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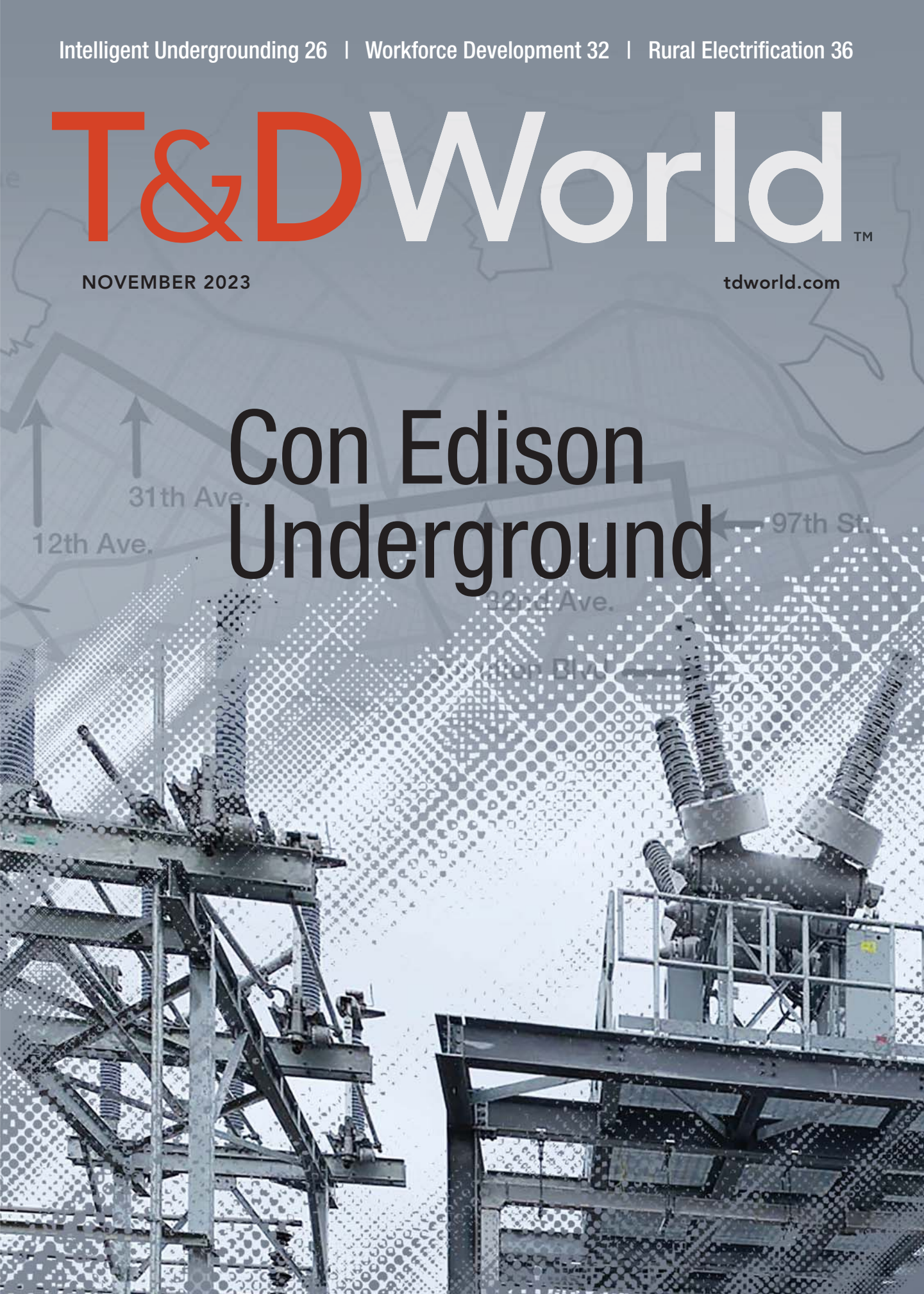

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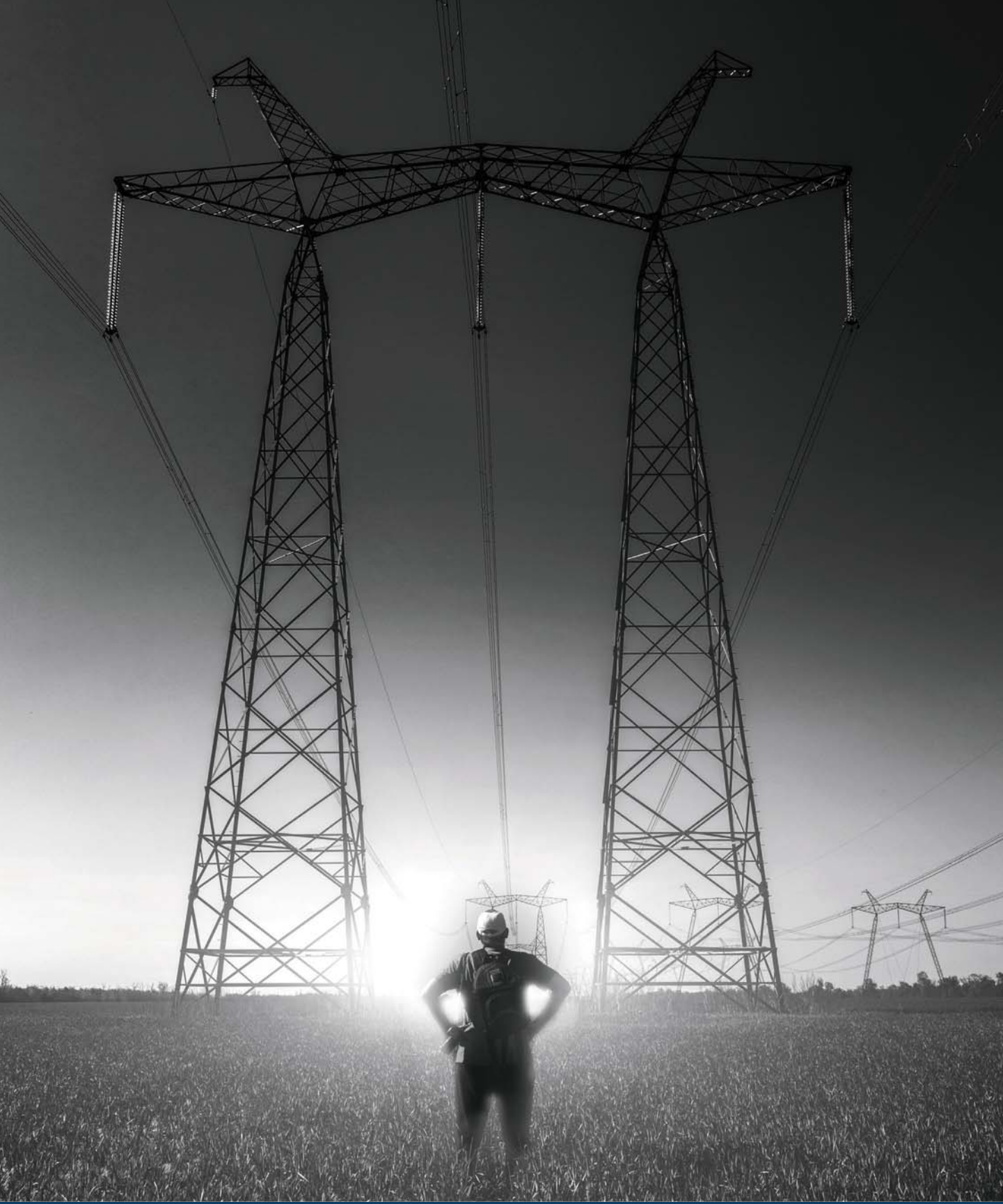

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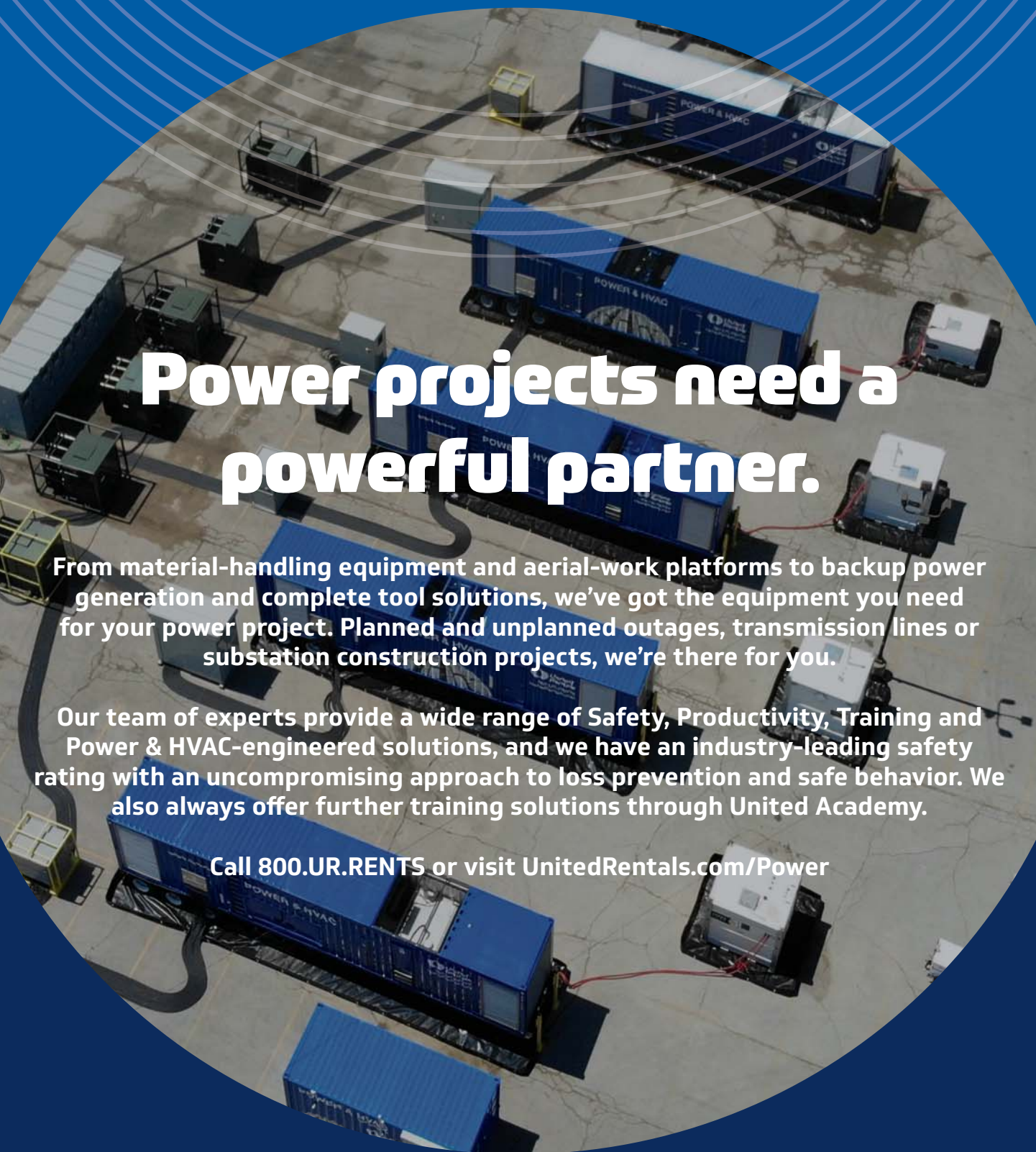

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Thriving in the Dark: Why Adaptation Matters for Salamanders and Utilities

In my junior high school years, I had the opportunity to tour Blanchard Springs Caverns, a captivating cave nestled in northern Arkansas. The cave's subterranean world left a lasting impression on me, but what intrigued me most and continues to intrigue me to this day are the Ozark blind salamanders that live in its spring-fed waters. These creatures have spent generations in complete darkness, adapting to a difficult environment. They have no pigmentation and are blind (their eyelids fuse shut as adults), yet these salamanders have thrived in the cave's ecosystem since their ancestors ventured in and were unable to find their way out. They adapted to their new surroundings. Now, you might be wondering, "Why the biology lesson?" Bear with me.

In my previous column, I delved into the issue of climate change, the record heat of this year, and the surge in severe weather events, all of which pose significant challenges for grid owners and operators. I emphasized that we must prepare ourselves and our infrastructure to exist in a harsher, less hospitable world. This isn't a new concept, and the electric utility industry is already actively engaged in what they refer to as 'grid adaptation, hardening, and resilience' (AHR). I'm familiar with grid hardening and resilience, but the addition of adaptation to create the new acronym AHR is new to me.

The Edison Electric Institute articulates AHR as the ability not just to recover from extreme weather events, but also to proactively address a wide range of potential threats, including extreme weather, wildfires, earthquakes, and cyber or physical security attacks. In essence, it's about acknowledging that these unexpected severe events are no longer unexpected. They are certain to occur, and mere preparedness for recovery is no longer enough. Transmission and distribution grid owners and operators must proactively fortify and prepare the electricity infrastructure and possibly alter its design and operation to withstand extreme events, be it climate-related or due to physical and cyber threats.

Resilience, as defined by the Oxford Dictionary, is the capacity to endure and swiftly recover from hardships, or in simpler terms, toughness. To understand 'grid hardening' in the context of the electrical grid, I had to go beyond dictionary definitions. I found several definitions that define grid hardening as strategic measures taken to establish a robust infrastructure capable of mitigating risks and withstanding the repercussions of severe and catastrophic events. For years, utilities have concentrated on hardening and enhancing resilience to improve recovery from 'black sky hazards.' When we contemplate this definition of hardening, it's conceivable that grid adaptation and hardening are, to some extent, synonymous. However, I'm not entirely convinced that they are one and the same. Hardening bolsters the existing grid and infrastructure that have been in place for decades, while adaptation implies something more profound—a necessity for change and potentially a redefined purpose.

Several investor-owned utilities have already embraced AHR. According to EEI's Electric Power Industry Outlook (February 2023), its member companies have invested more than $1 trillion in critical energy infrastructure over the past decade. Moreover, in 2022 alone, nearly $30 billion was invested in AHR initiatives. I couldn't find AHR statistics for public power utilities or cooperatives. This might be because they haven't yet adopted the term or possibly because they haven't fully embraced adaptation. It's likely that some are investing in adaptation without necessarily using the AHR acronym.

I've read countless articles and listened to utility employees talk about how quickly they've restored power, even in scenarios where unprecedented numbers of poles, wires, and transformers were damaged, leading to disruptions for countless customers. Swift restoration is commendable, but the ideal scenario is not losing power at all. Utilities have made substantial investments in vegetation management, replacing analog systems with digital, incorporating sensors for enhanced visibility into system operations, harnessing data analytics and machine learning to reroute power, and numerous other initiatives to enhance resilience and hardening. These efforts are commendable, but creating an infrastructure that won't be severely damaged or destroyed by extreme events and will ensure customers never lose electricity is the real goal.

Every engineer, operator, and executive within the utility industry is acutely aware of this challenge. They would undoubtedly welcome an endless supply of resources to make it a reality. Designing and constructing a grid capable of withstanding extreme weather events and resisting malicious attacks, both of which are occurring with increasing frequency, is a monumental undertaking with an enormous price tag.

Yet, when one considers that certain utilities have faced numerous devastating weather events, each causing damages worth millions or even billions of dollars, it becomes evident that adaptation may well be worth the investment. Instead of merely creating a stronger, more resilient version of the same grid, we must consider rethinking its design and function. This might involve the integration of more distributed generation, encouraging and aiding customers in becoming prosumers, embracing virtual power plants, and exploring concepts and technologies yet to be defined or created.

Many utilities are already incorporating some of these strategies, signifying that adaptation is becoming part of their approach. However, is it happening quickly enough? I don't know, but one thing is clear: just like the Ozark blind salamanders thriving in their dark cave ecosystem, adaptation is imperative for thriving in the future of the electricity industry. TDW

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AI Aims for Real

The true story of artificial intelligence (AI), for all the frenzied publicity good and bad, has yet to be told. Debate around AI is focused on the future in two ways — fear and promise. Will it be the angel of commerce, the greatest efficiency and beneficially communicative tool to completely revolutionize the world for the better, or will it be the devil? Neither future prediction, heavenly or hellish, is likely going to be true. AI, for instance, is only as good as the historical data it evaluates and the specific algorithm it follows to truly work for the job intended. If it works as anticipated, it will definitely heighten the impact of digital transformation on the microgrid and distributed energy sectors and its interaction in the whole of energy infrastructure.

The sky is the limit if AI ever truly gets off the ground. Many microgrid-sector experts believe AI is here to stay and will offer quantifiable fruits for the labor it involves. Its work, and that of related tools such as machine learning (ML), will avoid bigger infrastructure problems, respond quicker to conditions around microgrids and distributed energy resources (DERs), and hopefully provide the instant knowledge for quick decision-making with less fear of human processing errors.

Only the bots know, right? Maybe, but experts from some of the industry's leading companies are developing pretty good hunches.

"AI is a key driver in the rapid expansion and effectiveness of microgrids," Sean McEvoy, chief product officer and president of North America operations for energy services firm GridBeyond, said. "Microgrids often incorporate a diverse array of energy resources, including solar panels, wind turbines, batteries and backup generators. By optimizing energy management within these systems, AI dynamically adjusts the operation of these resources, ensuring efficient energy utilization and cost-effectiveness."

Now you're speaking the money language — efficiency and cost-benefit analysis. The bottom line is music to a chief financial officer's ears. Creative grid professionals are certainly captivated by the technological innovation around decentralizing the electricity power infrastructure, but eventually it must pay off, too.

AI, essentially, is using software to teach hardware to act on key information, much like humans do. The tools are not completely new, but their implementation and expansion are evolving exponentially in all facets of society. This is particularly so in the energy sector where planners are trying to reach ambitious power sustainability and resiliency goals.

Microgrid controller technology firm PXiSE Energy Solutions has used machine learning as a way to improve optimization of power and load schedules, as well as DER management.

"In the power industry, predictive analytics has been used for a number of years to identify problems to take preemptive action on large pieces of equipment — think of wind turbine gearboxes," said Joe Sullivan, head of sales-North America for PXiSE. "Most of these systems are only as good as the data that is fed to them."

"I think where AI is going, leveraging unstructured data and operating with missing data, may support a larger number of use cases," Sullivan added. "Optimizing many resources, especially EV/mobile load can be very challenging for a standard optimization. With enough data to train on patterns, AI/ML benefits the resource optimization and scheduling of these resources and learning patterns over time."

AI's expertise at exaggeration might make it eligible to run for Congress, but it won't cut the mustard in the data analytics and interoperability worlds. AI has to get better and expand its impact in energy efficiency, energy resource balancing and other operational goals.

All of those skill sets make it ideal for microgrids, DERs and virtual power plant applications. Those types of assets are the key defensive lines in bolstering island-able backup power, grid services, and peak demand response participation.

The unique nature of microgrids creates both challenges and opportunities when it comes to the role of artificial intelligence. Microgrids are operated either in grid-connected mode or islanded in the event of a utility grid outage, with the manual switching traditionally handled by a remote human operator.

That's good … and maybe bad. Everything hinges on responsiveness and reliability, PowerSecure's Calderon pointed out. Human error is always a vulnerability. "This is encountered anywhere human factors are involved and is not unique to microgrid dispatch," he said. "These two factors, the human element and the overall qualities of the microgrid itself, exist in the context of the business need to satisfy contractual obligations."

Microgrids are investments in both reliability and, often, the announced sustainability and decarbonization goals of the client, whether it's an industrial or commercial facility, military base, municipal public safety center or university campus. Like other DERs, microgrids can also play a role as a revenue tool in energy spot markets or demand response.

"Its performance greatly impacts relationships with clients," Calderon added. "Nowhere else in the life cycle of an individual microgrid does one encounter a situation where AI-based software automation can play a key role in reducing overall liabilities and reputational damage."

For the most part, these are use cases yet to be told, stories yet to unfold. AI is offering a new language for a new translation of how the distributed energy infrastructure interacts in a complex interplay between the environment, physical equipment, developers, and customers. Microgrids aren't new, but they are relatively young compared to where they are going. And they will be wise to learn to speak AI. And, conversely, AI must be ready for them. TDW

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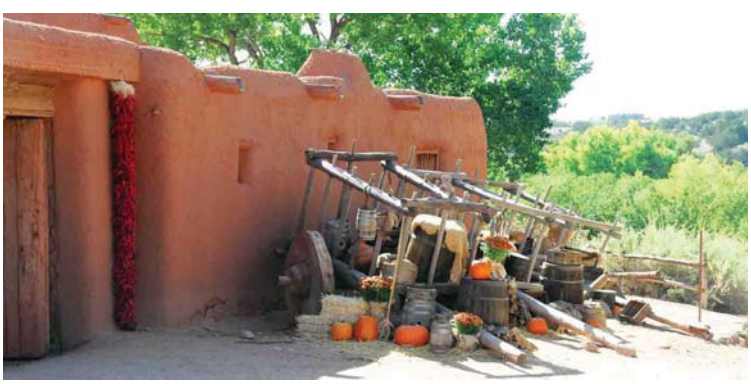
Inaction Has Consequences

Don't you just love it when several of your favorite things come together at the same time? That happens every fall for me because first of all, I love the fall season with its fabulous foliage and cool weather. In New Mexio it also marks the start of fall fiesta (festivals) season, which are usually associated with history in one form or another. That makes it a trifecta of favorite things since I love both of these activities too.

