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Quarterly Issue 4, 2024 — Volume 30

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FIVE AI LESSONS FOR UTILITIES, GRID OPERATORS AND REGULATORS

November, 2024

When we attended GridFWD 2023 just over a year ago, we sat in spellbound curiosity as Microsoft demonstrated the power of its AI engine during an initial keynote My, how far we've come.

It's now obvious that AI is an "unavoidable fact" of the electric grid. We are no longer in the era of sub-1% ho-hum load growth era. With a search using AI taking 10 times the computing power of a traditional search engine, the IEA is now estimating that AI and data center load growth will more than double from 2022 to 2026.

Ironically, some of that load growth will come from utilities using AI to improve their own planning and operations.

A Growing Range of Grid-Specific Case Studies

At GridFWD 2024, in Banff, Alberta, we saw utilities, grid operators and regulators starting to jump on the bandwagon. They are working on their own AI use cases to modernize the grid without compromising grid reliability. Our team attended several AI sessions at the event to get a feel for the intersection of AI and the grid. Here are some of the more prominent examples:

- At ENMAX AI is playing an increasing role in wildfire mitigation. The utility uses drones to capture images around transmission lines and turns to AI to analyze and create prioritized work orders for vegetation management or system upgrades.
- Shantia McNeil of NVIDIA described utility-specific AI use cases including predictive maintenance, infrastructure management, load forecasting, and DER integration. "We not only want to unlock growth and drive efficiency, but we need to create a more future proof sustainable and resilient grid," said McNeil.
- Leaders at Camus Energy and AES discussed how they used machine learning focused data analysis, which they referred to as "Small AI", to analyze the impact of EV adoption on the AES Indiana distribution grid to inform strategic allocation of utility capital. They reported their results in a recently released white paper.
- Harneet Panesar, COO of the Ontario Energy Board (OEB) gave us a regulator's perspective. To equip stakeholders with more efficient tools for searching the OEB's adjudicative documents, the OEB is launching iSearch, an AI-powered search engine and document analysis tool, to streamline access to over 170.000 documents.

Five Early AI Lessons for Utilities

It became clear that there are a huge array of potential AI uses cases for the grid, and that each utility and tech company will have their own plans and priorities. The AI leaders at GridFWD 2024 cautioned utilities to be thoughtful about deplying AI, rather than chasing every use case. "Capital is too precious and the risks of doing it wrong are great", said Alexina Jackson of AES.

After absorbing a great many discussions at GridFWD 2024, we discerned five lessons from the early initiatives to employ AI for managing the grid:

1. Create a governance model before moving to use cases. Hanna Grene, Global GTM & Operations Leader for Energy of Microsoft, shared principles of responsible AI that her team shares with its 500+ energy clients: Accountability, Privacy & Security, Inclusiveness, Transparency, Reliability & Safety, and Fairness.
2. Educate your workforce, from top to bottom. There is a tremendous need to train employees about AI – the technology, uses, and ways it will enhance their work. Operators who run the grid, and do it well, may feel that AI tools are a threat to the way they work.
3. Need for standardization. Joe Glazer of Hubbell noted that there is a diverse ecosystem of end customer devices, aggregators, hardware companies, energy providers and markets that need to coordinate to leverage the full power of AI tools.
4. Prioritize, prioritize. Take the time to go through the stack of AI ideas that are inevitably going to be generated, determine who will have access to AI, ensure the business case is in place, and evaluate the impact on customers and technical debt. This cannot be understated – AI has tremendous value, but the hype has the potential to create chaos.
5. Be brave and adopt AI. Utilities by nature are conservative and hold reliability and security sacred, but the grid benefits are too great to not embrace AI.

> ***"There is no doubt that the benefits of AI will transform the way the grid operates. Although it is not a silver bullet to all our challenges, it is a critical piece of the puzzle. The path of least risk for the industry is to invest in AI-ready infrastructure and determine how to leverage AI to achieve a clean and reliable energy transition," says Marissa Hummon, CEO of Utilidata.***

Grid Forward is excited to continue this conversation through the "AI and the Grid" focus its GridFWD 2025 conference theme.

