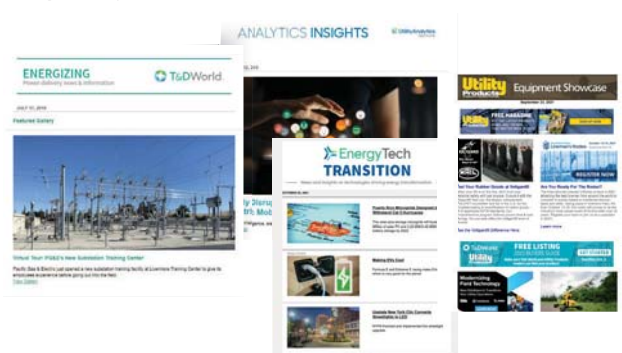


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University of Warwick (UoW) Primary Substation and the FCLi housing. Photo by GridON.

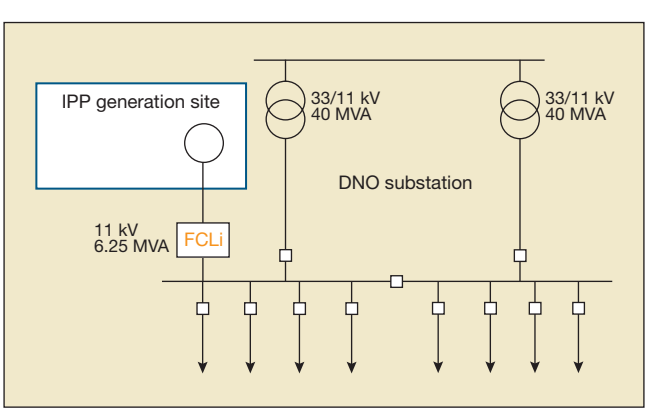
# Quick Fault Recovery in the UK

Based on power electronics, a 5-MW, 11-kV fault current-limiting interrupter can recover immediately and needs minimal maintenance.

By **URI GARBI**, GridON Ltd.

The energy market transformation to distributed generation is happening rapidly. Renewable energy sources such as wind, solar and biogas are ever increasing in the generation mix. It is now estimated total distributed generation installed capacity will reach 1182 GW by 2030, accounting for 10% of the global installed power generation in the year, according to Frost and Sullivan.

The existing electrical infrastructure cannot accommodate the vast connection of distributed energy resources because of the increasing fault current level from these new sources. If the fault current is too large and exceeds the distribution network equipment ratings, utilities face the risk of equipment damage and power interruptions. It is becoming clear that, without reliable solutions for fault current limitation, the connection of new energy sources will become costly and be postponed.



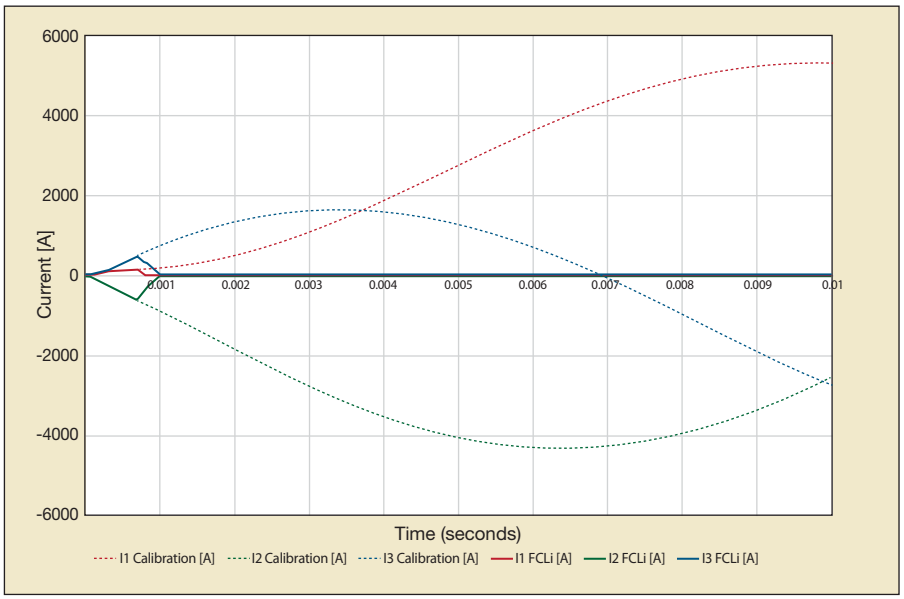

Single line diagram showing the UoW FCLi installation.