What got me focused on these topics were recent announcements for the annual fall harvest festival being held at "El Rancho de las Golondrinas" (the ranch of the swallows). Las Golondrinas is a living museum that dates back to the early 1700s and houses many historical buildings in a bucolic setting. Its volunteers and docents take visitors back to a less complicated period where 18th century technology abounds.



Eighteenth-century technology. Photo by Gene Wolf

I don't know why, but there's something about older technology that's reassuring, maybe it's nostalgia for a less complicated world. Watching a waterwheel-powered gristmill grind grain is soothing, but it was probably unsettling to those whose job was crushing grain between handheld rocks. There's no getting around it, the world has gotten a lot more uncomfortably complicated.

Keeping Up with the Times

This came into focus last year when I wrote about problems with my home's air conditioner and was looking at replacing it. The new technologies were very different, and they led me into something unexpected. As I researched the latest technologies it became apparent that industry standards were not keeping up with global warming and the environmental changes it was causing. Unfortunately, it was not just refrigeration standards needing updating.

With that in mind, it was perfect subject-matter for the October 2022 "Charging Ahead" editorial titled "Changing Standards For Climate Change." After the column's publication, I continued watching the efforts of numerous groups working on updating the guidelines, practices, and standards used by our industry. Interestingly, the results have been both encouraging and discouraging.

On the encouraging side of the equation I ran into an article titled "Is My Substation Ready For The Next Extreme Event?" It gives an interesting summation of ASCE's work to revise those guidelines, procedures, and standards used in building the power grid with an eye towards our changing environment. This article can be found in this year's "ASCE Lines and Structures" special supplement included with the October 2023 issue of *T&D World*.

Regulatory Support

There was the discouraging side of the equation to consider too. There has been some strong pushback due to the cost of these upgrades. There is also the idea that there isn't a problem because these old-school standards are based on solid engineering and so on. Luckily DOE (Department of Energy) is weighing in on the side of updating. Last year they announced their "Building A Better Grid" initiative. It calls attention to an aging grid and making it more resilient to the impacts of climate change.

Likewise, early this year FERC (Federal Energy Regulatory Commission) published a number of positive measures addressing the reliability and resiliency risks created by climate change. One asks transmission providers to make reports on if they have made extreme weather vulnerabilities assessments to their systems and how they did it. FERC also finalized a rule requiring NERC (North American Electric Reliability Corporation) to update the national reliability standards to require planning for an extensive array of extreme weather risks, including extreme heat and cold.

One report I read said this order requires utilities and transmission operators to perform detailed evaluations of the risks from extreme weather events. It doesn't stop there. These grid operators are expected to take corrective action where risks are identified. This brings us back to the need for updating guidelines, procedures, and standards we use to redesign and remodel the power delivery system.

To aid in this task, the Pacific Northwest National Laboratory (PNNL) published the report "Emerging Best Practices for Electric Utility Planning with Climate Variability: A Resource for Utilities and Regulators" last May. PNNL said the report is intended to help utilities and regulators work together as they address climate issues and the power grid.

In last year's editorial I said I thought "adapting our grid's standards to climate change is going to be a trending topic." This year I'd like to add it's going to be a rocky process. This new reality requires new standards because inaction has consequences — failure! TDW

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Fast-Tracking Transformer Replacement

Prolonged heat waves and record breaking high temperatures are stressing the power grid's most critical elements.

This has been one hot summer, and it's extended into fall. September has seen continuous record-setting high temperatures and unprecedented electricity consumption. The Electric Reliability Council of Texas (ERCOT) reported a peak load of 82,705 megawatts (MW) in September, but it's more complicated. Epic customer loads resulted in ERCOT issuing an Energy Emergency Alert 2, which meant there was less than 1,750 MW of reserve power.

ERCOT hasn't been alone facing this freaky weather. Extreme temperatures are occurring throughout the northern hemisphere, and they are taking their toll on everyone including the power grid. Unparalleled temperatures diminish the capability of power generation including renewables. They also reduce transmission lines and distribution circuits efficiencies by raising conductor resistance. Heat related equipment failures can result in outages, and transformers are one of the grid's most vulnerable devices.

The Weakest Link

According to the Department of Energy (DOE), more than 90% of consumed power passes through high-voltage transformers. That makes them one of the most critical elements on the power grid, but they are also very susceptible to prolonged heatwaves. Keeping it simple, transformers produce a lot of internal heat as they step-up or step-down voltage.

Doing that when ambient temperatures are high can be a problem. Transformers are designed with sophisticated cooling systems to dissipate the internal buildup of heat. The cooling system design usually takes advantage of the overnight drop in ambient temperatures to catchup with dissipating heat. It's a rest period when loads drop, and the ambient temperatures are cooler.

With extended heatwaves, it just stays hot. There isn't an overnight temperature drop, and the customer's cooling loads remain high. In other words, there is no overnight relief for heat-stressed transformers. Thanks to global warming these heatwaves are expected to continue while increasing in frequency and intensity. This double whammy is expect to increase transformer failures and associated outages.

If the failure is a distribution transformer, the outage will affect a few customers for a few hours. But as the size of the transformer increases so does the customer number and the duration of the outage. Large power transformers (LPTs), units above 100 megavolt amperes (MVA), would affect large numbers of customers and the power outage could extend into weeks. The effect of one LPT is a major concern, but numerous failures would be catastrophic.

Experts are concerned that our power grid is aging, and it gets more disturbing when they talk about the age of the grid's LPTs. DOE estimates the average age of these LPTs is 40 years. That's an average age, which implies that about half of these transformers are over 40 years of age. What makes this more concerning is the expected operational life of an LPT is also 40 years. That infers about half the transformers on the grid have reached or exceeded their life expectancy. It's not a good feeling especially when we consider that continuously stressing the elderly is not a great idea. It's also upsetting because LPTs are critical to the nation's power grid.

Standardization vs Customization

DOE has said the loss of critical LPTs could disrupt electricity services to large parts of the country for unacceptable periods of time. They proposed stakeholders evaluate the establishment of a "Strategic Transformer Reserve" for LPTs. There were also proposals encouraging utilities to get together and standardize their transformer specifications for the purpose of sharing LPTs. Recently, there have been several mutual assistance programs started to share equipment such as STEP (Spare Transformer Equipment Program), SPAREConnect, and RESTORE (Regional Equipment Sharing for Transmission Outage Restoration).

Mobile transformers are another option for speeding up reaction times. They have proven to be essential for utilities when it comes to fast response to transformer outages, but their size and weight have been a limiting factor when it comes to deployment. That's changing, however, with the adaptation of modern materials and advanced designs. The marketplace for mobile transformers is growing as are the number of suppliers. Delta Star, Siemens Energy, GE, Hitachi Energy, and Southern States are a few of the companies providing mobile transformers.

Speeding up Deployment

Siemens Energy has been attracting attention with its innovative approaches for mobile transformer applications called the "Multi-Voltage Pretact Mobile Resilience Transformer." According to Siemens Energy, these mobile units are designed for, "ease of transportation, flexibility to system conditions,

and minimization of installation time." By using single-phase transformers the mobile units are compact, which minimizes transportation limitations. Once onsite they can be configured into three-phase units with cabling, quick-connect cooler piping, and conservator tanks.

In addition to mobile transformers Siemens Energy offers another option for utilities and renewable generation facilities. Siemens Energy's brochure leads off by saying, "Stored in the U.S. – available on demand." That refers to a GSU (generator step-up unit) that can be leased. Talking with Siemens Energy U.S.'s Scott Gray, Technical Support Manager, and David Calitz, Transformer Specialist Engineer, highlighted some interesting facts about the GSUs and the leasing program.

GSU lease transformer. Courtesy of Siemens Energy.

Gray started off the discussion saying, "The idea of leasing a smaller (70 MVA) mobile transformer isn't a new one, but taking a multi-voltage Pretact 250 MVA GSU transformer, and making it available as a leased unit was a pioneering step for Siemens Energy. The leasable GSU was delivered to the U.S. in 2019. Shortly after, Siemens Energy began evaluations with multiple customers, working together closely studying the units, the ratings, and the application. Then in 2021, a GSU at a combined cycle plant in Ohio failed."

Gray continued, "It was determined that the rapid response leased GSU was a compatible replacement for this failed GSU. The Pretact Mobile Resilience Transformer was leased and deployed. The easy-to-install Pretact technology resulted in the facility being returned to service in less than two months, which was much faster than the typical replacement scenario."

Calitz explained, "The GSU transformer application utilizes three single-phase modular units for compactness with plug-and-play bushings and cable connections for operational flexibility. It also takes advantage of high temperature insulation material (aramids), to make the units as lightweight as possible. Each single-phase unit is rated 83.3 MVA, which allows the mobile unit to be configured to replace GSUs up to 250 MVA. In the voltage category, they have multi-voltage ratings on both the high and low voltage terminals for more flexibility. Siemens Energy has also made the units environmentally friendly by filling them with biodegradable synthetic ester insulating fluids. It reduces environmental contamination risks during transport and operation."

Gray pointed out, "Siemens Energy saw a need for leased transformers to fill the gap for users without spare units. The current solution is a single unit, but Siemens Energy is evaluating an enhanced portfolio to serve customer needs. The leased GSU was initially deployed for 10 months beginning in 2021. Just as soon as that deployment ended, another customer leased the unit. Today, the unit is on its third deployment, and it has been in service continuously since 2021. The product has proven to be a valuable resource for the lessees. The current solution is a single unit, but Siemens Energy is evaluating the program to determine if more leasable units should be built and offered to the marketplace."

Flexibility

When it comes to fast replacement of an LPTs, it's all about flexibility. In early 2022, the prototype "flexible LPT" was commissioned and placed in service. This first-of-its-kind transformer is funded by DOE's TRAC (Transformer Resilience and Advanced Components) program and being managed by NETL (National Energy Technology Laboratory). The "flexible LPT" was designed and built by GE and Prolec GE.

It's designed to be adaptable for a wide range of voltage ratios and impedance levels. This flexibility can cut down on manufacturing costs and time. It also does away with the need for customized, one-of-a-kind LPTs. The protype was installed at a Cooperative Energy substation in Columbia, Mississippi where it's operation is being evaluated.

There is no easy solution to this issue. Experts agree, however, on one thing when it comes to LPTs and the growing risk of failure, it's important to perform a risk analysis on each of the LPTs on the grid. Stakeholders should determine the criticality of each unit, its health, and how fast it can be replaced. Is there a spare available, or what about a parallel LPT, and how much of the load can it be expected to pick up?

LPTs are assets when they operate correctly, but quickly become a liability when they aren't. Keeping them in the asset column has been complicated by climate-change-induced extreme events. To battle global warming we need to take advantage available. Being able to lease an LPT is an innovative step in the right direction as is the "flexible LPT" project. Standardization of LPTs is another step that should be taken advantage of to make sharing units between utilities easier. It's an ambitious task, but it's necessary for grid resiliency! TDW

BIG WIRES ACT INTRODUCED TO ADDRESS SHORTFALL OF TRANSMISSION CAPACITY

U.S. Senator John Hickenlooper (D-Colorado) and Representative Scott Peters (D-California) last week introduced the *Building Integrated Grids With Inter-Regional Energy Supply (BIG WIRES) Act*, legislation to update and streamline the country's patchwork energy transmission system.

"If we want to maintain our national security amidst growing international conflict, make our power system more reliable, and cut high energy costs for Americans, we can't have a faulty, outdated electric grid," said Hickenlooper. "Our bill advances two priorities simultaneously: make electricity more affordable and build a power grid fit for the 21st century."

"During a heatwave, hurricane, or other natural disaster, the last thing you want is for the power to go out. It can be the difference between life and death," said Peters. "There is no reason neighboring electrical grids should not have the capacity to share power during these situations to avoid blackouts. The associated buildout of electric transmission lines would greatly improve reliability and keep costs down for consumers. BIG WIRES will help get clean, reliable energy from where it is produced to where it is used by people, but above all else, it is an American energy security and independence bill."

In an age of energy innovation, the United States' electrical grid still can't move large amounts of energy from one part of the country to another. Meanwhile, new energy projects are stuck paying expensive fees to connect numerous, smaller transmission lines to the existing grid, like building new highways to crisscross the U.S every time we want to connect two towns. This haphazard buildout has led to lower reliability and higher costs for consumers.

Hickenlooper and Peters' legislation, which will be formally submitted Monday, proposes a fix to this issue by directing the Federal Energy Regulatory Commission (FERC) to better coordinate construction of an interregional transmission system. Specifically, the bill would require each of the FERC transmission planning regions to be able to transfer 30% of their peak electrical loads to neighboring regions, working to close current gaps in the nation's transmission network: instead of building new highways, building new exit ramps off the existing interstate.

The BIG WIRES Act would:

- Improve Electrical Grid Reliability: Establishing minimum-transfer requirements would enable greater interregional power flows, which is key to electrical grid resilience against extreme weather events like Winter Storms Uri and Elliott.
- Reduce Energy Costs: Upgraded transfer capabilities would dramatically lower energy costs for American families, both by allowing regions where power prices are cheap to sell to regions where it is more expensive, and by allowing all regions to connect new, low-cost resources to the grid.
- Be Tech-Neutral: All types of generation – fossil, renewable, and nuclear – need transmission to connect to the grid. Relieving grid congestion gets energy where it is needed, more efficiently.
- Prioritize Regional Flexibility: In meeting the minimum-transfer requirements outlined in the bill, FERC regions decide how they will upgrade their systems.

102804004 © Makenzie Newman | Dreamstime.com

Notably, this bill would cost the government no money, according to Hickenlooper's statement. Instead, utilities and transmission developers within each of the transmission planning regions would be responsible for upgrading the grid. Because interregional transmission makes the grid more efficient, in the same way that interstates make our road systems more efficient, money spent on new lines would be more than offset by savings on numerous smaller projects.

The BIG WIRES Act garnered national attention in May when it was proposed as a possible component to a debt ceiling compromise. ■

ENTERGY MISSISSIPPI REPLACES MORE THAN 1,000 WOODEN TRANSMISSION POLES

Entergy Mississippi launched a project last year to accelerate the replacement of existing wooden transmission structures with steel or concrete poles, with the goal of replacing all wooden poles in 12 to 15 years. The replacement of the wood structures represents the majority of a $28 million annual investment Entergy Mississippi is making to harden the grid. So far, more than 1,000 aged wood structures have been replaced.

"We identified wooden transmission structures in need of replacement across the state," said Shawn Corkran, vice president of reliability, Entergy Mississippi. Additional crews were brought on the system for the execution of the incremental work to replace the structures holding the lines, which will fortify the grid; these additional crews will also be available to help restore damaged transmission lines, improving the restoration times during unplanned outages or outages that may occur during storms. An investment in infrastructure now pays dividends in fewer outages and lower bills for customers today and in the decades to come. ■

DTE ENERGY ANNOUNCES PLAN TO IMPROVE RELIABILITY BY OVER 60% IN NEXT FIVE YEARS

As part of its five-year, $9 billion plan to build the grid of the future, DTE Energy will today has filed reliability (Distribution Grid Plan) with the Michigan Public Service Commission. The plan accelerates system upgrades, with a goal of improving reliability for customers by more than 60% over the next five years. As part of this roadmap, DTE announced three customer-focused goals:

- Increase average reliability by over 60% within five years, putting DTE on track to be in the top half of best performing utilities nationwide for both the frequency and duration of outages.
- Transition to a smart grid with full automation within five years, resulting in smaller and shorter outages.
- Within three years, 90% of the circuits in Detroit will have been updated, with the remaining 10% actively undergoing upgrades.

Highlights of the reliability roadmap include:

- Trimming more than 30,000 miles of trees throughout DTE's service territory.
- Updating more than 10,000 miles of existing infrastructure.
- Rebuilding some of the oldest sections of DTE's grid to increase capacity and reliability, including new substations in Detroit, Ann Arbor, Port Huron, Almont Township, Lenox Township, Van Buren Township, Plymouth Township and Lapeer. Where it makes sense, overhead equipment will be relocated underground.
- Fully automating the grid within five years by installing 10,000 smart devices, allowing for faster identification of damaged areas and rerouting of service for most customers during an outage.

Over the past five years, DTE has invested more than $5 billion in its electric grid and the company will invest an additional $9 billion over the next five years as part of its plan to improve reliability.

With this investment, the company will accelerate its four-point plan already being executed, focusing on work that delivers the most reliability improvements for customers: trimming trees, updating existing infrastructure, rebuilding significant portions of the grid and accelerating the transition to a smart grid. These investments will not only harden the grid against more frequent and extreme weather events but will also support Michigan's energy transition, including electrification and distributed generation.

"We are committed to building the grid of the future," said Matt Paul, president and chief operating officer, DTE Electric. ■

MINNESOTA ELECTRIC UTILITIES ENSURE RELIABILITY WITH 345 KV TRANSMISSION PROJECT

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The Minnesota Public Utilities Commission (PUC) and many Upper Midwest energy companies are together accelerating plans for a 345 kV Big Stone South-Alexandria-Big Oaks project, a transmission project in Minnesota and northeastern South Dakota, to deliver reliable energy to customers and open new pathways for additional renewable energy proposed in the Upper Midwest.

The project consists of two segments, with one running from Big Stone City, South Dakota to Alexandria, Minnesota (western segment) and the other running from Alexandria to Becker, Minnesota (eastern segment).

The eastern segment proposes to pass through a new transmission circuit on existing structures built as part of the CapX2020 Fargo-St. Cloud and St. Cloud – Monticello projects between Alexandria and a new substation on Xcel Energy property near the Sherco power plant in Becker.

The western segment proposes a new transmission line between Otter Tail Power's Big Stone South substation in South Dakota and the Alexandria substation owned by Missouri River Energy Services.

A Certificate of Need application for both segments and a Route Permit application for the eastern segment was filed together. The western segment Route Permit application is expected to be filed in 2024 post an ongoing public outreach process.

The participants included in the project were Great River Energy, Minnesota Power, Missouri River Energy Services, Otter Tail Power Company and Xcel Energy.

With a continued electric reliability and improved system resilience in the Upper Midwest, the project will provide additional capacity to mitigate current capacity issues, maintain electric system reliability, relieve congestion on the grid and allow an economical wind power from western Minnesota and the Dakotas to reach customers throughout the region.

It also supports efforts of energy companies to meet carbon reduction goals and progress towards carbon-free energy standard of Minnesota.

"Investments in transmission are critical to accelerating a sustainable, clean-energy future and are a key piece of Minnesota Power's EnergyForward strategy to safeguard the reliable delivery of energy to our customers and communities in northeastern Minnesota," said Dan Gunderson, Minnesota Power VP of Transmission and Distribution. "Utilities in Minnesota have a long history of planning for the future and the foresight by the Commission and stakeholders in CapX2020 to recognize the value of future capacity is beneficial for our state and region." ■

NATIONAL GRID TRANSPORTATION STUDY HIGHLIGHTS PATH TO READYING GRID FOR ELECTRIC FLEETS

A new study by National Grid and Hitachi Energy emphasizes the need for proactive planning and strategic investment to ensure the grid is primed for electrification of medium and heavy-duty vehicles (MHDVs) like buses, trucks, and vans. The study, "The Road to Transportation Decarbonization: Readying the Grid for Electric Fleets," builds on a 2021 collaborative study conducted by the two companies. This latest study provides insight into what is needed from utilities and external stakeholders, including state and local government, businesses, and communities, as electrification of fleet vehicles ramps up in the coming years.

While the 2021 study evaluated total electric load growth associated with the electrification of more than 50 fleets in one city in National Grid's service area in the Northeast, this study provides a zoomed-in view of electrification's impacts on a specific community.

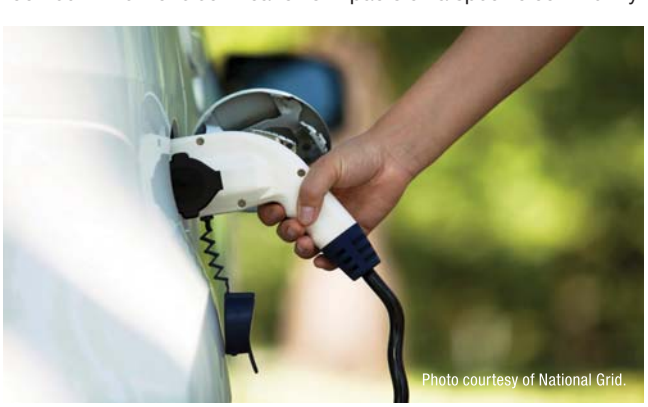


Photo courtesy of National Grid.

By focusing on this case study line, or feeder, the analysis provides snapshots of how the phased introduction of EVs will affect grid infrastructure over time. The study reveals that when just 10% of current MHDVs electrify, peak electric demand on the case study feeder will nearly double. When one-third of MHDVs electrify, the line will exceed its rating and utility solutions will be required to enable further electrification.

The study demonstrates how three infrastructure strategies – electric network reconfiguration, multi-value grid infrastructure upgrades, and non-wires solutions – can meet the identified needs. The case study feeder is what the study identifies as an "Area of Capacity" since it has more headroom than 75% of the distribution lines in National Grid's territory. It can accommodate substantial MHDV charging load without major upgrades. Other "Areas of Need" will have grid headroom constraints or contingency requirements, and the three grid infrastructure strategies allow readers to apply study insights to these areas.

The study indicates that, to maximize efficiency and reduce costs, utilities should consider each location's near and long-term needs and existing capacity on the grid. In doing so, utilities can support early electrification in Areas of Capacity with minimal cost while targeting investment to Areas of Need, ensuring no community is left behind.