Authored by Tom Brim, AVP and Brett Lyon, Manager in North Highland Consulting's utility practice.

> ***"We need to standardize protocols and data schemes so that that devices can easily and effectively communicate with one another and with software suites. Without removing these barriers, devices (such as smart inverters) with unique protocols and software will require expensive backend integrations, or worse, will become stranded," Glazer said.***

Photo (L to R): Marissa Hummon, CTO of Utilidata moderates panel with AI thought leaders: Marie Steele , VP of Integrated Energy Systems at NV Energy; Shawntia McNeil, Global Energy Ecosystem Partner Manager at Nvidia;Joe Glazer, Director – NPX at Hubbell

CIGRE PARIS SESSION 2024: OPENING CEREMONY

Renewable Energy Integration at the heart of CIGRE Paris Session 2024

November, 2024

Sunday, August 25, was the begining of one of the largest and most important events in the power system and energy sector, CIGRE Paris Session 2024.

For its 50th edition, the Paris Session welcomed a worldwide community of experts to share their knowledge and researches knowledge and research over five-and-a-half days.

The opening ceremony, one of the session's highlight events, welcomed more than 2,700 experts and industry players.

Michael Augonnet, the outgoing CIGRE president, started the ceremony with a speech that put forth key numbers and information about CIGRE and its events:

- More than 20,000 members
- 250 Working Groups
- 120 countries
- 4,500 participants
- 280 exhibitors
- 10,000 visitors
- The digitalization era that has begun these past years with multiple projects that have enabled CIGRE to provide more services to ts members

During the second part of the opening ceremony Keisuke Sadamori, the director of Energy Markets and Security at the International Energy Agency (IEA), spoke.

Sadamori presented the latest IEA reports and upcoming research that provide the current global landscape of the power sector and renewable energy deployment as well as insights into upcoming work on renewables integration and secure electricity.

Sadamori's offered his insights into IEA's work on these pressing issues and provided recommendations for policymakers and industry stakeholders, of high relevance to the work that CIGRE members are doing today.

The last part of the opening session was a summary of the content and programme of the CIGRE Paris Session 2024, presentedby outgoing Technical Council Chair Marcio Szechtman, which included:

- The organisation of different conferences during the week (Panels, Tutorials, Workshops, Poster Sessions, NGN Forum, WiE Forum)
- The technical council strategic plan for 2023-2030
- Presentation of the 16 study committees

CIGRE Paris Session 2024, which was the 50th year for the event, was a tremendous success and THE place to be for experts in the power system industry worldwide.

U.S. DEPARTMENT OF ENERGY ANNOUNCES UP TO $365 MILLION TO EQUIP MULTIFAMILY HOUSING AND HEALTHCARE FACILITIES ACROSS PUERTO RICO WITH RESILIENT SOLAR AND BATTERY STORAGE

December, 2024

The U.S. Department of Energy (DOE) today (Dec 12) announced four Puerto-Rico-based teams selected to install solar and battery storage systems under its new **Programa de Comunidades Resilientes**, funded by DOE's **Puerto Rico Energy Resilience Fund (PR-ERF)**. This investment of up to $365 million aims to improve community-level energy resilience for vulnerable populations across Puerto Rico, funding solar and battery storage installations for community healthcare facilities as well as common areas within public housing and privately owned subsidized multi-family properties. This investment will also boost local workforce development opportunities in Puerto Rico.

Teams selected for award negotiations under the Programa de Comunidades Resilientes have an existing presence in Puerto Rico and will coordinate the deployment of projects across many facilities or properties (*e.g.*, 100-150) in partnership with local stakeholders. The selected teams include community-based organizations; nonprofit organizations; solar installation companies; engineering, procurement, and design firms; consultants, and more.