Because the issue of excessive fault currents is so widespread, a reliable solution for fault current management is required. When multiple connections of distributed generation are made on the distribution network of a given substation located in dense urban or industrial areas, it becomes necessary to install fault current interrupters at the generation sources. This eliminates the fault current contribution from the distributed generation source into the distribution network.

To address this potential problem, Western Power Distribution (WPD, now called National Grid) — one of the UK's distribution network operators (DNOs) — launched the EDGE-FCLi innovation project. Funded by the Office of Gas and Electricity Markets (Ofgem's) Network Innovation Allowance, the project kicked off in September 2018.

WPD selected GridON to develop and demonstrate a novel fault current-limiting interrupter (FCLi) based on power electronics that would have an immediate recovery capability and not require

site presence or parts replacement following an interruption operation. The FCLi was built and successfully tested. It has been energized within a field trial in a live network, which will allow for its adoption. This device is aimed to be used by distributed generation customers to accelerate their connection to DNO networks.




The FCLi's short-circuit interruption test.

## Fault Current-Limiting Interrupter

GridON's FCLi uses a proprietary power circuit based on insulated-gate bipolar transistors (IGBTs) as electronic switches that conduct the generators' current to the network in normal conditions. An ultra-fast fault detection mechanism enables rapid interruption of the fault current, typically within less than half a millisecond. The FCLi is connected to the operator's network management system, which enables remote control of the device.

After an interruption operation, the device is immediately ready to resume normal current conduction by remote command with no need for on-site service or parts replacement. The FCLi is easy to install and operate, and it requires minimal maintenance. It also is equipped with signal logging capabilities that enable analysis of its behavior by simple data retrieval from its local storage device. The design of the FCLi was accompanied by a distribution network connection study.

## Testing The Design

The development stage of the FCLi culminated with the execution of a comprehensive suite of tests reviewed and approved by WPD. Initially, an enclosure was manufactured for destructive internal


The FCLi in housing. Photo by GridON.

arc classification tests. The tests were conducted at KEMA Labs and carried out in accordance with IEC 62271-200. Following these tests, a fully functional FCLi unit was manufactured and factory acceptance tests (FAT) were performed.

The tests included dielectric tests, such as a power-frequency withstand test at 28 kV, and lightning impulse tests at 95 kV. Then the unit was subject to a series of functional tests that demonstrated all its operational modes and, finally, went through full-rated current tests, including temperature rise tests. The FCLi is designed with self-diagnostic capabilities, which also were tested during FAT. Following successful FAT, the FCLi was tested at KEMA Labs for short circuits.

The unit was subjected to faults ranging from a few hundred amperes up to 25 kA rms, demonstrating its capability to interrupt these currents well before the first current peak. This is a necessary feature for any fault current limiter, as its main purpose is to ensure no equipment on the network is exposed to a fault current beyond its ratings.

Furthermore, the FCLi is designed with power-circuit redundancy to enable current interruption even in the unlikely event of some components failing. Some of the short-circuit tests were aimed to prove the FCLi could indeed interrupt fault current when parts were simulated to fail. The device passed these tests successfully.

All the tests were witnessed by WPD representatives and, subsequently, the FCLi was approved for installation.

## Installation And Energization

Following the successful testing at KEMA Labs, the FCLi was installed in WPD's 33/11-kV primary substation on the University of Warwick campus, where high current levels are generated by three combined heat and power (CHP) generators with a total power of 4.2 MW. The FCLi is connected to an extension panel added to the 11-kV switchboard for this installation.

WPD supervised the installation, connection, commissioning and energization of the FCLi, which had an initial operational run period. Following minor adjustments, the system was put into service in late 2021. The FCLi is connected in series between three 1.4-MW synchronous CHP generators and the WPD substation's 11-kV bus bars, supplied by two 40-MVA, 33/11-kV transformers running in parallel.

## FCLi Features

The FCLi is equipped with a high-resolution data logger that enables recording both analog and digital signals when events occur, such as fault current interruption and any abnormal device behavior. It also includes an auto-start feature to ensure it is ready for operation within a matter of seconds. The operator remotely controls the FCLi's operation through a simple interface and monitors its condition through telecontrol. The FCLi includes extensive self-diagnostic features, providing clear visibility of any potential problems that may develop within the device.

The FCLi can instantly recover from fault current limitation to normal current conduction, by a remote command from the operator. This means, following fault clearance, the generator that is protected by the FCLi can be resynchronized to the distribution network. It can immediately resume normal power generation, so there is minimal impact to the generation customer.