The study calls for a coordinated response, including utilities, regulators, businesses, communities, and others, to meet the forthcoming challenges. The study suggests that regulatory and planning structures must evolve to accommodate MHDV electrification, and new partnerships must arise to support the electrification journey.

National Grid recently submitted a Future Grid plan in Massachusetts to implement wide scale upgrades in the state that would improve network infrastructure, implement new technology and platforms, and install new customer programs to provide more customer choice and control.

The Future Grid plan is intended to upgrade the grid to enable, among other benefits, the ability to charge 1.1 million EVs by 2030. In New York, National Grid is active in a new regulatory proceeding established to address the grid demands of MHDV charging. In both states, National Grid supports its customers in installing EV charging through make-ready incentives, fleet assessments, and rate options. ■

CON EDISON EXECS OUTLINE SUBSTATION BUILD PLANS

Consolidated Edison Inc. plans to add five distribution and transmission substations by 2028 to its network on Long Island to meet growing demand, executives said Oct. 3.

Outlined as part of a broader investor presentation, the projects include the $810 million Brooklyn Clean Energy Hub transmission site that was approved in April by the New York State Public Service Commission and on which the company broke ground last week eyeing a 2027 completion date. Con Edison's plans also call for transmission stations in the Vinegar Hill neighborhood of Brooklyn (expected to be completed in 2025) and in Eastern Queens.

That latter project will be accompanied by a distribution substation as Con Edison works to upgrade its services in conjunction with the modernization of the nearby John F. Kennedy International Airport. Matt Ketschke, president of Consolidated Edison of New York, said the work in Eastern Queens will split into two the company's existing network and should be finished in 2028.

The outlined transmission and distribution substation works build on investments Con Edison is making in its transmission lines in the area. In May, the company wrapped work on a six-mile transmission line in Queens. Together with work on lines in Brooklyn and on Staten Island, the company will add 900 MW of transmission capacity by 2025.

All of these projects are part of Con Edison's three-year, $14.6 billion spending plan that looks to set the company on a path to have all of its electricity be green by 2040. Its CECONY and Orange & Rockland utilities plan to spend a combined $72 billion in the coming decade to that end and Con Edison Chairman and CEO Tim Cawley said Oct. 3 that work and other investments in transitioning to clean energy are bearing fruit.

"We are seeing real, measurable results every day," Cawley said, calling out the fact that, with help from energy efficiency programs run by his team, the company's customers recently passed the 100 million MWh mark in energy savings.

Another project toward this end could come from the company's geothermal business. New York's PSC has called for pilot project proposals using geothermal energy and Kathy Boden, Con Edison's senior vice president of gas operations, said the company has submitted plans for a number of pilots to connect multiple buildings and share geothermal energy as well as waste heat. The total cost of those pilots, Boden added, is about $308 million.

Shares of Con Edison (Ticker: ED) were changing hands around $83.10 following the presentation, an increase of nearly 2% from their prior-day close. Over the past six months, however, they have fallen more than 10%, trimming the company's market capitalization to about $29 billion. ■ *—Geert de Lombaerde*

SPP RTO WILL EXPAND WITH COMMITMENTS FROM WESTERN UTILITIES

Southwest Power Pool (SPP) will soon become the first organization in the U.S. to provide full regional transmission organization (RTO) services in both the Eastern and Western Interconnections of the nation's power grid. SPP has received commitments from seven western utilities to become full members in the RTO. Basin Electric Power Cooperative, Colorado Springs Utilities, Deseret Generation and Transmission Cooperative, Municipal Energy Agency of Nebraska (MEAN), Platte River Power Authority, Tri-State Generation and Transmission Association, and three regions of the Western Area Power Administration (WAPA)—Colorado River Storage Project (CRSP), Rocky Mountain Region (RM) and Upper Great Plains-West (UGP)—are preparing to join the RTO in early 2026. The expansion of SPP's service territory is expected to create economic and reliability benefits for its member companies through access to a larger generation fleet, greater geographic diversity, and increased trading opportunities in SPP's energy markets.

Regional transmission organizations.

Since October 2020, SPP has been working with parties interested in evaluating the benefits and requirements of RTO membership. In addition to at least $49 million in annual savings according to a study conducted by the Brattle Group, this group of western utilities also identified opportunities to leverage a number of benefits from SPP services to achieve renewable energy goals, protect reliability, enable more holistic transmission planning, and participate in a day-ahead wholesale electricity market. WAPA and Basin Electric announced their decision to pursue membership in the SPP RTO this month, rounding out the group of new members that will now prepare for participation in SPP's governance structure, energy markets, planning processes and other services."

The commitments of these utilities solidifies SPP's long-term strategy for RTO and market expansion to bring increased value to existing and new members. Additionally, this growth will allow SPP and its members to enhance sustainability and reliability in the west and involves optimizing energy markets across three DC ties, creating new opportunities for energy transfers and increased resilience for both current and future members. This is the first major expansion of SPP's RTO service territory since October 2015 when it grew from 9 to 14 states by incorporating the Integrated System into its full suite of market and transmission services.

"The expansion of our RTO will open a vast array of opportunities for utilities in SPP's growing market footprint" said Bruce Rew, SPP senior vice president of operations. "Creating multiple market options for new members will enable market designs that align with the unique needs of one or more geographic regions and provide opportunity for all to benefit."

The western utilities now pursuing RTO membership are currently participating in the SPP Western Energy Imbalance Service (WEIS) market. The WEIS, which facilitates efficient real-time energy dispatch, provided an estimated $31.7 million in net benefits for participants in 2022 and reduced wholesale energy costs by $1.35/MWh. The noted enhancements to reliability and increased value for participants was a key driver for making the move to full RTO membership.

SPP anticipates further expansion of its RTO service territory in the west and will integrate additional members beginning in 2027. Other western entities interested in joining SPP's growing RTO market footprint have a deadline of March 1, 2024, to signal their interest if they wish to participate in the market by March 2027.

SPP currently has 110 member companies in the Eastern Interconnection, has operated as an RTO since 2004, and has managed regional reliability since 1941. ■

NEXTERA ENERGY TRANSMISSION SOUTHWEST TO BUILD 345 KV TRANSMISSION PROJECT

Southwest Power Pool's (SPP) board of directors has approved an industry expert panel (IEP) recommendation for NextEra Energy Transmission Southwest, LLC to build the Crossroads-Hobbs-Roadrunner transmission project. The proposed 90.5-mile and 44.5-mile, 345-kilovolt lines will connect the Crossroads, Hobbs and Roadrunner substations in New Mexico, will cost an estimated $291.6 million to construct and are expected to be completed in 2026. The board approved Southwestern Public Service Company as the alternate builder.

The IEP evaluated this project through its competitive transmission owner selection process, which is required under the Federal Energy Regulatory Commission's (FERC) Order No. 1000 for certain transmission projects. It is the fifth project for which SPP facilitated this process.

In response to FERC's Order 1000, SPP annually forms a pool of individuals used to create an industry expert panel who reviews, ranks, and scores proposals for certain transmission projects approved for construction by the SPP board of directors.

EVERSOURCE READY TO BRING SMART METERS TO CONNECTICUT CUSTOMERS

As Eversource continues to modernize the electric system to increase reliable service and benefits for its customers, the energy company is focusing on investing in Advanced Meter Infrastructure (AMI). The new technology provides automatic, real-time information to Eversource when a power outage happens, eliminating the need for customers to report the outage and enabling the company to respond and restore the power interruption more quickly outside of a major storm.

Eversource's proposal has multiple aims, leading with the need to balance smart meter implementation with customer affordability, the need for "ready and willing" collaboration among all stakeholders to maximize the benefits of the program, and the recognition that this technology serves the state well in reaching its goals to fight the devastating effects of climate change. With the current electric meters across the state nearing the end of their useful life, conditions are favorable to engaging on the quickest, efficient pathway to accomplish these goals for Connecticut customers. The energy company started implementing AMI in Massachusetts earlier this year and is prepared to work with regulators to make this program a reality for Connecticut customers.

The AMI technology also paves the way for Eversource to collaborate with PURA and other regulated electric operations companies to establish a new rate structure that would allow for costs to be based on peak times and lower usage periods. Customers would also be able to set usage and bill alerts, letting them know when their bill reaches a certain dollar amount or a certain kWh usage, so the customer could adjust accordingly. ■

DOE ANNOUNCES $350 MILLION FOR LONG-DURATION ENERGY STORAGE DEMONSTRATION PROJECTS

The Biden-Harris Administration, through the U.S. Department of Energy (DOE), has announced about US$350 million for emerging long-duration energy storage (LDES) demonstration projects capable of delivering electricity for 10 to 24 hours or longer to support a low-cost, reliable, carbon-free electric grid. Funded in part by President Biden's Bipartisan Infrastructure Law, this funding opportunity will advance new renewable energy technologies, enhance the capabilities of customers and communities to integrate grid storage more effectively, increase grid resilience, and expand America's global leadership in energy storage.

Together with the President's Inflation Reduction Act, which provided expanded clean energy tax credits for energy storage installation, this new investment is meant provide businesses the confidence they need to build and deploy innovative clean energy technologies.

"Advancing energy storage technologies is key to making energy generated from clean renewable resources available for 24/7 use, and is critical to achieving a decarbonized power grid and reaching President Biden's ambitious climate goals," said Jennifer M. Granholm, U.S. secretary of energy.

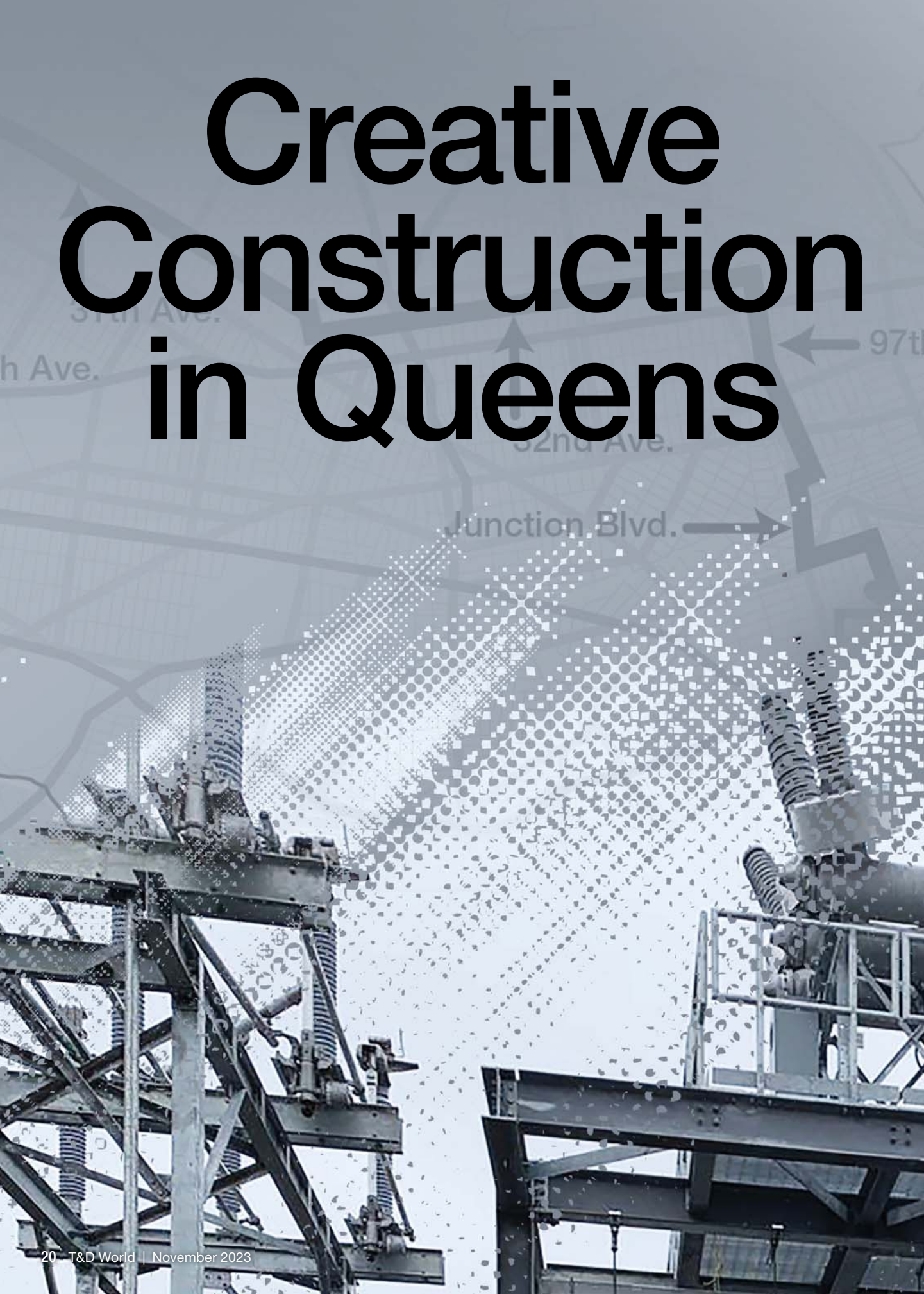
As the U.S. moves toward a carbon-free electric grid that relies more on diverse renewable energy generation, the need for reliable LDES that can supply enough energy for long periods of time and during periods when energy generation is reduced or unavailable becomes more essential. Today's energy storage technologies are not sufficiently scaled or affordable to support the broad use of renewable energy on the electrical grid. Cheaper, longer duration energy storage can increase community involvement in local power systems, build resilience for communities, and minimize disruptions.

The LDES Demonstrations Program will be managed by DOE's Office of Clean Energy Demonstrations and will fund about US$350 million for up to 11 demonstration projects — projects that will contribute to the Department-wide goal of reducing the cost of grid-scale energy storage by 90% within the decade. DOE will fund up to 50% of the cost of each project to catalyze impactful LDES demonstrations and open enormous new possibilities for clean, baseload power. The program aims to fund projects that will overcome the technical and institutional barriers that exist for full-scale deployment of LDES systems by focusing on a range of different technology types for a diverse set of regions.

To ensure these projects create good jobs and benefits for communities, the funding announcement includes a community benefits plan from each applicant. Community benefits plans are based on a set of four core policy priorities: investing in America's workforce; engaging communities and labor; advancing diversity, equity, inclusion, and accessibility; and implementing the Justice40 Initiative. These key principles, when incorporated comprehensively into project proposals and executed upon, will help de-risk these projects to ensure that the transition to a clean energy economy benefits all Americans.

Letters of Intent are due by Dec. 15, 2022, and full applications are due by March 3, 2023. Additional funding opportunities may follow this announcement to validate and accelerate commercialization of LDES technologies. In October, DOE issued a US$ 30 million Lab Call Announcement for Long-Duration Energy Storage Demonstrations. Remaining funding for LDES programs will be covered at a later date. ■

Creative Construction in Queens

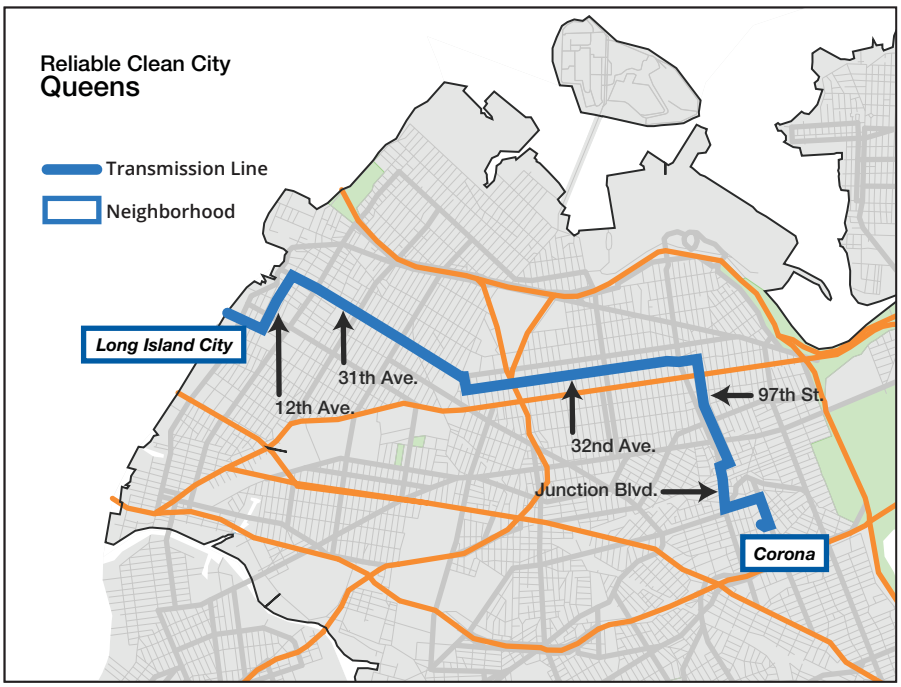


Consolidated Edison considers options for building new underground transmission lines that will carry increasing amounts of renewable energy to customer in New York City.

By **WALTER ALVARADO**, Consolidated Edison Co. of New York Inc.

When New York state adopted a regulation limiting nitrogen-oxide emissions from peaker power plants, Consolidated Edison Co. of New York Inc. was supportive. Con Edison has reduced its own nitrogen-oxide emissions by 70% since 2005, earning the utility recognition as a leader in the region's clean energy transition.

However, the utility realized it would need the talent and creativity of its 13,000 team members to find solutions that ensured continued reliable service to its dense service area once the new rule went into effect. Four years after the adoption of the regulation, Con Edison is well on its way toward completing three new underground 138-kV transmission lines that will carry increasing amounts of renewable energy to customers.



Planned 138-kV underground transmission lines.

The lines, which earned the support of the Sierra Club, are part of the utility's Reliable Clean City program, a major component of Con Edison's strategy in transitioning from fossil fuels to renewables. The company is determined to continue providing customers with industry-leading reliability. Its reliability is essential in a the city that is home to the World's Financial Capital, important transit systems, world-class hospitals and schools, and a 24/7 lifestyle.

New Energy Landscape

The new 138-kV lines are like giant extension cords. Each cable will make it possible for renewable energy — flowing from upstate New York and Canada to the utility's service area — to reach more customers. When complete, the lines will carry a total of 900 MW.

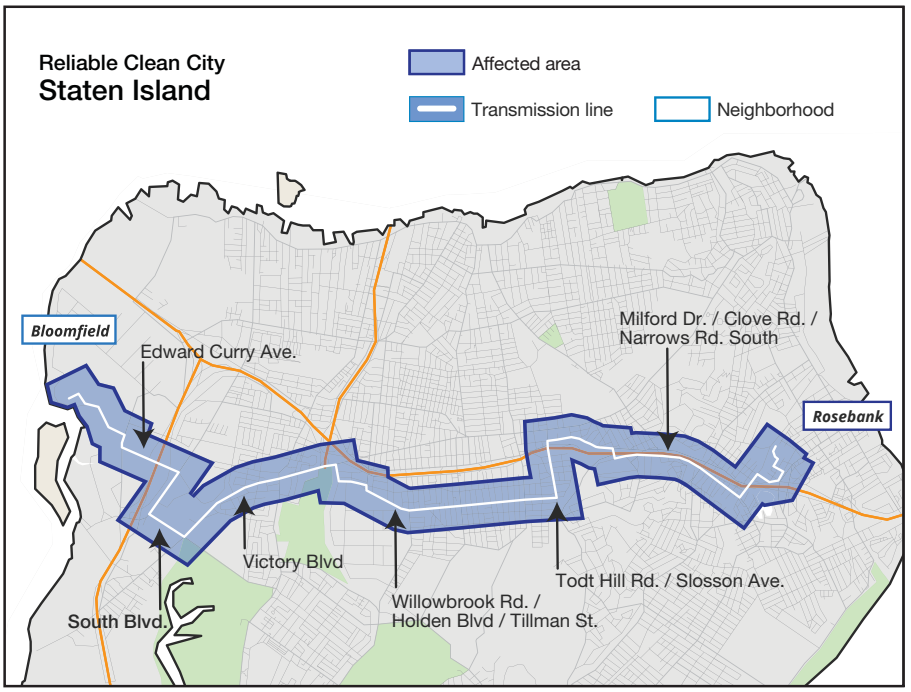
In 2026, clean power will flow from the Champlain Hudson Power Express via a 339-mile (546-km) cable that runs from the Canadian border to a converter station on Con Edison property in western Queens, New York. The lines will also carry some of the 9000 MW of offshore wind power New York is adding to its portfolio.

The Reliable Clean City projects are an example of how Con Edison is thriving in the new energy landscape. The utility must move more quickly and plan with a longer-term perspective than in the past, as the need for power is growing more

rapidly than at any time in history due to the electrification of buildings and vehicles.

In May 2023, crews completed the first project, a 6-mile (9.7-km) line that connects two substations in Queens. This line and associated substation upgrades enabled the closure of a 558-MW fossil fuel-fired peaker plant in the western Queens neighborhood of Astoria.

The symbolism of this site's transformation is notable. NRG Energy sold the property to Beacon Wind, which will create a point of interconnection for its planned offshore wind turbine projects.



Affected areas along lines.

Time and Budget

Thanks to creative construction processes, Con Edison finished its Queens line and associated upgrades on substations in Corona and Long Island City, New York, in two and a half years. The utility budgeted US$275 million but now expects to save $40 million.

In Brooklyn, New York, a 1-mile (1.6-km) feeder will connect two substations, while in Staten Island, New York, a 9-mile (14.5-km) cable will connect two substations on opposite sides of the island. These projects will start serving customers by 2025.