Multi-Family Housing Properties

Pending successful award negotiations, DOE anticipates awarding up to $190 million to fund solar and battery installations for common areas within public housing or privately owned multi-family housing properties subsidized by the U.S. Department of Housing and Urban Development and the U.S. Department of Agriculture. DOE anticipates funding projects that power common areas available to all residents as well as shared building infrastructure that depends on electricity, such as elevators. DOE selected the following projects and teams to enter award negotiations:

1. **100x35 Renewable and Resilient: Building a Brighter Future for Public Housing Communities in Puerto Rico - Up to $83.2 million**
   - Lead Applicant: Puerto Rico Public Housing Administration
   - Team Members: La Asociación de Contratistas y Consultores de Energía Renovable de Puerto Rico (ACONER), Colegio de Ingenieros y Agrimensores de Puerto Rico (CIAPR), Colegio de Peritos Electricistas de Puerto Rico, Cooperativa Hidroeléctrica de la Montaña, LUMA Energy
2. **Sol y Seguridad para Multifamiliar - Up to $107.3 million**
   - Lead Applicant: Dynamic Solar Solutions
   - Team Members: Baringa Partners, ConSOLCio, GRID Alternatives, Miramar Group, West LLC

Community Healthcare Facilities

Pending successful award negotiations, DOE anticipates awarding **up to $175 million** to fund solar and battery storage installations for federally qualified healthcare centers, dialysis centers, and diagnostic and treatment centers in underserved and vulnerable communities. DOE anticipates funding projects that power critical health care services, such as trauma and emergency services and cold chains for vaccines and medicines. DOE selected the following projects and teams to enter award negotiations:

1. **Enhancing Energy Resilience in Puerto Rico's Community Healthcare Infrastructure - Up to $58.3 million**
   - Lead Applicant: Hispanic Federation Inc.
   - Team Members: Asociación de Salud Primaria de Puerto Rico Inc., Consejo Renal de Puerto Rico, SolarTek, University of Puerto Rico - Mayagüez Campus, University of Puerto Rico's Sustainable Energy Center
2. **Sol y Seguridad para Centros de Salud - Up to $116.2 million**
   - Lead Applicant: Dynamic Solar Solutions
   - Team Members: Baringa, Collective Energy, GRID Alternatives, Interstate Renewable Energy Council (IREC)

Puerto Rico Energy Resilience Fund (PR-ERF)

In December 2022, President Biden signed into law $1 billion for the establishment of the PR-ERF to drive key investments in resilient and renewable energy infrastructure for vulnerable communities in Puerto Rico. The **Programa de Comunidades Resilientes** is the second round of energy reliability investments under the PR-ERF. In July 2024, DOE announced its first installations of subsidized residential solar and battery storage systems through the PR-ERF's **Programa Acceso Solar**, connecting low-income Puerto Rican households with reliable and affordable energy. Residents of Puerto Rico can visit **energy.gov/SolarPR** to check their eligibility and contact their local Solar Ambassador to apply.

BIDEN-HARRIS ADMINISTRATION ANNOUNCES THREE HIGH-PRIORITY AREAS ADVANCING IN NATIONAL INTEREST ELECTRIC TRANSMISSION CORRIDOR DESIGNATION PROCESS

DOE Seeks Public Input on Proposed Public Engagement Framework and Possible Scope of Analysis for Areas Moving to Phase 3 of Designation Process

December 16, 2024

In a continued effort to expedite the build out of a resilient and reliable electric grid, today (Dec 16) the U.S. Department of Energy (DOE) released a list of three potential **National Interest Electric Transmission Corridors (NIETCs)** moving to the next phase of the designation process. A NIETC is an area of the country where DOE has determined the lack of adequate transmission harms consumers and the development of transmission would advance important national interests in that area, such as increased reliability and reduced consumer costs. DOE recently established a four-phase process for NIETC designation; the potential NIETCs moving to Phase 3 of the designation process are:

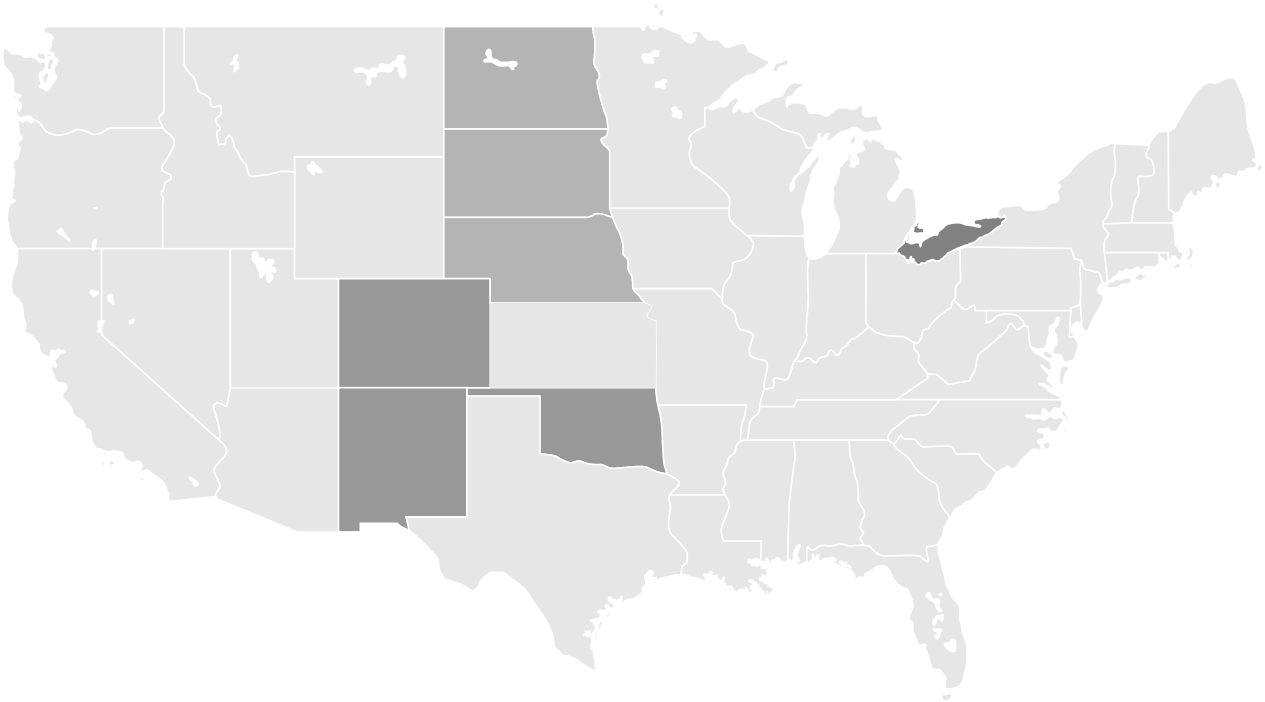
- Lake Erie-Canada Corridor, including parts of Lake Erie and Pennsylvania
- Southwestern Grid Connector Corridor, including parts of Colorado, New Mexico, and a small portion of western Oklahoma
- Tribal Energy Access Corridor, including central parts of North Dakota, South Dakota, Nebraska, and five Tribal Reservations

These potential NIETCs have been significantly refined since the release of the 10 potential NIETCs in May 2024, and each were renamed to better describe their location and purpose. DOE made these refinements in response to comments received from the public and its continued analysis of the value of NIETC designation to spur needed transmission investment.

A lack of transmission infrastructure can directly contribute to higher electricity prices, more frequent power outages from extreme weather, and longer outages as the grid struggles to come back online. In 2021, the Bipartisan Infrastructure Law amended the Federal Power Act to authorize the Secretary of Energy to designate any geographic area as a NIETC if DOE determines that consumers are currently harmed by a lack of transmission in the area or are expected to suffer harm from a lack of transmission in the future. DOE may also consider whether development of new transmission would advance important national interests for that region, such as increased reliability and reduced consumer costs, when designating NIETCs.