The FCLi installed in the UoW primary substation is under the full control of WPD's network management system, in common with all other devices connected to the distribution network. The FCLi is straightforward to maintain, as maintenance only includes periodic inspections and air-filter replacements.

With the 5-MW, 11-kV FCLi device now in operation, GridON also has developed a 1.5-MW, 400-V FCLi and is working on a power-electronics-based fault current limiter for networks up to 38 kV, supporting power ratings up to 150 MVA. This device will be targeted for DNO substations and large-scale generation.

## Equipment Longevity

With the ever-increasing demand for distributed generation connections into distribution networks, the issue of fault-level management requires solutions on the customer's side. For these solutions to be effective, they must be able to recover immediately after network fault events and provide a rapid return on investment to the customer.

Power electronics-based interrupters provide both of these benefits and enable DNOs to maximize the longevity of their equipment, avoiding operational restrictions and equipment replacement that would otherwise be necessary. TDW

**URI GARBI** (*uri.garbi@GridON.com*) has BSEE (cum laude) and MSEE degrees and has spent the last 28 years in senior research and development positions in the high-tech and power industries, leading engineering teams across multisite, multinational research and development projects. Garbi joined GridON in 2011 as vice president of research and development, leading the development of GridON's products in utility substations and coordinating the utility customer, engineering, manufacturing and commissioning contractors and technical consultants.

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ERCOT introduced the fast frequency response (FFR) market in response to reductions observed in system inertia because of increased renewable penetration. Inverter- or asynchronous-based power resources like wind turbines, solar photovoltaics and battery storage do not provide system inertia, but they do offer alternative benefits, including, in the case of energy storage, the ability to provide instant on-demand power injections to the grid. Photo by PXiSE.

# Smart Controllers Make Energy Storage Stronger

Grid controllers could be one answer to Texas' grid woes, paving the way for more energy storage.

In recent years, Texas' electrical grid has struggled to meet demand, a situation that becomes especially dire during times of high stress. When the winter storm of 2021 knocked large parts of the grid out of commission, millions of homes were left without power for days of grindingly cold temperatures. Mass blackouts were avoided during a sweltering summer that year, but mainly because the state spent extra to increase reserve capacity and incentivize customers to lower their usage.

According to the U.S. Energy Information Administration, Texas is the country's largest electricity consumer, with its industrial sector accounting for more than one-half of the state's energy consumption. With Texas' grid isolated from the rest of the country's grids, the Electric Reliability Council of Texas (ERCOT), which manages the power supply for over 26 million Texans, faces an uphill battle in ensuring the state's grid is prepared to meet capacity constraints. With a warming climate, an increasing likelihood of severe winter storms and one of the country's fastest-growing populations, supply issues will only grow worse in the years to come.

## Fast Frequency Response

Adding new utility-scale power plant projects and upgrading T&D networks are the most obvious ways to increase capacity, but to do so in a meaningful manner requires expensive and lengthy infrastructure projects. Adding adaptable energy resources is one way to expand the capability of the grid in the short term, and energy storage is one of the easiest ways to do this. Utility-scale batteries can be connected to the grid to expand existing capacity, storing energy when demand is low and providing a reserve supply when it is high. Energy storage also is useful as a source of backup power, so the lights and heat can keep running when the next winter storm strikes or the air conditioning can keep churning when a heat wave is on the brink of inducing brownouts.

ERCOT introduced the fast frequency response (FFR) market in response to reductions observed in system inertia because of increased renewable penetration. Inverter- or asynchronous-based power resources like wind turbines, solar photovoltaics and battery storage do not provide system inertia, but they do offer alternative benefits, including, in the case of energy storage, the ability to provide instant on-demand power injections to the grid. When inverter-based resources can be dispatched instantly, they can mitigate frequency fluctuations that lead to power disruptions and grid instability.

The FFR market incentivizes fast-responding assets like storage to be ready for dispatch instantly, effectively reducing the need for system inertia provided by spinning generators.

ERCOT's requirements state an FFR resource must be automatically deployed within 15 cycles (hertz) after grid frequency

reaches the trigger threshold. A resource also must sustain the response for at least 15 minutes or until ERCOT recalls deployment when the desired frequency is reached, whichever occurs first. A resource must be reset and made available for the next event within 15 minutes after deployment is ended. These FFR requirements can be handled by an energy storage system controller that can sense the grid's frequency — using high-speed measurements such as synchro-phasors — and automatically command the battery energy storage system under its control to discharge a set amount of energy for a sustained amount of time and reset itself per ERCOT's needs.