The New York Department of Environmental Conservation's 2019 rule required peaker units with 15 MW of capacity or more to comply with the new limits from May through September, the so-called ozone season. This season is when air quality is the worst and demand for power peaks in New York, as customers use their air conditioners to stay comfortable.

The regulation was well-founded. When coupled with volatile organic compounds in the atmosphere, nitrogen-oxide emissions lead to the formation of ozone and smog. Elevated ozone concentrations can irritate people's eyes and respiratory systems as well as aggravate the symptoms of asthma sufferers.

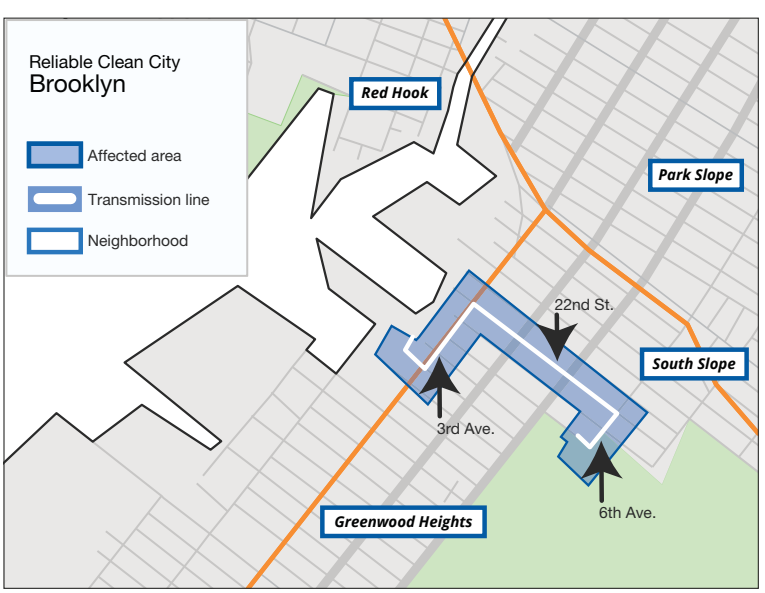
The regulation also was consistent with New York State's Climate Leadership and Community Protection Act, which sets out the most ambitious environmental goals in the U.S. As Con Edison makes clear in its Clean Energy Commitment, the utility supports the law and is building a grid to carry 100% clean energy by 2040. It offers incentives for building electrification and the installation of electric vehicle charging stations, as part of transitioning away from fossil fuels to a net-zero economy by 2050.

If a peaker unit could not comply, the owner had two choices: Stop operations during the ozone season or use renewable generation or battery storage to get emissions to the allowable level. Many of the peaking units have played a critical role by supplying power to certain areas, known as transmission load areas, in New York City. These are transmission-constrained areas where meeting demand requires local generators due to transmission limitations.

The fossil fuel-fired, simple-cycle combustion turbines run at times of high demand and are low in efficiency and high in emissions.

The Right Solution

In 2020, The New York Independent System Operator and Con Edison agreed that, with the peakers unavailable, the local transmission system could not reliably serve the forecasted load in New York City. The utility studied numerous options to solve this issue, including building a new transmission substation, expanding an existing transmission substation and transferring



The first project.

An aerial shot of Con Edison's Rainey Substation in Queens. The utility budgeted US$275 million for T&D projects in Queens, but now expects to save $40 million. Photo courtesy of Con Edison.

one or more networks to new distribution area substations. All these options were too costly.

The utility also considered whether deploying renewable generation or energy storage within the transmission load areas would be the right solution. However, it was clear the lack of adequate space within the transmission load areas meant neither large-scale solar generation nor energy storage were viable solutions. Also, storage in these areas would not fully address the reliability needs because the deficiencies can last up to 14 hours a day for consecutive days, longer than storage could support.

Once Con Edison settled on the Reliable Clean City program as the right solution, it turned to execution of the first project in Queens, which had to be completed by May 2023. Under a tight timetable, the utility had to find a way to work all 12 months, rather than halting substation work in the summer to avoid taking feeders out of service during high demand.

The Rainey Substation from the ground up. In May 2023, Con Edison crews completed a 6-mile (9.7-km) line that connects two substations in Queens. Photo courtesy of Con Edison.

The utility decided if it needed to do below-grade work at a station, it would reinforce those structures — instead of demolishing them and building anew. This approach resulted in the utility being able to perform work without taking feeders out of service, meaning it could work throughout the summer.

The utility also moved the project along by hiring an engineering, procurement and construction contractor to manage the project from design to construction.

Another key to its success with the Reliable Clean City program in Queens was early, open communication with elected officials, neighborhood groups, business organizations and other stakeholders. The utility created new communication channels and held open houses to ask what it could do to accommodate customers before starting work. It also sent mailers, texted messages and placed signs along the construction route. Con Edison's approach to the Queens project built trust and reduced complaints as work progressed. The utility did not have to stop a job to reassure the community.

All-In Approach

Thanks to the resourcefulness of the utility's engineers and planners, as well as the skilled work of the union workers in the field, the utility is building projects that will bring numerous benefits. Not only will the Reliable Clean City program help to facilitate the transition away from fossil fuels and provide a pathway to deliver clean energy to customers, but it also will provide redundancy for existing transmission infrastructure, boosting reliability.

Safe, reliable service — the goal of every utility — takes on even greater importance for Con Edison because of its particularly dense service area. The utility is now embracing a third imperative: leading the region's fight against climate change.

The Reliable Clean City projects are part of Con Edison's all-in approach to lower carbon emissions and help New York, both the state and city, meet their environmental goals while continuing to deliver first-class reliability. The utility also has begun construction on the Brooklyn Clean Energy Hub, a separate project that will strengthen grid reliability while potentially acting as a plug-in point for future offshore wind farms. In addition, the utility has robust energy-efficiency programs that have helped customers in New York City and Westchester County, New York, connect 60,000 rooftop solar projects with the cumulative capacity to produce 540 MW of clean, renewable power. The combined efforts of Con Edison, its customers, regulators and elected leaders are ensuring a safe, sustainable future for those who live and work in this great city. TDW

WALTER ALVARADO is vice president of system and transmission operations for Consolidated Edison Company of New York, Inc. He has responsibility for transmission planning, system operations, transmission operations and transmission project development for 3.6 million customers. Before assuming his current position in 2016, he served as vice president, Staten Island electric operations. Alvarado has held numerous other positions since joining the utility as a management intern in 1992. He holds a master's degree in computer science and a bachelor's degree in mechanical engineering from New York University Polytechnic.

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With a growing season of March through November in the state of Alabama, vegetation growing in the now inaccessible utility right of way resulted in maintenance and reliability challenges. Photo by Alabama Power.

Green Valley Distribution Undergrounding Project

The Southern Co. unit's Central Engineering Green Valley project achieves simpler maintenance and better reliability with undergrounding distribution lines.

By **HOLLY JOINER**, Alabama Power Co.

Alabama Power seeks to continuously improve service and reliability in communities across the state. We are now more connected than ever both at home and work, and these enhancements are increasingly important to better serve 1.5 million Alabama homes, schools, businesses, and industries that depend on us. The Green Valley Distribution Underground project is one example of how Alabama Power is investing in Alabama.

Historically, distribution lines have only been installed underground when a customer was willing to pay the differential upfront cost between the underground installation and the overhead installation. However, the world around us has changed. Costs to maintain reliable overhead service to customers, like vegetation management, have increased. In some cases, lines now have restricted access due to the development patterns of older residential areas. Restricted accessibility results in longer restoration times for customers.

Undergrounding for Better Service

The Central Engineering Undergrounding Program uses system outage and maintenance cost data to identify existing overhead distribution lines that would be beneficial to underground, thus upgrading our power grid's infrastructure to decrease the number and length of power outages experienced by customers.

The Central Engineering Green Valley project is an example of converting an aged, access-constrained overhead line to a roadside-underground line resulting in improved reliability and reduced future maintenance costs. The existing overhead distribution line was constructed in the 1960's during the early stages of the Green Valley Residential development. Over the years, lots were developed with homes, fences, sheds, landscaping, and various other common residential property features. Restricted easement access in an established residential area with mature vegetation requires manual tree trimming using climbers on a more frequent cycle than easements that can be accessed with machinery and buckets. This can increase routine maintenance costs.

The goal of the Green Valley Distribution Underground Project was to remedy those challenges by relocating the rear-lot overhead distribution system to a front-lot underground distribution system. The front lot underground system was installed along the front of customer properties along a combination of newly obtained private and municipality right of way. Relocating the distribution system in this manner upgraded Alabama Power grid's infrastructure, decreasing the number and length of power outages experienced by customers.

The Green Valley undergrounding project was a challenge from both a size and complexity perspective. Approximately 8,000 feet of overhead was located rear of customer properties serving 101 separate meters. Relocating the line would require

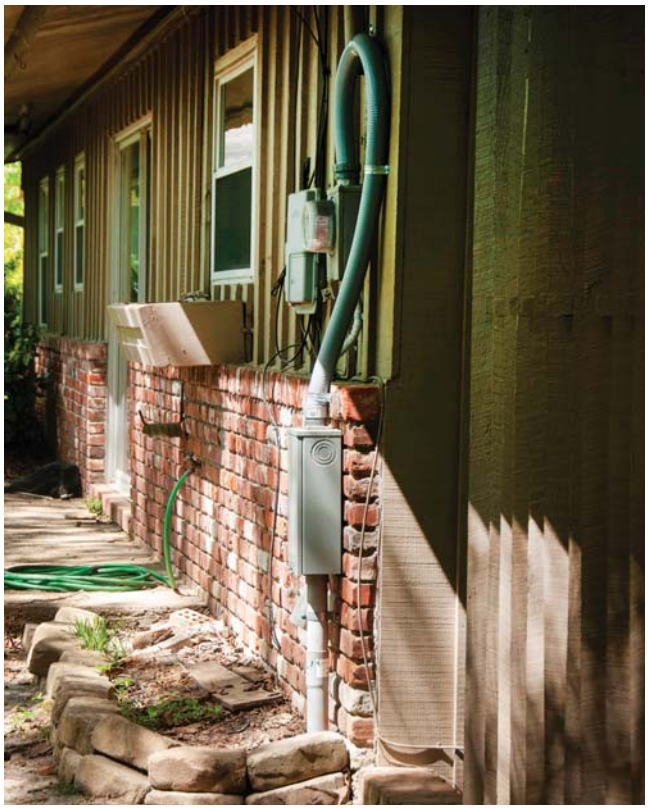
a new property easement from each landowner. Educating the customer quickly became a necessary goal to ensure customer satisfaction and buy in.

Two weeks prior to fielding, letters were sent to property owners informing them of the up-coming project, providing them with a point of contact and advanced notice that field personnel would soon be in their area gathering field notes for design purposes. Next, individual appointments were established with customers to discuss the project's reliability benefits and its construction and facilities footprint on their property.

Keeping Customers Happy

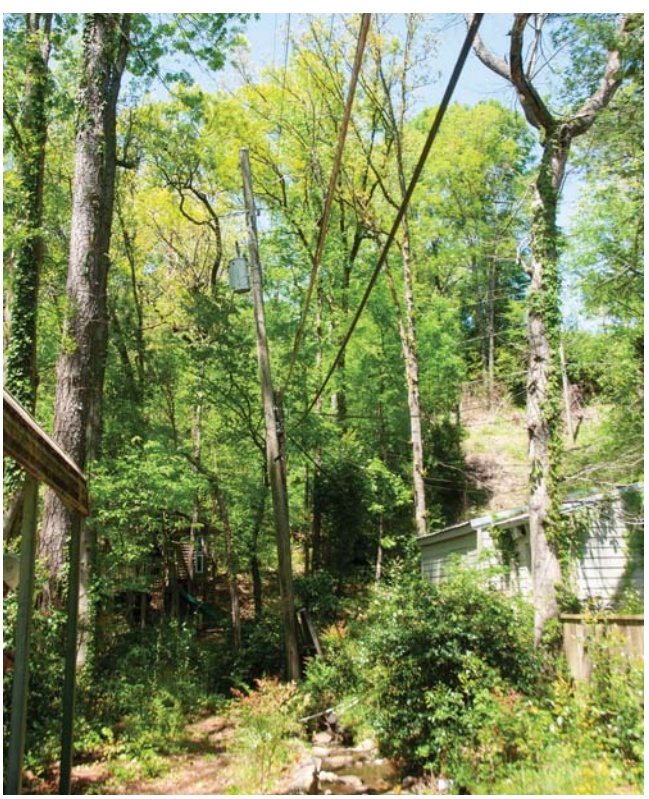
Customer engagement was very high. Green Valley is a residential area with a diverse demographic including young families, retirees, and work at home professionals. Primary concerns heard from customers were associated with limiting the footprint of construction, and Alabama Power's commitment to restore their property to its original quality prior to any construction taking place. These asks were answered by reviewing and editing design where possible, using specialized equipment and construction practices, and agreements to make repairs associated with construction activities.

Customer service was a top priority and relationships with our customers were critical to the success of this project. The customer interaction on the Green Valley project played a part in several standard undergrounding public relations materials that are currently an integral part of the Central Engineering Program.



The goal of the Green Valley Distribution Underground Project was to remedy those challenges by relocating the rear-lot overhead distribution system to a front-lot underground distribution system. Photo by Alabama Power.

Relocating the line would require a new property easement from each landowner. Educating the customer quickly became a necessary goal to ensure customer satisfaction and buy-in. Photo by Alabama Power.



The Green Valley undergrounding project was a challenge from both a size and complexity perspective. Nearly 8,000 feet of overhead was located rear of customer properties serving 101 separate meters. Photo by Alabama Power.

The existing overhead distribution line was constructed in the 1960's during the early stages of the Green Valley Residential development. Photo by Alabama Power.

These standard materials have not only served as educational resources for the customers, but also educating other departments within Alabama Power, such as the customer call center, statewide management, district field employees and several others.

Getting With the Program

Internal education to all the departments within Alabama Power with first line of communication with customers allows them to be knowledgeable about the Central Engineering Program, its mission, and the benefits it is providing to the grid and our customer base. Program educational resources resulting from this project that are now a standard practice on each Central Engineering underground project are provided via multiple medias such as personally addressed letters to customers effected, post cards, door knockers, and an externally accessible website.

Each resource contains direct contact information to a monitored undergrounding email inbox or a project manager associated with a project. These educational resources also serve as a conduit for information to come back into the program such as customer feedback and questions.

In addition to internal program education efforts, the Central Engineering public relations materials were critical in spreading the message about the underground program to key community contacts and third-party entities associated with or effected by the projects in their area.

Educating customers, internal leadership and workgroups, and Alabama Power community partners has served as a strong

platform for program discussion, feedback, efficiencies, and as an opportunity for partnership across all those entities.

Meeting Terrain Challenges

The combination of dealing with 100 landscaped, compact yards over various types of challenging terrain and removing rear-lot overhead facilities required innovative equipment, such as compact boring equipment, rock-boring head adapters, all-terrain boring rigs and rear-lot machines. Diversifying contracted construction equipment allowed for boring in tighter spaces or when encountering rock, where traditional trenching is not an option.

The all-terrain equipment also offered an alternative means of limiting the footprint of construction on a customer's property, which was a helpful option for navigating manicured yards, paved driveways, carports, sheds and other access-limiting factors. Rear-lot machines were used for removing the existing overhead line from customers' confined backyards.

While this equipment is not necessarily practical for all day-to-day work, it certainly has times when it adds value, and this project was an example of one of those times. The engineering team used this experience with the innovative equipment for the design and planning of other projects similar to Green Valley.

Construction's use of the innovative equipment provided an opportunity to learn the equipment and apply seasoned judgment around when to implement it into the construction of a project.

The Green Valley team, left to right: Justin Harrison, Central Engineering Manager; Jonathan Bowen, Central Engineering Underground Coordinator; Wayne Garner, Grid Investment Team Leader; Holly Joiner, Central Engineering Underground Coordinator; Shane Powell, Data Analytics Manager; Adam Carr, Grid Investment Manager. Photo by Alabama Power.

Underground Engineering

Converting the overhead customer services to underground service entrances came with its own set of challenges and opportunities for innovation. Three types of conversion kits were supplied and installed at no cost to the customer. The type of conversion kit used by construction varied by the location and available space around the customer's existing service entrance.

Service entrances that could not be converted – due to lack of room for a conversion kit at the service point – were left with overhead service fed from an inverted secondary riser pole.

Other factors that played into leaving services overhead were customer preference or presence of outdoor lighting. The various

customer service entrance conversion cases were another part of the construction process that required detailed and constant communication between the design team, construction team, and the customer being affected.

Placing the Green Valley distribution lines underground resulted in some operational and maintenance benefits. The line's underground location reduced exposure to trees, vehicles and severe weather that cause most power outages.

In addition, by moving underground the most difficult-to-access and outage-prone line segments, our line crews can focus on other areas after major storms, thus reducing restoration time for all customers. The underground cable was installed in high-density polyurethane conduit adding a dig-in barrier and providing for efficient future maintenance and operation of the system.

Installing an underground distribution system serving 101 active meters across 100 separate properties, needing 100 separate easements. Design and construction navigated many limitations, such as property easement constraints, tight workspaces, various challenging terrains and converting customer service entrances.

The technical complexity, various construction challenges and detailed customer involvement were navigated by a comprehensive design, innovative construction means and methods, and an unwavering dedication to customer satisfaction.

Improved Performance

Approximately 8,000 feet of hard-to-access, overhead distribution line built in the 1960s was removed from the rear-lot of customer properties. The project lasted 18 months from preliminary concept to construction completion.

Green Valley project customers have experienced improvement in customer minutes of interruption (CMI) and in customers interrupted (CI) since construction completion in April 2022. Both metrics directly correlate to improved outage duration (SAIDI) and frequency (SAIFI).

In conclusion, the Green Valley Distribution Underground project was successful in converting an overhead distribution line with limited access to an accessible underground distribution line reducing the number and duration of outages and reducing future system maintenance costs.

In addition to the Green Valley project, approximately 240 other central engineering undergrounding projects have been completed and hundreds like it are being designed. As one of the first for the company, the knowledge and experience gained on this project has shaped central engineering undergrounding best practices from the undergrounding guidelines document to day-to-day decisions in the field. TDW

HOLLY JOINER has 13 years of Power Delivery Distribution experience with Alabama Power. She currently serves as the Connectivity Supervisor for APC's Fiber To Distribution program. Previously, Holly was a Central Engineering Underground Coordinator for APC's Strategic Underground Program

Editor's Note: *This project was the 2023 S.E.E. Industry Excellence Award Winner in the Distribution Category.*

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Exelon has a responsibility to help its communities become stronger and more resilient. One important way it does that is through workforce development. Photo by Exelon.

Exelon Prioritizes Workforce Development

The company has a unified strategy to develop an expanded, diverse talent pipeline.

By **TANIKA DAVIS**, Exelon Corp.

Exelon's more than 19,000 employees work hard every day to keep the lights on and gas flowing for 10 million customers across the Mid-Atlantic and in the Chicago, Illinois, area. Their goal is building a cleaner future for all by working to achieve net-zero operations-driven emissions across the company's six utilities by 2050.

Pipes and wires are the core of what Exelon does, and it is round-the-clock work, critical to the operations and sustainability of the regions it supports. However, the company also knows there is other important work it must do that is vital to the success of its customers and the communities it serves — and that is human work.

Exelon has a responsibility to help its communities become stronger and more resilient. One important way it does that is through workforce development.

"Through our workforce development initiatives, we're transforming communities for the better and working toward a more equitable economy — one job at a time" said Mike Innocenzo, president and CEO of PECO, an Exelon utility.

In 2019, Exelon launched a company-wide workforce development approach, bringing together and building on work that was already happening at each of its six utilities and corporate offices under one unified strategy. The strategy is targeted at enhancing economic stability and prosperity in the areas Exelon serves. It is about changing lives and transforming communities.

An External Strategy

Workforce development is often thought of in the context of job training. Yes, that is one component, but Exelon's approach is primarily an external strategy intended to tackle the long-standing inequities that exist in underserved and under-resourced communities.

Exelon Vice President of Talent and Chief Diversity, Equity and Inclusion Officer Robert Matthews often describes it as "origination vs. destination." The company is focusing on customers who live in or come from underserved or under-resourced communities; that is their origination. It uses workforce development to prepare them to compete for family-sustaining careers in the energy industry; that is their destination.

Jobs at Exelon, with its contractors and suppliers, and elsewhere in the local communities are all in play. Exelon wants its graduates to secure roles at companies that will pay them a wage that enables them to support their families, grow in their careers and thrive. This work is inextricably part of what Exelon is all about: helping to grow the energy workforce of the future, which will innovate to help serve customers and solve business problems and challenges that likely do not even exist today. But,

more importantly, Exelon does this because it believes addressing economic inequities and enhancing prosperity in the areas it serves is the right thing to do.

The communities in the major cities Exelon serves — for example, Atlantic City, New Jersey; Baltimore, Maryland; Chicago; Wilmington, Delaware; Philadelphia, Pennsylvania; and Washington, D.C. — are rich with talent, creativity, vitality and enterprise. Unfortunately, they also experience significantly higher rates of unemployment than the nation's average and higher rates of poverty, due, in part, to racial and economic inequities. According to the Economic Policy Institute's (EPI's) latest figures, in 2019, African American unemployment rates (6.1) exceeded white unemployment rates (3.0) by a ratio of 2-to-1. In fact, EPI has said that "one of the most durable and defining features of the U.S. labor market is the large and persistent disparity in unemployment that exists between Black and white workers." Similar disparities exist among white and Latino workers as well.