In December 2023, DOE's Grid Deployment Office announced a **new four-phase process for designating NIETCs**. The process aims to maximize opportunities for public input throughout each of the phases to help DOE identify narrow geographic areas where transmission is urgently needed and where NIETC designation could help accelerate solutions.

DOE initiated the first phase of the new process by opening a public comment window for suggestions on where DOE should consider designating NIETCs. In May 2024, DOE initiated Phase 2 of the process by releasing a **preliminary list of 10 potential NIETCs**, including maps with rough approximation of boundaries and a high-level explanation of the transmission needs within the potential NIETCs. DOE also opened a public comment window.



The announcement today initiates Phase 3 of the designation process, the public and governmental engagement phase, during which DOE will continue to refine geographic boundaries, determine the appropriate level of environmental review for each NIETC, if any, and conduct any required environmental reviews under the National Environmental Policy Act (NEPA) and other applicable federal statutes, conduct robust public and governmental engagement, and prepare draft designation reports.

Additionally, DOE is aware of potential impacts to military testing, training, and operations and will continue working with the DoD Military Aviation and Assurance Siting Clearinghouse to address these impacts as these potential NIETCs are further refined in Phase 3. →

DOE is also publicly releasing **detailed maps of each of the three potential NIETCs moving to Phase 3**, including underlying geographic information system data. A **60-day comment period is now open to solicit comments** on DOE's proposed public engagement framework and possible scope of analysis of the potential NIETCs, including environmental, cultural, or socioeconomic effects should DOE designate any of the potential NIETCs. Additional public engagement will occur after this initial comment period. In addition, DOE is providing the names of known transmission projects under development within the potential NIETCs, as well as anticipated next steps of the NIETC process.

DOE combined and refined the boundaries of four of the 10 potential NIETCs from Phase 2 to form the boundaries of the **three potential corridors** proceeding to Phase 3. The following potential NIETCs announced in Phase 2 are **NOT** moving forward in the designation process:

- New York-New England
- New York-Mid-Atlantic
- Midwest-Plains
- Mid-Atlantic
- Delta-Plains
- Mountain-Northwest

DOE's decision to not move these potential NIETCs forward does not constitute a finding that there are no transmission needs in these areas; rather, DOE is exercising its discretion to focus on other potential NIETCs at this time and may in the future revisit these or other areas through the opening of a new designation process.

Public Engagement Opportunities

In January 2025, DOE will host informational webinars on each of the three potential NIETCs:

- Tribal Energy Access Corridor Webinar:
  Tuesday, January 14, 2025 at 3:00 p.m. Eastern
- Southwestern Grid Connector Corridor Webinar:
  Wednesday, January 15, 2025 at 3:00 p.m. Eastern
- Lake Erie-Canada Corridor Webinar:
  Thursday, January 16, 2025 at 3:00 p.m. Eastern

Registration is required. Registration for each event will remain open until the event starts, and recordings will be made available online.

After the close of the public comment window on February 14, 2025, DOE will review comments and create tailored public engagement plans for each potential NIETC. DOE will determine its obligations under applicable environmental laws in Winter and Spring 2025, and then proceed to conduct any required environmental reviews. DOE will continue to accept meeting requests, public comments, and questions on the potential NIETCs throughout Phase 3. After further evaluation during Phase 3, DOE will release any draft NIETC designation report(s) and any required draft environmental document(s) and intends to request public comments on both.

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XCEL ENERGY USING AI TECHNOLOGY TO DETECT WILDFIRES IN TEXAS PANHANDLE XCEL ENERGY, INC.

Plans include more than 50 camera stations in nearly a dozen counties.

December, 2024

Xcel Energy is increasing its wildfire detection and mitigation efforts in the Texas Panhandle by introducing artificial intelligence to spot fires early. We are partnering with Pano AI to install more than 50 camera stations across the region. Carson, Gray, Roberts, Hutchinson, Wheeler, Hemphill, Garza, Cochran, Moore, Potter and Yoakum counties are currently being considered. First responders and firefighters will have immediate access to this data, shortening response times.