The high bar ERCOT has established for assets providing ancillary services such as frequency response, while borne out of necessity to keep Texas' grid stable, means operators with utility-scale storage now have an opportunity for additional revenue sources. By installing a controller that meets ERCOT's FFR standards, developers can provide an additional revenue stream for operators, making the case for installing energy storage that much stronger.

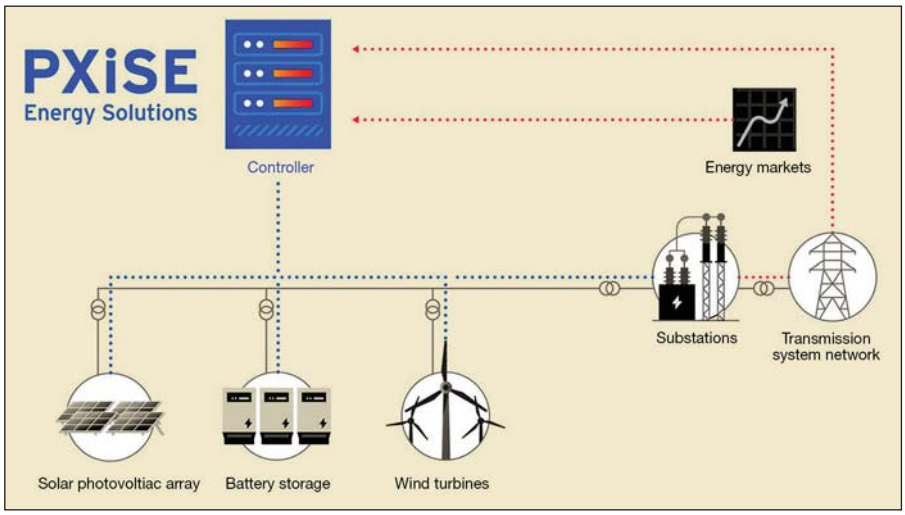
## New Generation Of Controllers

Recent developments among controller developers mean there are now options, albeit limited, that meet ERCOT's FFR requirements. Power plant controllers (PPCs) are a particularly useful solution for renewable power plant operators interested in adding energy storage to their portfolio. A PPC autonomously can control the real and reactive power of one or multiple resources, as measured at the point of interconnection (POI), to support multiple use cases, such as energy and ancillary service markets, including ERCOT's FFR market.

Because a PPC is managing all the resources of a project, rather than individual inverter controls, the PPC can holistically look at the capabilities of all resources under control to provide coordinated support to the grid connection point. Of note for Texas, as the country's largest source of wind generation, PPCs also can manage power from wind farms and wind-plus-storage projects.

Time-synchronized phasor measurement units (PMUs) are an ideal tool to measure system frequency, as they offer high-speed, precise data that, when leveraged by a smart controller, provide the measurement data to meet and exceed the FFR market response threshold. Additionally, these capabilities typically are included in devices already installed at a project, so no additional measurement hardware is required. A PPC such as PXiSE Energy Solutions' renewable PPC relies on PMU data — processing it as soon as it is captured, at the same speed as the 60-Hz grid — and can manage any mix of renewables and energy storage. It also enables operators who wish to participate in the ERCOT energy market to do so in addition to the FFR market, as the control software can adapt autonomously to multiple types of resources and different batteries on a single system for parallel use cases.

With controllers that meet ERCOT's FFR requirements now available, energy storage in Texas will be considerably smarter and a more cost-efficient asset, sweetening the rationale for project developers to add storage to their renewable projects and




The high bar ERCOT has established for assets providing ancillary services such as frequency response, while borne out of necessity to keep Texas' grid stable, means operators with utility-scale storage now have an opportunity for additional revenue sources.

pursue stand-alone storage opportunities. Paired with intelligent controllers, more utility-scale energy storage in ERCOT can be both a short-term and long-term solution to the grid capacity and reduced system inertia issues that plague Texas.

## Smart Controllers

The availability of controllers that meet ERCOT's FFR requirements means energy storage project economics can be improved for project developers — and power plant operators looking for additional revenue streams. Investing in a high-speed controller that is software based de-risks the project for future market requirements, as software can be easily adapted to meet new requirements. A smart controller with advanced capabilities can even provide control for markets yet to be defined.