Exelon believes it has a responsibility to do all it can to chip away at that disparity. Exelon's President and CEO Calvin Butler said, "When we tolerate this imbalance of resources and opportunities that strongly privileges one group over another, we limit progress for individuals, communities and cities. And that limits progress for all of us."

Butler pushes Exelon employees — and peers in the energy industry — to be all in on bringing about change, and he is right. With its wide range of family-sustaining jobs in fuels, electric power generation, transmission, distribution and storage, energy efficiency, alternative energy, cybersecurity, data analytics, innovation, customer experience and fleet electrification — the electric utility industry should, can and must be a strategic disruptor to economic inequities in underserved communities.

PECO President and CEO Mike Innocenzo (right, standing) greets participants in a PECO Helper Pre-Apprentice program, where workers gain instruction in safety and equipment overview. Photo by Exelon.

Brieanna's Story

Exelon's workforce development strategy is focused on addressing economic inequities and changing lives one career at a time. Take Brieanna Ware, for example. Brieanna lives in the Chicagoland area. She had worked in various customer service jobs for 10

A job training participant at BGE gets utility pole climbing instruction. Photo by Exelon.

The academy provides young women the opportunity to participate in mentor-guided, hands-on activities and experiments, preparing them for future careers in STEM, where women and people of color are traditionally underrepresented. Photo by Exelon.

years and was looking for a career change that would provide her, as a single mother, more stability and better growth opportunities. At a career fair at the YWCA, she learned about ComEd's CONSTRUCT Infrastructure Academy, one of Exelon's job training programs designed to prepare people for careers in the utility and construction fields.

Brieanna was surprised to learn the program offered women the opportunity to train in a variety of roles, including those in the field, which tend to be male dominated. She took a leap of faith and joined the construction field. After successfully completing the 11-week program, she now works at Aldridge Group, an electrical contracting company and ComEd partner, as an assistant project manager. Graduating from CONSTRUCT was a major milestone and turning point in Brieanna's life — and her son's.

"This is like an 'us win,' so it is exciting," Brieanna said. "For the first time, I am proud of myself and just excited to move forward within the field."

She also wants to spread the word about the opportunity that workforce development programs such as CONSTRUCT can provide women. "I stand behind empowering women and getting more women into a male-dominated field. This was something that really sparked my interest," Brieanna said. "My goal is to get away from the stigma of construction being for just males — I would like to normalize this field and encourage other women to join."

Brieanna's story, and so many like hers, is why Exelon has positioned itself as a workforce development thought leader, championing economic equity and transforming the communities in which it operates.

Talent Pipeline

Exelon is steadfast in its commitment to develop an expanded, diverse talent pipeline in a variety of ways:

- Igniting STEM in young minds
- Eliminating barriers to economic empowerment
- Equipping work-ready adults and youth for family-supporting careers
- Engineering and encouraging new ideas in workforce development.

The company's programs try to capture the imagination of future energy workers as early as possible, to get them excited about the STEM and technical careers of today and tomorrow. For example, its annual STEM Leadership Academy connects 10th and 11th grade girls to women working in STEM and other leaders; allows them to explore sustainability, energy efficiency, renewable energy, and climate change; and partners them with like-minded peers while working on a team energy challenge.

Since the academy launched in 2018, 1000 young women — and 80% students of color — have attended the summer program, and more than 400 employees have participated throughout the years in networking engagements and as coaches. The academy provides young women the opportunity to participate in mentor-guided, hands-on activities and experiments, preparing them for future careers in STEM, where

Through its programs, Exelon also works with community partners to manage high-quality workforce training academies that prepare youth and work-ready adults who are unemployed, underemployed or changing careers for family-supporting roles in energy and STEM. Photo by Exelon.

women and people of color are traditionally underrepresented.

Exelon's workforce development programs advocate for policies and practices that reduce systemic barriers and obstacles. They strengthen current and execute new approaches and partnerships with employers, nonprofits and community groups to expand training and job opportunities as well as help to create family-sustaining jobs.

Through its programs, Exelon also works with community partners to manage high-quality workforce training academies that prepare youth and work-ready adults who are unemployed, underemployed or changing careers for family-supporting roles in energy and STEM, such as the one from which Brieanna Ware graduated. They provide construction and skilled trades (CAST) and assistant mechanic operator (AMO) assessments preparation, offer transportation resources, and help participants to obtain their driver's license. They bring people in to attend a climb school, where participants learn to safely climb utility poles. Or they pair them up with mentors as helpers in a pre-apprenticeship role, where they learn on the job while taking courses in safety, electric and gas basics, technical maintenance, tools and other essentials. They provide interview preparation, case management and so much more.

Measure Of Success

Exelon's workforce development programs meet people where they are to help them get where they want to be. Its efforts to date have been successful by almost any measure.

Since 2019, when Exelon first synergized its programs under the current strategy, more than 1500 people have been hired in family-sustaining careers — either internally or externally with partner contractors or other companies in the industry. In 2022, the company invested US$16 million in its workforce development programs because its impact as a business leader is tied directly to the impact it makes every day for families.

For the last two years in a row, Exelon was recognized with the Center for Energy Workforce Development's highest honor, the Chairman's Award, at the national organization's Impact Awards for Workforce Development Excellence. The company will continue to build on that honor by modeling community partnership and leadership for businesses across the utility industry. Exelon plans to do more and do it better.

What do utilities owe the customers and communities they serve, the people who are key to their business growth? For any business looking to grow equitably and sustainably, the answer to that question must be access and opportunity. Exelon knows that as it is powering communities — keeping the lights on and the gas flowing — it is generating a cleaner, brighter, more secure future for its customers. It also is powering opportunity: changing lives and transforming communities — one family-sustaining job at a time. TDW

TANIKA DAVIS (*Tanika.Davis@exeloncorp.com*) is director, workforce development, at Exelon Corp., the nation's largest utility company, serving more than 10 million customers through six fully regulated T&D utilities — Atlantic City Electric, Baltimore Gas and Electric, Commonwealth Edison, Delmarva Power & Light (DPL), PECO Energy Company (PECO) and Potomac Electric Power Company (Pepco).

Husk Power has installed twelve of its mini-grid systems in Nigeria, with a long-term goal of installing 500. Photo by Husk Power.

Localized Distribution Key To Rural Africa and Asia

Mini-grids are the most economical model to provide access to reliable, renewable, affordable and modern power to rural communities.

By **NIKHIL MURARKA**, Husk Power Systems

For emerging markets in South Asia and Sub-Saharan Africa, transmission and distribution have long been overlooked and underinvested, despite its critical role in delivering energy services to the more than 3 billion people who still live without reliable access to electricity.

Husk Power Systems, which owns and operates the largest fleet of community solar mini-grids and T&D networks across rural Asia and Africa, works in low-voltage settings within the overall electricity supply chain and builds last-mile distribution systems that serve off-grid, weak-grid and under-the-grid communities. To date, the company has installed and maintains a distribution network of more than 600 km (373 miles) in length, serving a population of 500,000.

Mini-grids are the most cost-effective way to provide reliable three-phase alternating-current electrical infrastructure to rural and peri-urban communities. They can have major implications on enabling socioeconomic progress in the Global South. For example, extending a national grid to a community 25 km (15.5 miles) away from the point of generation or a transmission substation would require an estimated four times to five times the investment Husk makes in setting up both the generation and distribution assets.

Low-voltage distribution networks often have been neglected in terms of design innovation. However, Husk treats distribution with the same importance as it puts on the generation system in terms of quality and protection. It is investing heavily in research and development (R&D) and working to ensure last-mile electricity delivery makes an important contribution to eradicating energy poverty globally.

Levelized Cost Of Energy

In the power industry, levelized cost of energy (LCOE) generally is calculated only based on generation systems. At Husk, however, LCOE covers the complete system — from point of generation to the consumer, including the distribution assets. As a result, the company is simultaneously optimizing on multiple T&D fronts:

- Use of high-quality, tested and verified material
- Implementation of a preventive maintenance schedule to ensure the health of assets
- Reduction and management of both technical and nontechnical losses
- Deployment of monitoring systems to reduce the cost of maintenance, without compromising reliability.

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Five Focus Areas

Husk focuses on five areas when it comes to its distribution systems:

1. Efficiency — Husk has designed a distribution network that ensures the aggregate technical and commercial losses are under 9%, compared to about 35% in losses by state-run distribution utilities in the markets in which Husk operates. Husk's distribution system delivers less than 6% technical losses and has established management capabilities to control commercial losses under 3%. The major contributors to the reduction in distribution losses has been quicker response times and solving technical and theft-related issues on the grid. Husk has sized its systems using learnings from data on over 15 years of operation. Besides addressing loss reduction, another important area of focus for mini-grid operators is on phase balance, as the mix of users is still 80-to-20 between single phase and three phase, respectively.

Street scene in Kiduna, Nigeria. Despite being Africa's most populous country and the continent's largest economy as well as an important oil and gas producer, Nigeria has about 90 million people still living without electricity. Photo by Husk Power.

2. Life cycle — The life cycle of the system is a critical feature in LCOE management. Thus, it is important to select the best set of components and develop management systems that will ensure they last 20 years to 25 years. Husk focuses on even the smallest items, like cable clamps. It invests heavily in testing and building quality control for all components, including the poles, AB cables and junction boxes used for power distribution. As a part of its asset management practice, the company conducts a routine survey and maintenance of the entire distribution grid to track any major challenges and take corrective actions. A quality control team has also been put into place to manage the health of the infrastructure along the life cycle of the installation.

3. Safety — An essential part of Husk's design is safety, starting from the selection of components through to maintenance. The company has installed circuit breakers at all customer end points as a compulsory process, allowing both switching capabilities and short-circuit protection. Additionally, the distribution point on a pole has additional fault protection. Finally, the plant has multiple levels of protection, including short-circuit protection, earth-fault protection and surge protection — both from lightning and issues caused on the customer's end.

4. Customer service — Husk's commissioning and design processes are highly customer centric. The company ensures an average of 240 V ±10% (line to neutral) across the grid at any customer point. In addition to this, all customers have access to their power quality through Husk's customer-facing mobile application at any point in time, including their operational load pattern. The grid infrastructure is designed to ensure most issues caused at any specific customer end point remains isolated, so other customers are not impacted. Husk has a grievance tracking system that covers all issues received from customers about potential overload conditions at their business or home. On average, all such issues are resolved in two hours.

5. Installation — Often, the process of installing distribution systems is neglected because of contractual management for ease of cost and scale. Husk avoids this pitfall by having a supervision team at various levels, including appropriate handshake processes embedded to provide quality assurance. The installation

Electrifying Nigeria

Husk Power has installed 12 of its mini-grid systems in Nigeria, with a long-term goal of installing 500. Where twelve mini-grids can deliver energy security benefits to 50,000 people, 500 could improve electricity service for 2 million people. The Nigeria Electrification Project (NEP), administered by the Rural Electrification Agency and funded by the World Bank, are partners for this effort. Despite being Africa's most populous country and the continent's largest economy as well as an important oil and gas producer, Nigeria has about 90 million people still living without electricity. Most Nigerians are connected to the power grid, but only about 1% reported having electricity 24 hours per day according to NOIPolls.

Lack of electricity has stifled the economy, particularly the rural economy, as healthcare workers, farmers, government workers and others must rely on fossil fuel generation sets for power and light. Community mini-grids, which combine solar power generation and battery energy storage with the local T&D networks is thought to be one of the quicker ways to bring power to remote areas as power grid investments are not a near-term option.

For rural business partners, Husk Power mini-grids has allowed them to stop relying on costly and polluting diesel generator sets and switch to using solar power. For some, this has realized energy cost savings of 30% on monthly bills. Husk mini-grids are also powering public services facilities and local health centers, which boosts security, education and healthcare services.

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Aerial shot of a mini-grid under construction in Aurai, India. Husk's mini-grids are located close to main market areas, and distribution networks need to cover 80% of commercial customers to maximize both local impact and company revenue. Photo by Husk Power.

process for power distribution at Husk focuses on many simple yet critical checks related to waterlines, telecom or data lines, and underground electrical connections to ensure no damage is done to existing infrastructure. The process begins long before installation. In advance of civil works, Husk's team invests heavily in local stakeholder engagement, making the community an integral part of the installation to ensure a smooth rollout of distribution assets. This is critical because Husk's mini-grids are located close to main market areas, and distribution networks need to cover 80% of commercial customers to maximize both local impact and company revenue.

What Next?

Mini-grids are the most economical model to provide access to reliable, renewable, affordable and modern power to nearly 500 million people, according to the World Bank. Distribution systems are going to play a crucial role in last-mile delivery infrastructure.

As such, much greater levels of R&D are needed to increase reliability, sustainability and efficiency of distribution, with the goal of leapfrogging beyond incremental improvements and creating new paradigms, such as wireless electricity transmission or by radically reducing the cost of smart meters. Such R&D must focus on further reducing the LCOE of T&D by doubling down on digitization and automation.

Smart distribution systems will enhance customer satisfaction and ease the process of troubleshooting. The mini-grid industry goal should be to reduce the cost by 30% of operating and maintaining distribution systems over the next three years. In addition, there is an opportunity to use geographic information systems and build proprietary algorithms to achieve mapping and installation of distribution systems across 25 sites to 30 sites per month per country. TDW

NIKHIL MURARKA is head of innovation and engineering at Husk Power Systems.

ELECTRIC UTILITY OPERATIONS

NOVEMBER 2023

tdworld.com/electric-utility-operations

Trees & Utilities: The Power of People

OUR NOVEMBER FEATURED LINEWORKER

Nick Nelson

IBEW Local 3

- Born in Racine, Wisconsin, and moved to south Florida at a young age.
- Only child of a single mother and unmarried with no children.
- Nominated by John Faiello, an apprentice from Local 3, who says Nick has gone above and beyond to teach him everything about the trade.
- Is currently working on Con Edison property starting a reconduct public improvement project.
- Played competitive paintball since he was 14. The sport has allowed him to travel all over the United States and the world.

Nick Nelson enjoys preparing apprentices to work in the line trade.

Early Years

When I was 18 years old, I was asked the question, "Are you afraid of heights or electricity? No? Then I have the perfect trade for you." I never looked back—only forward. I'm a first-generation lineworker. My first job was working on FPL property learning simple street light circuits and "how the lights come on." It was an easy enough introduction into what would be a life-changing career.

Day in the Life

I currently work as a working foreman/journeyman lineworker in IBEW Local 3 jurisdiction with EJ Electric. My current job scope is basic outside construction and maintenance of overhead electrical equipment on Con Edison property in the greater New York City area. My normal work day consists of pole setting, conductor transfer/repair/replacement, installation of new electrical equipment and integration of smart grid/smart switch technology.

Safety Lesson

In 2007, I worked on a crew who made a direct contact pole-to-phase, which caused an individual to stop breathing. My foreman and myself were able to perform CPR, saving the man's life. The incident was not without injury. The man received burns to his body and back. This incident was an eye opener for me. The smallest gap and the slightest error can be near fatal, if not fatal. My view on safety after that day completely changed. The philosophy of "any way possible" became "no job is so vital that it needs need to be completed unsafely."

Memorable Storm

I will never forget turning the power on to 10,000 people following Hurricane Sandy. Four weeks worth of work paid off. I was fortunate enough to be in a hotel, and I never missed a meal during the storm response. I worked long days and there were tons of broken poles and downed conductor, but it was very rewarding at the end.

Challenges and Rewards

The challenge of any day in this business is to complete all tasks in the safest and most efficient manner possible. Some lineworkers may consider their paychecks as their reward, but I think it's much more than that. It's a great feeling to know all your training has paid off and allowed you to complete a task. Another reward is obviously seeing our apprentices grow into strong, capable and confident workers.

Tools and Technology

I was raised on click/clicks or bug wrenches. The introduction of impact wrenches rated for the work was amazing. As for new technology, the high press tools allowing for cutting and pressing without the use of our full body is a huge benefit. Our shoulders and elbows will be saved.

Future Plans

I recommend line work to anyone with a mechanical inclination. This career gave me purpose and still pushes me every day. I would absolutely choose this again if the choice was given. TDW

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


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EMPLOYEE OWNED

UVM professionals from arborists to field managers to executives participated in the 2023 Trees & Utilities conference. Photo by Joe Appel.

Trees & Utilities: The Power of People

Utility vegetation management professionals shared best practices, connected with peers and learned about new technologies.

By **AMY FISCHBACH**, Field Editor

When severe weather strikes, arborists are on the scene ahead of line crews to clear roads and remove fallen limbs. Vegetation management crews also work year-round to remove hazard trees, maintain ROWs and support utility's biodiversity and sustainability programs.

Each year, the Arbor Day Foundation and the Utility Arborist Association (UAA) celebrate the hard-working UVM professionals with the annual Trees & Utilities conference. Years ago, the event started with a small gathering of 150 people in 1992 in Nebraska City, Nebraska, but has since grown to a multi-day event with close to 1,000 attendees. Dan Lambe, CEO of the Arbor Day Foundation, says there's never been a more important time for trees and the safe, reliable delivery of electricity.

"It's not Trees *or* Utilities, but Trees *and* Utilities," he says. "We need to make sure that they work together in cohesion."

The 2023 event was live at the downtown convention center in mid-September in Pittsburgh, Pennsylvania. The event kicked off with a charity golf tournament presented by Asplundh and the Tree Fund on Monday and a morning Women in Vegetation Management Workshop on Tuesday morning.

Everyone from arborists and foresters to supervisors and executives came together to celebrate the power of trees and learn new strategies for utility vegetation management. George Leader, distribution maintenance supervisor for Pedernales Electric Cooperative, has attended three of the conferences over the last five years to earn continuing education units and network with others in the industry.

"There's a lot of experience here, and that means a lot," he says. "This conference has been instrumental for our program due to the amount of inspiration and knowledge."

Dennis Fallon, executive director of the UAA, says across the UVM industry, he's noticed much more intellectual sharing than in the past.

"A lot of people are prepared to share their experiences and solving some of these things for the industry," he says. "It is relevant content at the right time aimed at the right audience."

Learning New Skills and Strategies

At the start of the event, Fallon says 950 attendees had registered, and they were still accepting walk-ons. He attributed the growth of the event to the line-up of speakers and the

need for education and networking in the UVM industry.

"In these economic times and during the energy transition, we look at the opportunities, and there's a tremendous amount of work coming at us that we need to be prepared for," he says. "It's an exciting time to be in the industry. People come here to share experiences and work together on solutions."

Joshua Roberts, vegetation management coordinator for Medina Electric Cooperative, says he has wanted to go to the event since 2019, and he had the opportunity to attend for the first time this year. He was sitting close to the stage to watch the keynote speaker for the conference share strategies on how to improve work/life balance.

"I want to see what other people are doing," he says. "We all have similar problems, but we have different approaches to them."

For example, he says at his cooperative, he's facing the challenge of a limited talent pool in small town America to maintain the right of ways (ROWs).

"We have been cutting trees forever, but when managing it day to day, we have a lack of resources," he says.

Roberts was not alone. Other utility vegetation management professionals also voiced their concerns about challenges in the industry from shrinking budgets to performing more work with a smaller field workforce. The multi-day conference hit on some of these topics with sessions on everything from diversifying the workforce to the business of UVM to managing tight resources.

In addition, the attendees packed the conference rooms to listen to presentations on biodiversity, sustainability and integrated vegetation management (IVM). Brandon Hughson, the new president of the UAA, says he's passionate about IVM and will continue to promote it during his presidency. He says the conference sessions gave the attendees a view into the past and future of the industry.

"The presentations allow us to focus on what is up and coming and where we have been where we are going and moving to," Hughson says.

This year, the conference also included panel discussions on the role of trees and utilities in a decarbonizing world, a utility cooperative roundtable and sessions on tribal outreach, wildfire mitigation strategies, remote sensing and safety.

Technology in the UVM industry was also a highlight at the conference with several sessions educating attendees on how to improve productivity and elevate safety through new software, tools and technology. For example, the UVM professionals learned about topics from sonic tomography to mobile LiDAR.

Kristy McDermott of Sharper Shape gave a demonstration about how her company can use a variety of different data sources—from mobile image uploads in the field to LiDAR imagery captured via helicopter—to create a living digital twin.

"The traditional approach is time-, cost- and resource-intensive," she says. "Through the digital twin software, we can tell which circuits have the greatest risk of failure due to vegetation

The trade show floor included exhibitor booths, a break area and a Skills Arena. Photo by Joe Appel.

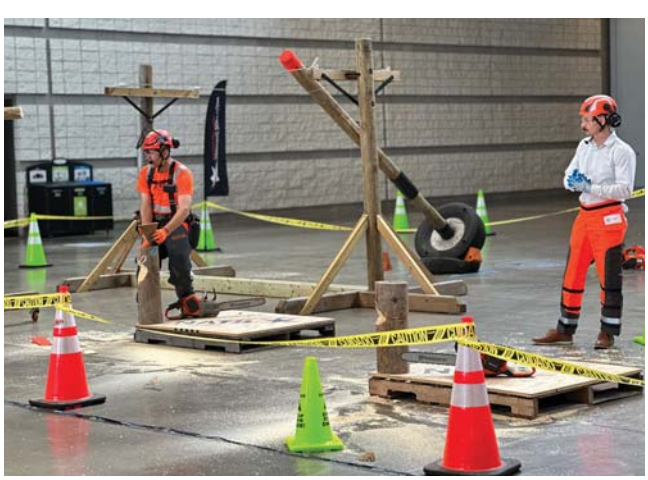
clearances. Utilities can then know where to concentrate their efforts and prioritize by risk level."

Exploring the Show Floor

After learning about the technologies and best practices in the conference sessions, the attendees could walk the trade show floor to visit with the exhibitors and discover new products and services.

This year at the sold-out Expo, Fallon says many new vendors showcased their products, services and solutions for the utility vegetation management industry. The exhibitors ranged from technology and software vendors to the providers of tree growth regulators and aerial inspection services.

As in past years, attendees could also check out the latest personal protective equipment, machines, tools and clothing for arborists. Buckingham Manufacturing displayed its products for field workers including the newly redesigned 4D Ring Saddle and a lightweight climber pad. Nearby, ArborWear displayed three new styles of its mid-weight fleece in vest, pullover and jacket styles.



North American Training Solutions once again invited arborists to join them on the show floor in competitions in the Skill Arena.

Utility vegetation management contractors also showcased their services, with many showcasing their years of service to the industry. Lucas Tree Experts, a family-owned company, returned to the event this year to exhibit on the show floor.

"There are a bunch of good people here—customers, friends and utilities who we work with," says Mark Chandler of Lucas Tree Experts.

Companies also showcased their training programs and materials to improve the education of the field workforce.

Through its "From the Boots to the Boardroom" approach, Grow With Trees can educate contractors on how to get up to speed with IVM and learn technical specifications and rules. The trainers can also work with executives to teach them about biodiversity and ESG reporting, says Mike Stein.

Like last year, North American Training Solutions also provided a live competition in the Skills Arena at the back of the Exhibit Hall. The trainers invited attendees to participate in one-on-one contests using a chainsaw to show off their cutting techniques.

New for this year, the UAA and Arbor Day Foundation organized a silent auction to raise funds or the Nelson Money Scholarship Fund and the Arbor Day reforestation program. Donors could view the baskets in the exhibitors' booths and then place their bids online.

In addition, the UAA honored excellence, safety and education in the UVM industry through its award program. The association presented the Lifetime Achievement Award to Dan Marsh; the Will Nutter Silver Shield Award to Adrienne Jones and Jerry Staton; the President's Award to Diona Neeser and Renee Phillips, the Rising Star award to Phil Swart and the Education award to Dr. Robert Vanderhoof. During the awards banquet, the Arbor Day Foundation also highlighted Tree City USA Utilities , many of whom had representatives in the audience.

Next year, the Trees & Utilities conference will move to Fort Worth, Texas, from Sept. 12-14, 2024. Hughson expects the event to continue to expand.

"There are new young people coming into this industry, and that will allow us to continue to grow," he says.

Editor's Note: To view a photo gallery and highlight video from the event, visit *www.tdworld.com/vegetation-management*.

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

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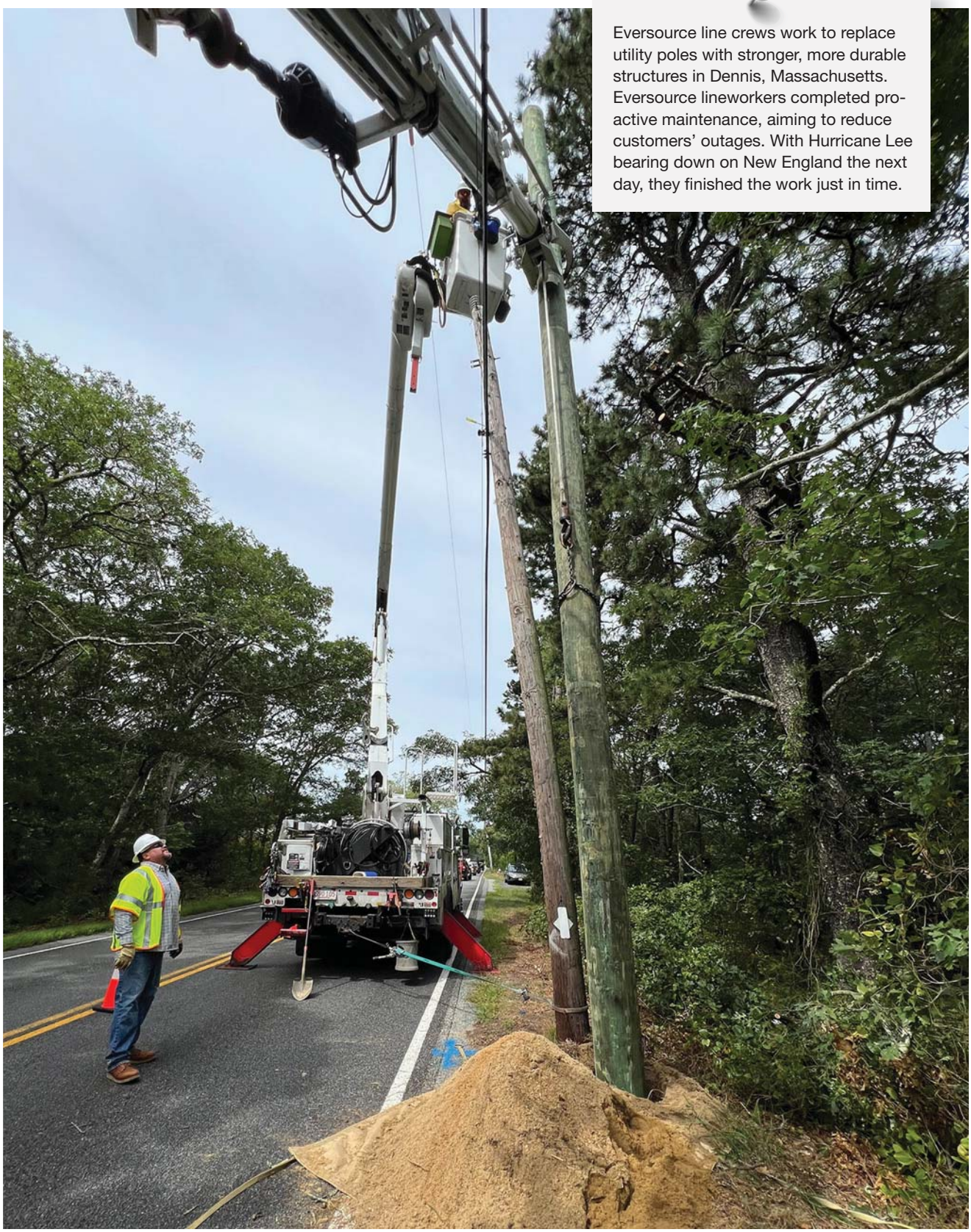
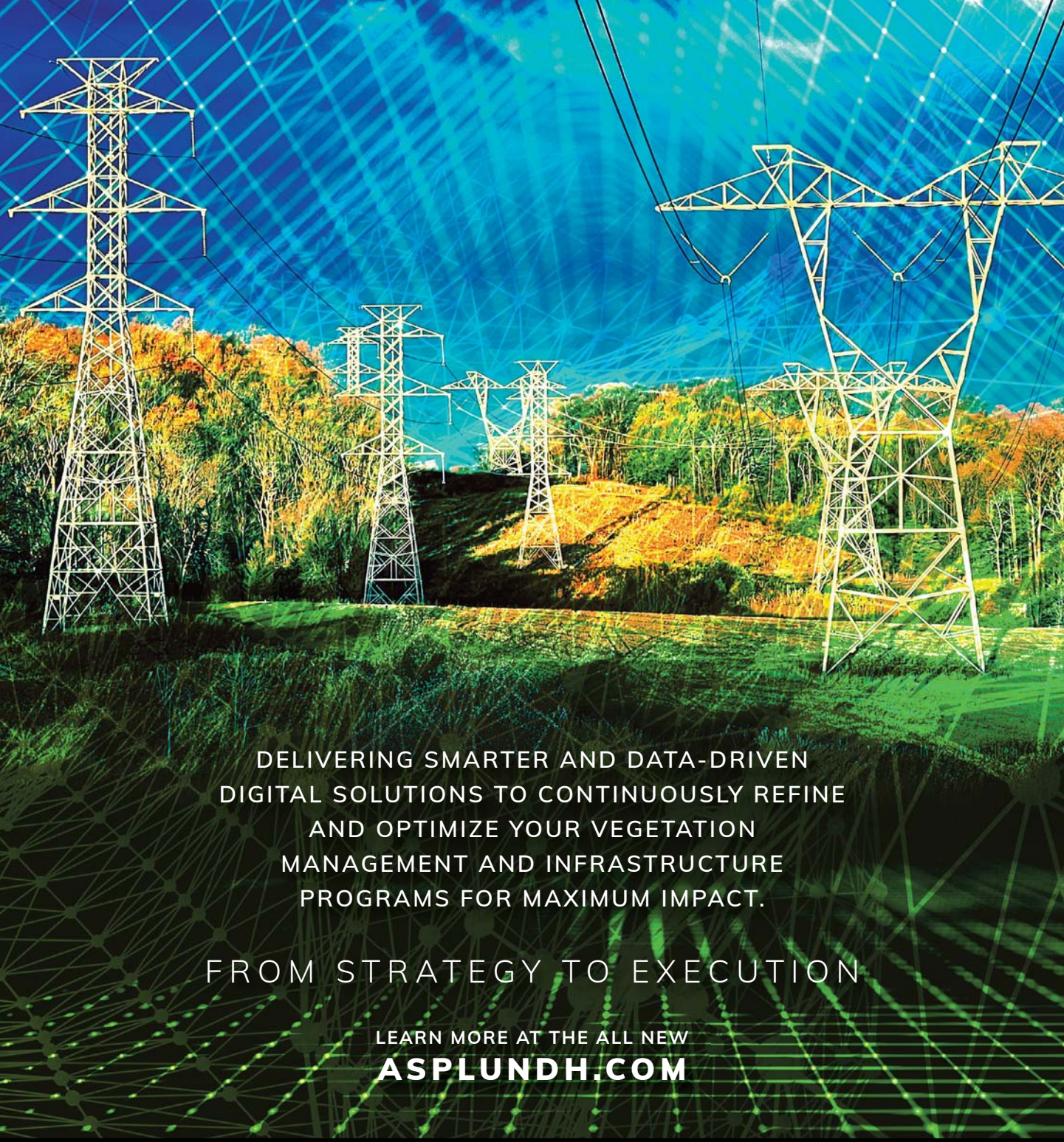
Parting Shot

Photo by **PRISCILLA RESS** of Eversource



Eversource line crews work to replace utility poles with stronger, more durable structures in Dennis, Massachusetts. Eversource lineworkers completed proactive maintenance, aiming to reduce customers' outages. With Hurricane Lee bearing down on New England the next day, they finished the work just in time.



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BY **DUSTIN TROUTMAN**, CREATIVE COMPOSITES GROUP

An Engineered Solution For Utility Poles

With a potential wood shortage coming, utilities should look at alternative pole materials like fiber-reinforced polymer technology.

Major utilities are already hearing about deficits in wood utility pole availability, but there are other options. Photos by Creative Composites.

Wood has been the most widely used material for utility distribution poles for many decades. However, the availability of wood is at the mercy of Mother Nature. Unlike diamonds, which can be created in a laboratory setting, no artificial process exists to create the amount of wood the electric utility industry demands. Wood needs time to grow.

The broad demand for a stronger utility grid is growing faster than the wood that nature can supply. As an alternative, fiber-reinforced polymer (FRP) utility poles can be sustainably produced on demand, and they offer resiliency, have excellent dielectric strength, and are lightweight and insusceptible to rot and vermin damage. Utilities should consider FRP among their options, alongside wood and steel, when specifying poles.

Nature's Supply Chain

Wood utility poles come from specific tree varieties. They are made primarily from southern yellow pine (80%) as well as Douglas fir and western red cedar (20%). These trees comprise 5% to 10% of an average forest, and a single tree can take over 25 years to grow to a usable size. However, the number of trees that become wood utility poles is much lower: Up to one-half — sometimes more — of the trees of usable size

The larger and stronger the tree, the better its ANSI pole class rating.

Class	Horizontal Load, lb (kg)	Suitable For
10	370 (168)	Telecom
9	740 (336)	
7	1,200 (544)	
6	1,500 (680)	
5	1,900 (862)	Distribution
4	2,400 (1089)	
3	3,000 (1361)	Distribution and Transmission
2	3,700 (1678)	
1	4,500 (2041)	Transmission
H1	5,400 (2449)	
H2	6,400 (2903)	
H3	7,500 (3402)	
H4	8,700 (3946)	
H5	10,000 (4536)	
H6	11,400 (5171)	

Source: National Pole Standards report by Nelson Research.

are not of suitable quality and, therefore, cannot be used to make utility poles.

A series of issues are combining to create strain on the wood pole supply chain. The 5G build-out is surging in the U.S. and Canada, as are storm-hardening efforts. Add to this the banning of the pentachlorophenol wood preservative and move to increased electric alternatives to cooking and heating fuel sources common to the U.S., especially in many rural areas. Factor in the demand for high-quality, high-strength wood for industries beyond utility poles, like pulp and manufactured wood. This adds stress on a supply that can only grow at nature's speed.

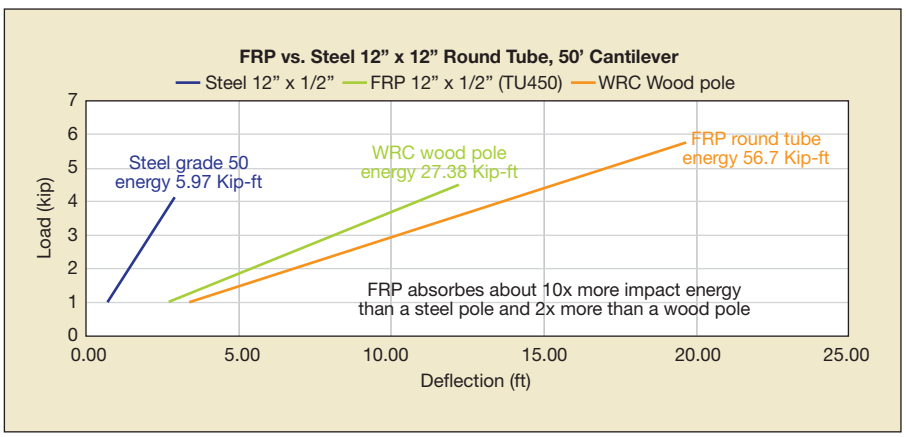
Demand in the electric utility industry is not just for more poles but also for stronger ones. Utility poles must be strong enough to maintain grid resiliency under any conditions. Poles are selected based on design and safety codes and standards. Dead loads like conductor weights and tensions and live loads like wind and ice are factored against pole capacities. The capacity of a pole must be greater than the sum of all the loads experienced during the life of the pole. Therefore, strength reduction and safety factors applied to the pole strength must be greater than the amplified loads and load combinations to ensure the pole is strong enough. This further narrows the field of suitable wood poles.

A recent report by the North American Wood Pole Council (NAWPC) acknowledges the conflicting problems of less wood availability and increased demand: "In the last 10 years, utilities have moved to a slightly larger and stronger class pole due to the increased use of third-party attachments, the push for grid resiliency and the general increase in power demand that requires larger conductors. Today the use of Class 3 poles and stronger has increased while the production of Class 5 and 6 poles has declined."

Today's storms throw more at the grid than Class 5 and 6 poles can handle. Continuing to use these classes requires substantially more poles and crossarms. To use the same number of poles, a stronger class is needed. However, Class 3 up to Class H1 poles must come from the largest, hardiest trees. And large, hardy trees take more time to grow. Considering these trees take over 25 years to grow to a usable size, our forests cannot keep up with the grid's demands.

Fire Properties	
Flame rating (UL 94)	V0 self extinguishing
Flame spread ASTM E-84	Class A 25 or less
Electrical Properties	
ASTM F7 (100 kVAC per foot - 5 minutes dry)	Passed
IEEE978 (75 kVAC per foot - 1 minute wet)	Passed

Creative Composites Group's StormStrong™ utility poles underwent flame rating testing per UL 94 and were rated V0 sSelf-e Extinguishing; flame spread testing per ASTM E-84 and were rated Class A 25 or less; and passed electrical testing per ASTM F711 and IEEE978.



Engineering data on steel, western red cedar wood poles and FRP energy load (kip) to deflection (ft) rates. These plotted load displacement curves, associated with ASTM D1036 pole testing, show FRP absorbs twice as much impact energy as wood.

A series of issues are combining to create strain on the wood pole supply chain.

FRP poles have been used for 25 years in the industry, with success and reliability. FRP is as suitable for utility poles as steel, concrete and wood.

An Engineered Alternative

Wood poles remain an important option for the utility pole market, but they cannot be the only option. FRP poles have been used for 25 years in the industry, with success and reliability. FRP is as suitable for utility poles as steel, concrete and wood — and should be considered alongside traditional materials.

Made of reinforcement fibers, polymer resin and additives, FRP is an engineered material that creates a strong, durable material that meets the demands of heavily loaded civil infrastructure. As a man-made product, manufacturers can quickly make formula changes to meet changing market needs for strength and produce poles in near-limitless quantities and with a low coefficient of variation.

FRP also can be more reliable and resilient at times than competing materials, as it is less susceptible to deterioration from weather, pests and time. The American Society of Civil Engineers (ASCE), in conjunction with the American Composites Manufactures Association (ACMA) and Pultrusion Industry Council (PIC), developed the Pre-Standard for Load & Resistance Factor Designs of Pultruded FRP Structures design standard, which thoroughly vetted FRP to assess pultruded profiles and their extended service life. Strength and stiffness factors are based on resin formulations and end-use environmental conditions.

FRP poles also keep line workers safer. Although fiberglass poles are handled and installed in a manner similar to that of wood poles, FRP's superior dielectric strength reduces electrocution risks when setting pultruded poles between live conductors. The dielectric strength of FRP poles is rated at 100 kV ac per foot and they dry in 5 minutes, when tested per ASTM F711. They also are V0 self-extinguishing, per UL 94.

Furthermore, FRP's lightweight characteristic makes these poles safer for line workers to move, hoist and handcarry. The FRP poles are light enough to be rolled by line workers without equipment, like a cant hook. This is because FRP poles are 3.6 times lighter than wood poles. For example, a Class 2 50-ft FRP pole weighs 600 lb (272 kg) compared to a southern yellow pine that weighs around 2200 lb (998 kg).

FRP poles are inherently resilient to impact energy due to their mechanical and physical attributes. FRP poles tend to be strong in bending. It is not uncommon for pultruded poles to exhibit a bending strength above 50,000 psi, which is stronger than grade 50 steel. FRP poles also have a moderate modulus of elasticity, which is higher than wood but considerably less than steel. FRP poles have a high bending strength and the tendency to deflect more than steel and wood poles. During impact events associated with storms, like downed trees, deflection helps the line to absorb impact energy with minimal damage.

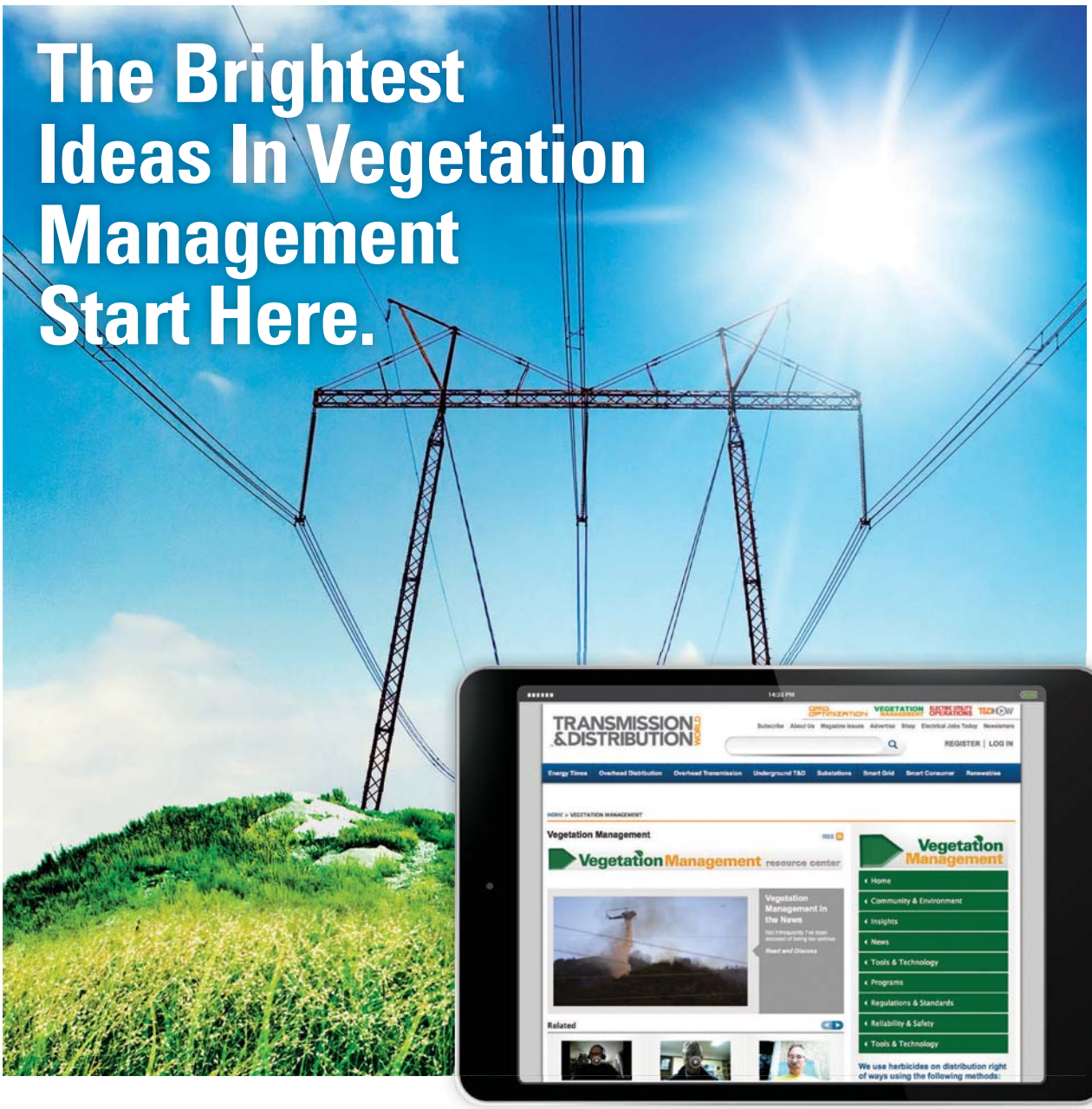
Sustainable Poles

Ultimately, FRP is more sustainable than wood, helping the environment and companies' environmental, social and governance (ESG) initiatives. FRP's automated production method, pultrusion, is a greener process than preparing wood or steel poles. FRP also does not require treatment with harsh chemicals that can leach into the surrounding groundwater, limiting where the poles can be installed. While a single wood pole has a lower carbon footprint than a single FRP pole, an FRP pole has more longevity and reliability over the service life when comparing life cycle analyses of FRP, wood and steel. FRP poles must be replaced half as often or less than competing materials, reducing the emissions for production and transportation, and they can be recycled or repurposed — a less-common end-of-life outcome for wood poles than incineration or disposal.