It may take years of building power plants and investing in T&D to meet the growing energy needs of Texans, but in the meantime, smart controllers that can enable storage project owners to participate in ERCOT's various markets, like FFR, have made the case for adding battery energy storage in Texas stronger than ever. TDW

**ELLIOT STEIN** is a technical sales manager at PXiSE Energy Solutions. In this position, he leverages his background in both renewable and electric utility industries to find solutions for clients' energy management and control challenges. Before joining PXiSE, Stein held engineering and technical roles for the development and construction of solar, wind and storage projects at Sempra Renewables, ConEdison Clean Energy Businesses, and Matrix Renewables. He also spent five years in T&D system protection and substation operations and commis-sioning at the electric utility Pepco Holdings. Stein has a wide-ranging technical background and is focused on using it to accelerate the implementation and deployment of advanced grid control solutions.

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# A Human-Centered Approach to Distribution System Planning

A human-centered approach to distribution planning puts people at the center of our planning and infrastructure projects. It evolves our distribution planning process, advances energy justice and integrates diversity, equity and inclusion. It is also key to meeting our ambitious decarbonization goals. It assists in the transition from traditional technical outreach to an equitable community engagement practice, which includes the voices of those who have been historically excluded. Traditionally, utilities have not focused much on the human capital of our planning, but rather organized around systems and infrastructure, while doing our best to make sure it was safe and reliable in the face of potential catastrophic failure.

Distribution system planning (DSP) is a sophisticated process composed of several steps that includes load forecasting, identifying grid needs and arriving at a set of recommended projects to be funded to solve those needs that modernize the grid. As an environmental scientist, my role is to contemplate the intersection of people, the environment and systems and the long-term impacts of this work.

A key element of human-centered planning is the transformation and enablement of a modernized grid that uses large-scale Distributed Energy Resources (DERs) integration. It is a hyper-local approach to clean, resilient technologies and resources, specifically solar PV systems, storage capabilities and EVs. These resources must benefit the communities in which they are located and serve our most vulnerable communities.

When I took this role in 2019 and was confronted with the challenges of re-imagining how Portland General Electric planned and engaged with customers and communities, I embraced the opportunity and assessed everything that was happening in the world relative to climate change and applied it to the DSP.

PGE's DSP is our first step toward creating a 21st century community-centric distribution system. We envision a system that primarily uses DERs to accelerate decarbonization and electrification and provide direct benefits to communities, especially the environmental justice community. Our DSP is a path forward to equitably modernize our distribution system, while improving safety, reliability and ensuring resilience and affordability at fair and reasonable costs.

In 2019, the Oregon Public Utility Commission opened a public process into distribution system planning for investor-owned electric utilities. Throughout the course of the process a group of interested parties started to attend the public meetings, including community-based organizations and individuals, who wanted to understand how utilities were making investment decisions.

Community engagement was the main objective of our human-centered planning efforts. We wanted to understand our community's energy needs, desires, barriers, interest in clean energy projects and where opportunities exist. We approached the development of an equity metric in three phases:

- Phase 1 used electricity burden, an already used metric in the industry.
- Phase 2 involved developing an equity metric that reflected our service area.
- Phase 3 is a longer-term process of building statewide-vetted equity metrics that can be used as the future standard by all parties.

In response to partner feedback and recommendations, we began integrating socioeconomic and demographic data and mapping into our planning processes. The tools used to analyze the data were Greenlink's Equity Map data, our customer payment metrics and public data sources such as the U.S. Census American Community Survey, U.S. Department of Energy's Low-Income Energy Affordability Data tool and U.S. Environmental Protection Agency's EJScreen. From that, we began to implement equity within our current decision-making framework by developing equity definitions, identifying key variables to track equity in programming and quantifying equity metrics.

During our process we held 23 workshops between the two audiences: technical and non-technical.

- Our technical audiences attended partner workshops where we took a deep dive into our analysis, data, sources and assumptions. We invited partners to provide feedback and assist in refining our approach where necessary.
- Our non-technical audience participated in community-focused workshops where we thoughtfully curated Utility 101 content that was accessible and covered energy related planning topics.

The overarching goal of the workshops was to provide learning opportunities to participants, build awareness of the DSP and share our processes for long-term planning initiatives. This method led to creating a space for dialogue with our community partners and how their contributions would help inform our future planning.

Community engagement is based on the belief that those impacted by a decision, program, project, or service system need to be involved in the decision-making process. This belief promotes PGE's philosophy of "Nothing about me without me," which is our guiding principle for conducting and evolving toward equitable community engagement practices. Additionally, we believe a clean energy future that is affordable and equitable requires a commitment to diversity, equity, and inclusion throughout our business. We commit to engaging communities that have been historically excluded from utility planning processes; doing so will ensure that our plans achieve a holistic approach that consistently applies an equity and resiliency lens. TDW

**ANGELA LONG** is senior manager of Strategy & Planning at Portland General Electric.


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