Major utilities are already hearing about deficits in wood utility pole availability, but there are other options. Utilities should consider FRP poles alongside wood and steel poles, so that the right materials can be placed in the right locations and under the right circumstances to ensure the best outcome. Quality manufacturers are already assisting utilities with the necessary coding of new hardware, stocking of locations and training of workers on FRP poles. TDW

DUSTIN TROUTMAN is corporate director of marketing and product development and sales for the Creative Composites Group (CCG). He earned his BSCE degree in 1993 and spent the early part of his career in utility line construction. Troutman has been with CCG for 27 years and continues to be instrumental in the market investigation and development of major pultrusion products and product lines associated with civil/structural applications, holding four patents related to pultruded systems. He is a key player in the development of codes and standards in support of the FRP industry.

The Brightest Ideas In Vegetation Management Start Here.



1. Transmission & Distribution World's Vegetation Management Resource Center

It's your resource for management from programs and safety, to tools and technology. Regulatory compliance, public health standards and environmental topics are also covered.

tdworld.com/vegetationmanagement

2. Vegetation Management Insights Arrives Monthly In Your Inbox

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BY **MIKE BEEHLER**, POWER DELIVERY INTELLIGENCE INITIATIVE

Planning the Power Grid of the Future at T&D World Live

Utilities met to talk about the benchmarks they have laid for the future in terms of building a more reliable, less carbon-intensive grid.

We set goals for renewables, net zero energy and carbon free energy. These resource related goals will require a 21st century distribution grid that is reliable, resilient and still affordable. Will it be our grandfather's distribution grid? No.

The electric distribution grid of the future will be a modern, integrated grid that accommodates distributed energy resources like rooftop solar, fuel cells, storage, and vehicle to grid electric vehicles (EV). This increasingly complex grid that delivers the clean electricity that we need for our future will be fundamentally transformed into a new and dynamic technological wonder.

Underground electric distribution lines will be an important part of that transformation. Therefore, as we set ambitious goals for clean electricity, we need to do the same for the distribution grid that delivers that electricity.

This topic and much more was presented and discussed during the 50% Underground by 2040 panel at the T&D World Live conference held Sept. 11-14, 2023 in Sacramento, California.

Beehler reminds the audience that the industry sets many goals related to carbon, net zero energy, renewable integration and electrification of transportation, and that the industry benefits from the discussion and debate. Courtesy of Mike Beehler.

The "50% Underground by 2040" panel had standing room only for Pacific Gas & Electric's Matt Pender, Exelon Transmission's Joe Svachula, and Anaheim Public Utilities' Janet Lonneker.

At the panel, I reminded our audience that the industry sets many goals related to carbon, net zero energy, renewable integration and electrification of transportation. But whether we achieve 40% underground by 2050 or 50% underground by 2040, the industry benefits from the discussion and debate.

What did we learn at T&D World Live?

Anaheim Public Utilities

Anaheim has a 4% electric rate surcharge that has funded their major 12kV underground program for the last 35 years. Today they collect nearly $14 million per year for undergrounding. They have enhanced the beauty of their community and improved system reliability by 30% for big customers like Disneyland and the Anaheim Angels baseball stadium. They are 60% underground and 30% of that is direct bury. Anaheim has an underground gas insulated switchgear (GIS) substation built beneath a city park as well.

Initially, the cost of urban underground at Anaheim was approximately $2 million a mile. Today, with decades of inflation, that cost is more around $7 million a mile. Getting easements for underground equipment takes time and close customer coordination is required. Easement acquisition is typically the longest delay for a project.

Coordination with other utilities is important especially since Anaheim has a 3-year moratorium on cutting the street (pavement) after new work is completed. Anaheim Public Utilities has arranged a cost sharing program with local communications companies, said Lonneker.

"Funding sources for undergrounding in Anaheim include a 4% surcharge on customer electric bills, a wildfire mitigation grant through FEMA. We are also seeking grant funding opportunities through the Infrastructure Investment and Jobs Act offered through the U.S. Department of Energy," Lonneker said.

"The cost to underground electric lines in densely populated urban areas can be 2-3 times more than in rural areas because we're competing for space under streets where all other utilities such as water, gas, and communications are located. Each require a minimum separation in the trenches to maintain safety. In some instances, we need to work with property owners because the public space is full."

Lonneker said she wishes that they had done more underground earlier. She said reliability has improved 30%, but when outages do occur, they take longer to repair ranging typically from 10 to 24 hours. But, in general, over the 50-year life that Anaheim assigns to their new underground distribution, underground has a lower cost of ownership.

Pacific Gas & Electric

CEO Patti Poppe has said they are rebuilding PG&E from the "underground up."

Matt Pender confirmed that ambitious goal and said that PG&E will spend $30 billion to underground the first 10% of its T&D system. Undergrounding existing overhead lines will be prioritized for the areas most susceptible and at-risk to wildfire damage. It plans to have 3600 miles of line placed underground by 2026 and will then be one-third of the way to its 10,000 mile goal. PG&E seeks innovative ideas from the industry and actively looks for ways to implement that innovation in its program. Some of those participants were in the audience.

"PG&E strongly believes that undergrounding electric distribution lines in high fire-risk areas is the most effective long-term solution for keeping customers and communities safe amid increased wildfire risk and longer wildfire seasons across the Western United States. Undergrounding essentially eliminates wildfire ignition risk from those lines and helps reduce long-term operations and maintenance costs. That is why we've begun a journey to underground 10,000 miles of distribution lines in high wildfire risk areas," according to a statement by PG&E.

"To deliver on our 10,000-mile plan as efficiently as possible PG&E is leveraging the best techniques, methods and technologies to plan, design, construct and energize underground lines. We are using the tools we have and have engaged with industry experts, startups, academics and others through venues like our Innovation Summit in July and Pitch Fest in September to gather new approaches for challenges like mapping existing subsurface infrastructure, boring through hard rock and managing the dirt that comes out of the ground as efficiently as possible," according to PG&E.

While PG&E may not achieve 50% of its distribution system undergrounded by 2040, the utility is working at an unprecedented rate to reduce wildfire risk and deliver a system that is more resilient and cost-effective for our communities in the long term.

Today, PG&E has 27% underground distribution and 1% underground transmission. When PG&E completes its $30 billion, 10,000-mile underground distribution program, it will have 37% undergrounded.

Current PG&E experience is that 70% of the capital cost of an underground line is civil construction like trenching, boring, conduit and manhole placement, backfill and right of way/street repair. It has determined that the initial capital cost of undergrounding is about three times more expensive than similar voltage overhead distribution but when projected over the 49-year life of the asset the net present value of underground proves to be more cost effective. It currently had a three-year maintenance cycle for underground.

Conference attendees network at T&D World Live. Many utilities discussed their plans to invest in grid upgrades and other technologies meant to deliver more reliable power. Payton Lissau.

PG&E has put about 300 miles of distribution line underground this year toward its annual goal of 1000 miles per year. It has much to do.

Exelon Transmission

Exelon has major High-Pressure Fluid Filled (HPFF) transmission lines in Chicago, Philadelphia, Baltimore and Washington, D.C. It needs to replace the antiquated HPFF with solid dielectric cables and have a segment of super conductors installed between two downtown Chicago substations.

Joe Svachula, senior vice president of Transmission & Compliance at Exelon Utilities said, "Undergrounding Transmission is a powerful tool for our engineers and although it increases resiliency it can also be very expensive. The new underground systems also reduce maintenance allowing us deploy additional capital. We also continue to evaluate the application of emerging technologies such as advanced high temperature low sag conductors, dynamic line rating equipment and superconductors."

Exelon is interested in the lower cost of operations and maintenance (O&M) of its underground transmission systems because for every dollar of O&M saved, it frees up seven dollars for capital expenditures to improve and expand the system.

Conclusion

Today, the electric distribution system in America is approximately 20% underground. Some public power utilities like Ft. Collins, Colorado Springs, and Anaheim have had underground ordinances for years. They have beautified their cities and improved the performance of their systems. Fort

T&D World Live offered several learning opportunities besides the undergrounding panel; this was a commercial electric vehicle pre-conference session.

Collins is 99% underground and is 99.9% reliable. Colorado Springs started in the 1970s and today is 77% underground with 99.9% reliability.

They estimate they can be all underground with another $2.2 billion investment. Colorado Springs overhead transmission line with underground distribution Anaheim has been engaged in their Home Underground Program (HUG) since 1990 with excellent results. And, the phone and cable TV utilities in Anaheim paid to go underground as well.

Investor-owned utilities have put new neighborhoods underground for years, and now, many large IOU's like PG&E, FP&L, WEC Energy Group and Dominion are engaged in multi-year, multi-billion dollar programs to "strategically" underground laterals and other key parts of their systems.

Undergrounding the electric distribution grid provides a compelling solution to enhanced system reliability and resiliency, especially as we strive to achieve net-zero energy and carbon-free generation goals.

The many benefits of a 21st century underground electric grid include dramatically reducing weather and vegetation related outages, improving resilience to natural disasters, and delivering long-term value over the life of the asset, make it an important component of a modernized and sustainable energy infrastructure.

The integration of massive electrification and more distributed energy resources with an underground electric distribution grid will help us to potentially meet or exceed our clean energy objectives and create a safer, more affordable and environmentally conscious energy system for the future.

And, like PG&E's Matt Pender said as he concluded, "Maybe we will achieve 50% by 2040." TDW

MIKE BEEHLER (*mbeehler@pdi2.org*) has over 40 years of electric transmission and distribution experience at Tucson Electric Power, Hawaiian Electric Company and Burns & McDonnell. He was educated as a civil/structural engineer at the University of Arizona and is a registered professional engineer in eight states including Hawaii. He currently is the founding member and Chief Opportunity Officer of Mike Beehler & Associates, LLC and serves as the National Spokesperson for the Power Delivery Intelligence Initiative *https://www.pdi2.org/*. Beehler is a Fellow in ASCE and a Member of CIGRE and IEEE.

Intelligent Electric Transformer

Infrastructure firm Prolec and utility equipment firm Ubicquia have combined efforts to design and market what they call a fully integrated smart transformer. The new transformers deliver real-time monitoring and grid analytics. Units have begun shipping to North American utilities for field trials. The companies collaborated to integrate Ubicquia's UbiGrid distribution transformer monitoring (DTM+) platform into Prolec's single-phase pad mount transformers across a wide range of sizes. The integration, testing and certification is performed in Prolec's Monterrey, Mexico facility, a maker of distribution transformers.

The intelligent transformer provides real-time electrical and physical transformer health data along with advanced grid analytics deployed at scale. Ubicquia has delivered more than 30,000 units to monitor single-phase and three phase transformers to major utilities across the US and Latin America. Commercial availability of the intelligent transformer is planned for 2024.

By integrating the UbiGrid DTM+ platform into its transformers, Prolec eliminates the need for utilities to retrofit units in the field and reduces the total cost for a smart transformer.

Use cases for the transformer include:

- Predicting transformer outages to improve reliability;
- Detecting and diagnosing issues with failed assets to optimize field resources and improve storm response;
- Improving capacity planning, which has become more complex with the significant growth in electric vehicles, supply chain constraints, and distributed energy generation.

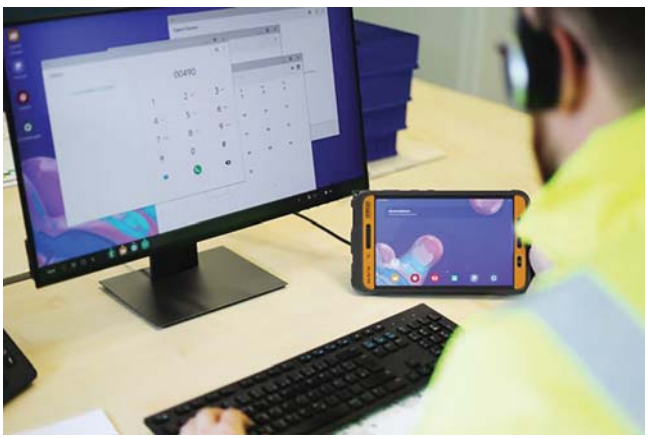
Prolec & Ubicquia | *www.ubicquia.com*

Load Break Tool

Utility Solutions, Inc. has announced the next generation of load break tools, the Load-Ranger Flex-LT. This tool features a patent-pending 180° rotating Flex Head, which is designed to solve a common industry issue: tool binding when approaching cutouts from certain angles. The product also addresses a common pain point in the industry: complicated service procedures. It can be disassembled in minutes using just two tools, simplifying maintenance and minimizing repair costs.

Utiity Solutions | *www.utilitysolutionsinc.com*

Predictive Maintenance Tablet



The Pepperl+Fuchs brand, ECOM Instruments, offers smart devices especially for use in explosion-protected areas. The Tab-Ex 03 is available in the variants DZ1 for use in Zone 1/21 and Division 1, DZ2 for Zone 2/22 and Division 2, and D2 for Division 2. Based on the Samsung Galaxy Tab Active 3, the Tab-Ex 03 combines state-of-the-art technology for harsh environments and use in hazardous areas.

Samsung Knox ensures high data and device security. With the Samsung DeX mode, it is possible to quickly use the tablet as a desktop. This allows to monitor various data immediately and to view dashboards required for maintenance on a larger display. This flexibility also eliminates the need for a second computer when a mobile worker is temporarily working in the office. The tablet's large screen with a resolution of 1,920 x 1,200 pixels is ideal for viewing digital documents, checklists, maintenance or repair instructions, for example, in greater detail than on a smartphone display. The powerful Tab-Ex 03 is designed to be operated with gloves or the S Pen stylus.

The smartphones in the Smart-Ex series are ideally equipped for flexible use in public and private networks of mobile phone providers or companies. Thanks to fast and secure transmission of large amounts of data, users benefit from state-of-the-art functions for communication and collaboration, such as remote support or video conferencing.

An important sub-area of predictive maintenance includes a company's asset management, which can be carried out via smartphones and tablets. This includes not only the inspection of equipment and components based on sensor data, but also the availability and localization of necessary spare parts in the warehouse. This means that reordering processes can be triggered as soon as the warehouse stock runs low. Machine parts can be replaced several weeks or even several months in advance before they reach the end of their service life.

In addition, the Smart-Ex series can be combined with Visor-Ex 01 smart glasses to enable mobile workers to solve tricky tasks that require additional information and continuous communication. The integrated microphone of the Visor-Ex 01 allows direct communication with an expert who is not available on site. The remote expert, for example, sees the same as the mobile worker thanks to video transmission and can thus better support predictive maintenance.

The operating systems of the Tab-Ex 03 and the Smart-Ex series also meet the latest technical standards: Both have the latest Android operating systems, which optimally support communication within public or private networks.

ECOM Instruments | *www.ecom-ex.com*

Personal Voltage Detection Safety

In high-risk industries such as utility, construction, oil, and gas, where workers face the constant threat of injury or even fatality, rapid emergency response is critical. Every minute counts, and the need for an efficient, reliable, and holistic safety solution has never been more apparent. COMPASS Pro provides a unique combination of features that empower individuals and teams to respond swiftly and effectively in emergency situations. Its primary focus is on detecting and locating energized sources, allowing field workers to avoid potential hazards, thereby significantly reducing the risk of accidents or fatalities.

Key features of COMPASS Pro include:

- Real-time Energized Source Detection: By utilizing cutting-edge technology, COMPASS Pro alerts users when an energized source is present in their vicinity, ensuring workers are immediately aware of potential danger.
- Precise Location Identification: COMPASS Pro provides users with information about the precise location of the energized source, enabling them to navigate the area with caution and avoid potential risks.
- Rapid Emergency Response Assistance: In the event of an emergency, COMPASS Pro acts as a lifeline, and facilitating quick emergency response. Its intuitive interface and user-friendly design ensure that even in high-stress situations, workers can access critical information and take decisive action swiftly.

COMPASS Pro represents a leap forward in mitigating risks and ensuring the well-being of field workers, setting a new benchmark for safety standards across the board.

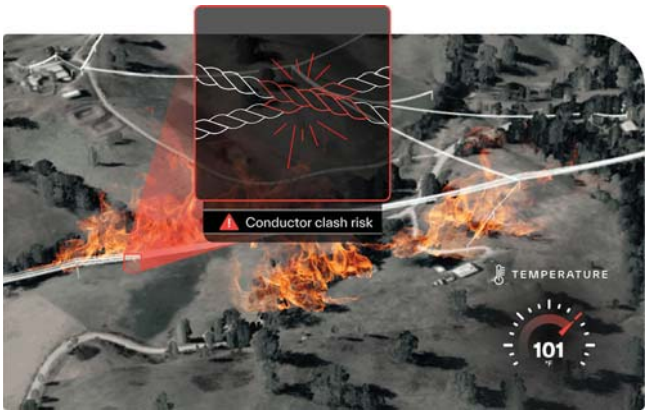
Safeguard Equipment | *www.safeguardequipment.com*

AI Technology for Wildfire Mitigation

Southern California Edison has partnered with Neara to implement dynamic AI capabilities across its 50,000-square-mile service area to enhance network analytics capabilities, wildfire risk mitigation, and vegetation management programs.

The enterprise-grade, 3D network modeling technology uses AI/ML to aggregate utilities' broad spectrum of data sources into one hyper-realistic digital simulation environment. Utilities can use the model to simulate how their assets will respond in the real world under multiple conditions based on hundreds of environmental and behavioral variables. These models help minimize network monitoring blind spots in stress-testing grid resilience and improving severe weather response while reducing reliance on manual field surveys.

By combining data sources — such as LiDAR and satellite imagery — into Neara's digital network model, SCE will be able to automatically discover and address potential issues before they



become serious risks. This bolsters a core pillar of SCE's network-wide safety and reliability strategy by leveraging automation and analytics to diagnose network risks.

Neara | *https://neara.com/*

Lightweight Pole Climber Kit

The ComfortLite Pole Climber Kit is said to be Buckingham Manufacturing's lightest and most comfortable climber kit. Weighing just 5 lbs. per pair, it is nearly 1 lb. lighter than any existing Buckingham Climber Kits.

The kit is ergonomically designed to relieve pressure points and direct pressure to non-sensitive areas of the leg while climbing. This was accomplished using both a dual layer of compression padding and a lightweight plastic cuff that achieve the ultimate fit for comfort. Features & Benefits:

- More than 4 lbs. lighter than the closest competition, according to the company.
- The ComfortLite cuff is a one-piece design removing the need for additional components traditionally seen on our kits.
- New weighted web-end designed to create grip, rigidity and add weight to the end of cinch strap making it easier and faster to cinch and uncinch pad.
- 4-in. wide upper strap with a cinch loop ensures a secure and snug fit.
- Patented GRiP (Gaff Ridge Position) technology keeps gaff pointed toward the heart of the pole, promoting ease of climbing and a more natural upright position.
- Hook and Loop cinch Foot Straps (21401C-BL).
- BuckViz Green Magnetic Gaff Guards (6909M2).
- Gaff length: 1 ¾ in.
- 350 lb. user weight capacity. Meets ASTM F887 standard.

Buckingham Manufacturing | *https://buckinghammfg.com*

Body Rescue Sticks

As a worldwide manufacturer of hotline tools and equipment, Hastings understands that every day has the potential to bring the unexpected to lineworkers. That is why Hastings designs every product, including its Body Rescue Hook products, with safety in mind. Body Rescue Hooks are available in a variety of configurations and lengths. The basis of each product variation is

an 18-in. open hook mounted on a 1 1/4-in. O.D. fiberglass pole that can be used for emergency rescue of injured personnel.

Weighing less than 6 lbs each, the hooks themselves may be purchased with universal end fittings or 1 1/4-in. spliced ends. The hooks can also be purchased attached to fixed-length or telescopic fiberglass poles. Available in lengths of 6, 8, and 10 ft, the fixed-length Body Rescue Hook Sticks weigh between 7.5 and 9 lbs each. Two telescopic pole options are available, both retracting for easy storage and shipping. The 6-ft extension weighs 7.2 lbs and retracts to 40.5 in. A longer, 8-ft version retracts to 43.5 in. and weighs 8 lbs.

Hastings | *www.hfgp.com*

Vegetation Management Software

LiveEO's VMi is an AI-powered solution, Vegetation Management Insights, delivers timely and actionable intelligence to safeguard linear infrastructures like electrical grids or rail networks against vegetation-related risks. The solution ensures safer and more reliable operations by effectively mitigating threats, ultimately enhancing overall efficiency for clients.

Features include:

- Large-scale overview: The company provides up-to-date snapshots of the entire grid at the right resolution.
- Comprehensive risk analysis: The solution doesn't just detect tree location, but also height, species, and vitality, to further increase the accuracy of risk assessments.
- Actionable insights: The AI algorithm applies risk models to identify potential threats, and provides easy-to-manage work orders to facilitate threat resolution.
- Desktop and mobile app: The solutions' insights, reports and work orders are all available via both desktop or mobile apps so managers at head office and contractors in the field can easily coordinate their work.

In the face of unforeseen challenges, like extreme weather events beyond preventive measures, LiveEO's RRi empowers the user to swiftly identify post-storm damages to infrastructure and orchestrate a swift, targeted response. Features include:

- Rapid change detection: experience change detections within a remarkable timeframe of under 12 hours, enabling immediate damage assessment.
- Synthetic Aperture Radar (SAR) data advantage: capitalizing on SAR data's unique capabilities–unaffected by clouds or darkness–RRi guarantees precise insights for comprehensive damage evaluation.
- Streamlined communication: through web and mobile applications, RRi streamlines communication workflows among emergency responders, ensuring seamless coordination for a swift and efficient response.

LiveEO | *www.live-eo.com*

Fleet Smart Cameras

Noteworthy specializes in fleet vehicle-mounted smart cameras + AI that help utilities evaluate the condition of the electric distribution grid at-scale while reducing operations and maintenance (O&M) costs. Exponentially increasing demand, along with extreme weather, wildfires and aging infrastructure threaten the reliability, resiliency and safety of the grid. Currently,

it is extremely challenging for utilities to know exactly where their distribution assets are, what's on them and what condition they are in. Collecting and analyzing the data necessary to answer these questions is a slow, manual and costly process—on average, only 10% of poles are evaluated annually. This makes it difficult to adequately mitigate risks related to grid reliability, resiliency and safety.

Noteworthy's fleet vehicle-mounted cameras + AI enable utilities to collect and analyze data during routine vehicle operations. Noteworthy's platform reduces O&M costs while increasing situational awareness of the distribution grid. By leveraging AI to perform data analysis, cost savings and efficiencies can be realized across a variety of reliability and resiliency use cases including, but not limited to: geolocation and asset inventory, asset inspection, vegetation management, storm response / damage assessment, joint use / attachment compliance and unregulated lighting assessments. Noteworthy's solution, Inspect, comprises two product offerings: Inspect Edge and Inspect Cloud.

Inspect Edge is a vehicle-mounted hardware and software solution featuring computer vision cameras and edge compute units. The system works together to detect, geolocate and capture high-resolution imagery of distribution assets.

Inspect Cloud is a cloud-based software platform that enables easy review and visualization of Edge-collected imagery and GIS data. Inspect Cloud also features proprietary AI models that can be run on imagery for detailed analysis of distribution assets including component inventory, defect detection, clearance measurements and more.

Noteworthy AI | *www.noteworthy.ai*

Hands-Free Headset

Speak Easy Communication Solutions LLC has introduced the new Actio FR PRO headset. When safety is on the line, having the right gear matters. The NFPA-compliant safety communications system guarantees flame-resistant protection inside its protective garment, so lineworkers can focus on the task at hand. Without coming in contact with the body, it works in tandem with the Actio Pro series radios.

Completely hands-free, easy to use and noise-filtering, the Actio FR PRO provides lineworkers with safe communication. Key benefits:

- FR Pro uses Westex UltraSoft (A Milliken Brand) flame-resistant fabric certified to ANSI 107 and UL certified to NFPA 2112 and NFPA 70E PPE Category 2 requirements in its protective garment.
- The FR Pro system is guaranteed flame-resistant protection inside the special protective garment from electric arc and flash fire exposures, including molten ferrous metal and welding exposures.
- FR Pro's "Zero Body Contact" design protects users from burns should the FR Pro get ignited inside the protective garment.
- The FR Pro is designed with no exposed metallic parts and is

concealed inside the protective garment during operation. It must be mounted on Class E or G helmets for effective protection with options for both Type 1 or 2 helmets. It also works with face shields, including arc flash hoods worn over the helmets.
- Clarity of communication is assured even when working in noisy environments with VERTIX's Cut-The-Noise Technology.

Speak Easy Communication Solutions
https://speakeasycommunication.solutions

Vegetation Management Software

AiDash has announced Intelligent Vegetation Management System (IVMS) 2.0. The SatelliteVision and VegetationAI powered software offers new capabilities for utilities to transform vegetation management operations.

IVMS 2.0 uses four key technologies:

- SatelliteVision — A proprietary and patent-pending AiDash technology that transforms how satellite imagery is acquired and processed at global scale. Partnerships with satellite providers enable IVMS 2.0 to scan and process large T&D networks with more than 100,000 miles of overhead lines in a matter of weeks.
- Multisource Data Fusion — AiDash IVMS 2.0 has native capability to ingest and process remote sensing data at scale. Data can come from satellites, aerial imagery from drones, helicopters, fixed-wing planes, and LiDAR data from aerial or vehicle-mounted sensors.
- VegetationAI — AiDash IVMS has been deployed on more than 800,000 miles of T&D lines across 48 U.S. states and on five continents. As a result, the patent-pending AiDash VegetationAI models are trained on extensive and diverse data sets, resulting in very high accuracy in predicting vegetation risks. The robust AiDash "human in the loop" process further enhances accuracy.
- Automated Workflows Through New Web and Field Mobile Application — Automated workflows allow utilities to analyze, plan, and execute vegetation management activities from a single software platform, communicating directly with field staff and contractors via the new AiDash IVMS Field App. The application captures data from field personnel and feeds it back into IVMS for the next analysis, improving planning and execution while providing work plans.

AiDash VegetationAI accuracy was validated in a third-party study by Tulane University Law School. This model ensures crews are directed to top-priority locations, predicts the type of work needed, and alerts crews to bring the correct equipment — thus reducing the duration of interruptions and improving reliability.

AiDash | *www.aidash.com*

Brush Cutter Attachment

Loftness now offers a brush cutter attachment for skid steers and compact track loaders. Featuring a combination of beveled blades and carbide teeth, the new Kwik Cut is designed to slice through

grass, weeds, brush and small trees up to 10 inches in diameter with the ability to grind stumps and brush to ground level.

The Kwik Cut's heavy-duty, 72-inch-diameter disc is equipped with four dual-edge beveled blades, which are designed to retract on severe impact to protect them and other components from damage. The underside of the disc contains 18 carbide teeth for grinding. They are mounted with a single bolt for easy maintenance.

An exclusive floating door at the front of the Kwik Cut opens as it is pushed against a tree to expose the blades for improved cutting. When fully opened, the door becomes solid, acting as a tree pusher.

Designed for power units with a 28- to 45-GPM hydraulic flow range and 50 to 110 hydraulic horsepower, the Kwik Cut is powered by a 150cc radial piston motor. It provides instant torque at startup for fast recovery times. A rubber-mounted pressure gauge allows operators to easily monitor the workload from the skid-steer cab. Other standard features include bearing anti-wrap protection, a premium strength steel body and disc, and a universal skid-steer mount. The Kwik Cut is backed by a two-year warranty.

Loftness | *www.loftness.com*

Data Analytics

It all started with the birds. The E Source Data Science story took flight helping a utility identify avian outage risk across transmission infrastructure. Its services have grown exponentially since, today supporting dozens of advanced analytics projects with utilities across the country, ranging from customer programming and demand response in the Pacific Northwest to advanced vegetation and storm analytics across the Eastern seaboard. Because innovation is a process and not a destination, E Source says it prioritizes long-standing relationships with clients.

While at the T&D World Live Conference and Exhibition this past fall, E Source showcased case studies and success stories from its GridInform and OneInform solutions.

GridInform has a focus on asset and infrastructure analytics, with solutions including:

- Wood pole replacement analysis
- Substation transformer failure
- Storm and vegetation analytics

OneInform is all about customer and energy demand and how utilities can take an integrated approach for forecasting growth and modeling customer behavior. Using machine learning models, utilities can measure the impact customers will have on programs and identify high performers.

The SMB Accelerator can help utilities precisely target business customers with the right program, and the company's pioneering Demand Response solution portfolio helps to target the right

customers in a peak-time event, and also monitors performance and rebate calculation in near real time, among other applications.
E Source | *www.esource.com*

Transmission Line Ratings

Monitoring the transmission grid was never as important as it is today, unlocking more renewable energy usage and dealing with more extreme weather conditions than ever before. PrismaPower is a large-scale transmission line monitoring solution. It monitors thousands of miles of lines without installing any sensors, lines, or towers. Using the existing optical fibers, it can measure, alert, and inspect transmission lines 24x7, locating events to the nearest tower.

The PrismaPower suite of products offers solutions for:

- Dynamic Line Rating (DLR), a sensor-Free, distributed grid monitoring, compliant with FERC order 881
- Physical and weather events monitoring, which helps grid resiliency by alerting on weather events (lighting strikes, galloping, icing, extreme winds), vegetation hits, vandalism, tower tampering, and more
- Electrical events monitoring, which helps operators in their preventive maintenance by analyzing short circuits, flashovers, partial discharge & Corona, fiber cut, and fiber quality (OTDR), allowing ground team response before things get worse.

Every line span, every mile, monitored in real-time, ensuring optimal performance. With rapid substation-based deployment, it easily scales to grid size.
Prisma Photonics | *www.prismaphotonics.com*

Safety Solutions

Electromark has provided utilities with services and durable safety solutions for more than 50 years. It does more than sell durable signs, labels and tags. The company provides sales support, R&D and industry knowledge. It says it strives to help find a solution that will improve the safety and reliability of services.

If it does not have a product that meets specific needs, it can create a custom solution, while complying with regulations and standards, set by the NESC and OSHA. The goal is to be a partner for all safety and hazard identification needs.
Electromark | *www.electromark.com*

Metals Recycling

As one of North America's largest metals recyclers, Radius Recycling facilities acquire, process, and recycle millions of long tons of ferrous metals and hundreds of millions of pounds of nonferrous metals every single year. For more than a century, Radius Recycling has developed robust networks to collect, process, and deliver recycled metals to customers around the world. Its integrated operating model advances a circular economy where metals never become waste and instead are redesigned into new products.

These recycled metals represent critical feedstock in the global economy, supporting production of bridges, buildings, cars, public transit and passenger rail systems, and appliances, as well as more metal-intensive technologies, such as wind turbines, hydropower dams, advanced battery storage systems, upgraded electricity lines and electric vehicle charging stations, new broadband and reliable high-speed internet technology, and data centers.

Its comprehensive recycling solutions ensure your business is capturing value, managing proper disposal, and helping to keep valuable materials out of landfills.
Radius Recycling | *www.radiusrecycling.com*

Sensing for T&D Networks

AP Sensing provides DTS (Distributed Temperature Sensing), DAS (Distributed Acoustic Sensing), and BOTDR (Brillouin Optical Time Domain Reflectometry) sensing solutions for electrical transmission and distribution networks.

Utilities can manage your system's thermal status and circuit condition status for optimal network performance at safe ampacity levels.

- Conductor Temperature Monitoring
- Hotspot Detection & Location
- Real Time Thermal Rating/Dynamic Cable Rating
- Cable Fault Detection & Location
- Third Party Interference
- Condition Assessment
- Dig-in Protection & Prevention

AP Sensing Americas | *www.apsensing.com*

Transformer Services

Emerald Transformer has more than 50 years of experience in the transformer services industry. Emerald provides a wide range of transformer services, including re-manufactured transformer stock, repairs, decommission, field technical services, parts, PCB disposal and recycling. Our national network of factories and service centers are strategically located to serve our broad and diverse customer base.
Emerald Transformer | *www.emeraldtransformer.com*

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@GeorgiaPower
Our team has been making the most of the cool weather by taking our work outdoors to support our incredible community! 🍂☀️ Heart of Georgia proudly brought home the trophy at the 2023 Dragon Boat races. These races support Big Brother Big Sister of Central Georgia. 🐉🏆

@ComEd
Our electrifying journey continues! 🚗⚡ Discover how we're demonstrating the power of #EVs with our recent cross-country road trip to assist @MyBGE and @PECOConnect crew members restore power after severe weather.

Public Service Company of Oklahoma
It's Careers in Energy Week! We're excited to celebrate the workers who power a brighter future for all Oklahomans, starting with our graduating lineman apprentice class. Congratulations!! 👏👏*#CareersInEnergyWeek #ThankALineman #PSOklahoma*

SMUD
We had an incredible time with the talented students at Capital College & Career Academy. Our team brought our bucket trucks to showcase the exciting world of the energy industry to these bright young minds.

Duke Energy Corporation
This weekend 60 of our lineworkers competed with the best in the world at the International Lineman's Rodeo, and brought home four major awards. Congratulations to all of our winners and competitors!

Steve Sullivan
President of Connecticut Electric Operations, Eversource
What a day! The turnout at the Eversource Hartford Marathon was so impressive with thousands of runners, volunteers, and spectators in the capital city, helping to support charities across the state.

AD INDEX

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How Do We Scale End-Use Decarbonization?

New England has been proactive in setting aggressive targets to decarbonize and address climate change. There is no playbook that guides us on how to achieve these targets, however. Now energy providers and communities need policymakers to foster the flexibility and freedom necessary to align stakeholders and trigger the collaboration, innovation, and execution necessary to achieve our goals at scale. Driving end-use decarbonization is fundamentally about changing customer behavior which, by its nature, involves a lot of testing, learning, correcting, and scaling. We welcome great ideas on how to drive customer adoption, but we treat them as hypotheses that must be vetted and tested before we scale them. We also know we must align customer economics with desired policy outcomes in an equitable way by addressing the needs of the more vulnerable members of our society.

Residential

New England has very old housing stock. By some indications, over three-fourths of our stock was built before energy codes were in place. Interlacing weatherization and phasing out fossil-based heating fuels in our climate zone, where winter heating bills and electricity prices are high, is a particular challenge.

It's tempting to suggest that we bundle weatherization and fuel switching. We hear this a lot. Yes – there is a segment of customers who will respond to that comprehensive approach. However, it is very difficult to achieve the scale we need by bundling the two. For most customers, these are discrete and large buying decisions.

Our current approach, understandably, emphasizes electrification. It provides significant near-term greenhouse gas benefits and prevents the sunk cost of keeping fossil fuel heating systems in place for the next 20 years. However, without weatherizing first – which has its own set of complexities – heat pumps, for example, become oversized for the coldest winter days, eroding their efficiency during milder ambient temperatures and putting more strain on the electric grid.

So, as a matter of policy, when it comes to meeting large decarbonization goals at scale in New England, what should we do? Should we distort the market to drive aggressive fuel-switching in the near term at a very high cost? Should we piggyback on more natural heating system replacement cycles, which may conflict with our desired 2030 goals, but could position us to achieve the 2050 ones more cost-effectively? A slower rollout of heat pumps, for instance, potentially allows space for a new generation of refrigerants to come into play. But how do we pay for all these changes and send the correct price signals that encourage customers to naturally make these transitions?

Large Commercial & Industrial

Over the last year, I've had the privilege of meeting with many of our largest institutional customers to discuss their thoughts and plans on decarbonization. What has impressed me is that, without exception, every one of them takes the issue of climate change very seriously and has committed to doing something about it. They are all at various stages of developing formal decarbonization goals and plans under the oversight of their boards. They all have an interlaced approach to decarbonization with three elements:

1. Execute on the no-brainers: These are usually focused on energy efficiency. They offer, by far, the biggest bang for the buck. Over ten years ago, we pioneered an approach to partner with these large institutional customers, leading to memorandums of understanding setting specific and aggressive goals, resource commitments, and execution plans to get there. This has been one of the most effective ways of driving institutional behavior change. The results show it. Customers reduced energy use by 20 to 50 percent in a few years.

2. Thoughtful and surgical electrification: Many of these customers own large portfolios of buildings of varying vintage and uses. They often find that partially electrifying multiple buildings is more cost-effective and has a higher carbon impact than the full electrification of fewer structures. This challenge has implications for the maintenance of existing fossil fuel-based systems for backup/peak shaving.

3. Exploration of solutions for full electrification: Most customers have some idea about how they could decarbonize by 70 to 80 percent, though they haven't figured out how to pay for it. When it comes to the last 20 to 30 percent, the complexity skyrockets. They don't have a line of sight into emerging technologies that could be used, while the implicit cost of carbon goes to multiple thousands of dollars per ton, making 100-percent decarbonization unrealistic.

So What?

Fully realizing end-use decarbonization in New England will be challenging. However, while we may not have a playbook for this challenge, we do have roadmaps from similar endeavors. That's especially true if we look at how gains in energy efficiency have been made on the ground. We know how to drive solutions into the market at scale.

I like the three-tiered approach of our institutional customers. It allows us to move the ball forward, even as we allow for safe spaces to undertake necessary experiments and objectively assess results. We need to be honest with ourselves about what we know, be mindful of unintended consequences, and have faith in, and allow for, the price performance of technologies and solutions to evolve, even as we acknowledge that the current state may not be ready to scale. TDW

TILAK SUBRAHMANIAN is vice president at Eversource.


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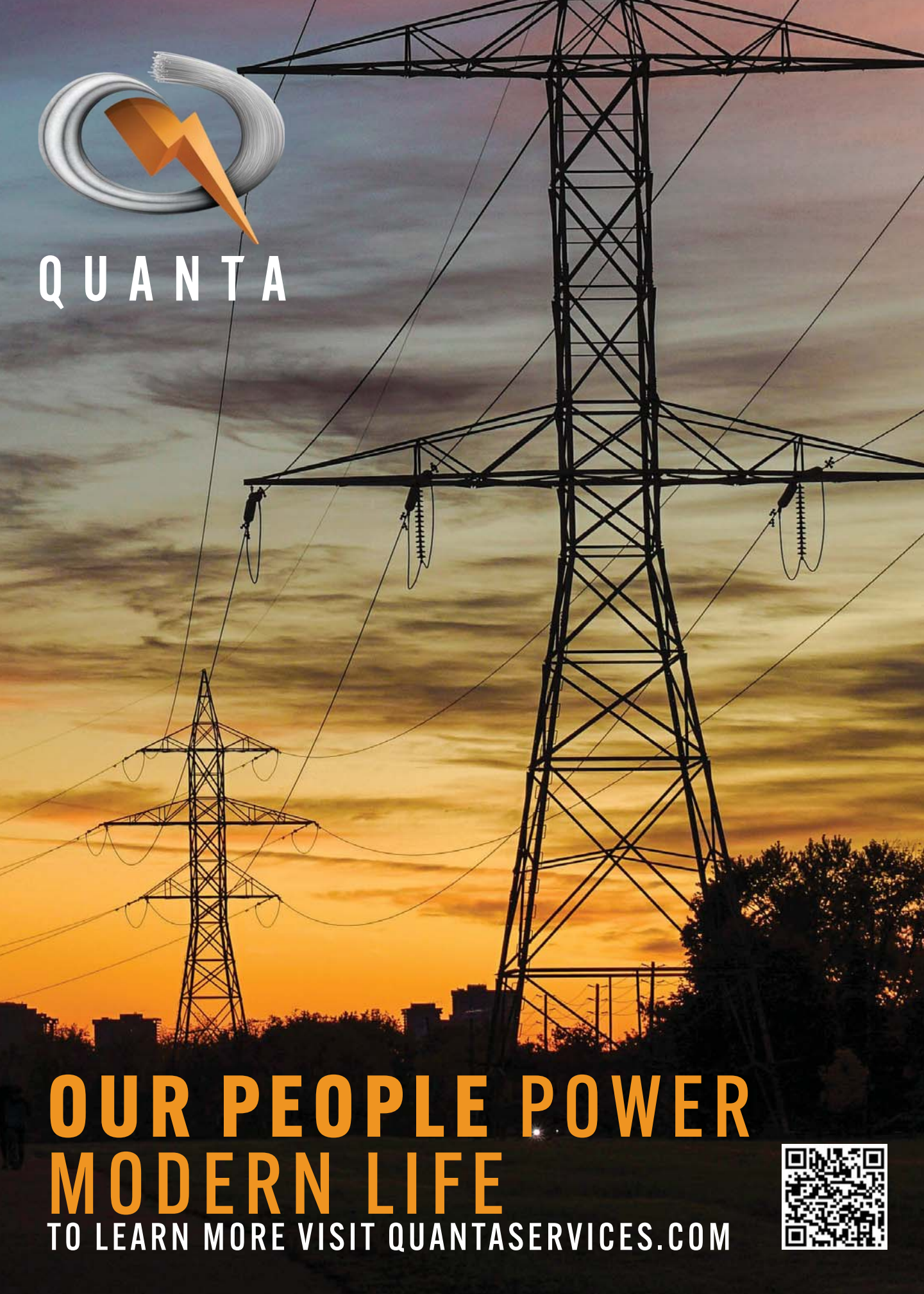
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