> *"We want to better safeguard our neighbors and reduce the risk of future wildfire loss by investing in advanced wildfire detection capabilities," said Adrian J. Rodriguez, president, Xcel Energy - New Mexico, Texas. "So many of our friends, families and communities have been impacted by the wildfires in the Texas Panhandle and we remain committed to supporting them. Providing this technology to our first responders with the information they need to act swiftly and safely to respond to wildfires will improve public safety."*

The company is currently identifying strategic locations for the initial camera stations in areas with the highest fire risk, which will be complete in 2025. This is a five-year program and underscores Xcel Energy's commitment to protecting our communities, fortifying grid resilience, and providing situational awareness for first responders in Amarillo and surrounding areas.

Pano AI's system combines 360-degree high-definition cameras, AI-driven smoke detection and satellite data integration to continuously scan for smoke. When a potential fire is detected, Pano immediately verifies it through human analysts, triangulates the location and notifies the 911 call center to activate the closest fire department. Fire departments will have access to these live streams for critical, real-time intelligence.

> *"Early detection of wildfires is critical, especially in high-risk areas like the Texas Panhandle," said Arvind Satyam, Co-Founder and Chief Commercial Officer of Pano AI. "We are proud to support Xcel Energy's commitment to community safety and resilience through cutting-edge technology that empowers first responders with the real-time information and enhanced situational awareness they need to act decisively."*

Each Texas camera station will perform a 360-degree sweep every minute. This initiative builds on Xcel Energy's existing measures, including power line inspections, vegetation management and aerial surveillance.

The company plans to install more cameras in Texas and expand the program into our New Mexico service territory in the future. As camera stations are added and their reach overlaps, their accuracy will improve, helping firefighters respond more quickly.

These efforts follow Xcel Energy's successful deployment of Pano AI camera stations in Colorado. Our comprehensive wildfire mitigation strategy also includes collaborations with other technology providers and thorough equipment inspections, reinforcing our commitment to protecting vulnerable communities and infrastructure.

We are one of the most reliable energy companies in the industry and we are taking proactive steps to safely meet the needs of our growing region. Xcel Energy is building the energy grid of the future by following our investment plan to modernize and harden our grid for increased resilience. While we make these investments, we will work efficiently to provide energy to our customers and keep their bills as low as possible.

SOME END-OF-YEAR THOUGHTS ON GRID MODERNIZATION'S PROGRESS/ IMPEDIMENTS

ELISABETH MONAGHAN
Editor in Chief

With 2030 arriving in just five years, will we see a greater push by energy providers and consumers to reduce global emissions by 45% by 2030 and reach net zero by 2050?

In this issue, EET&D Magazine wraps up 2024 with a great lineup of articles from experts, who have added to the conversation about how the electric energy sector is working to meet those net zero goals. This includes what obstacles have impeded or will continue impeding this effort and what must be done immediately to ensure the industry can move past those obstacles.

To give a sense of how the industry is tackling the challenges affecting the electric utility sector, I will touch on a few of the articles, starting with the article titled "The Digital Transformation of the Electric Utility Industry" by Scotty Buoy with Sendero Consulting.

Buoy weighs in on the complexities of digital transformation and how utilities can navigate them. To keep pace with the changing energy sector and succeed on its path toward a modernized grid, Buoy maintains that utilities must embrace and invest in the latest technological advances available. Rather than merely listing the tools, Buoy also explains how these tools work and why integrating them is a necessary step for utilities to succeed in achieving their goals.

In his article, "Challenges Impeding Electrification and Digital Transformation and Why Device Management Can Help," Curt Ahart with Digi International addresses several challenges getting in the way of utilities' efforts towards grid modernization. While each of the impediments Ahart discusses deserves consideration, I will highlight just two of them.

At the top of Ahart's list is the financial burden associated with aging grid infrastructure. As utilities transition to new technology and equipment, they must also find ways to maximize their existing assets, including those that need replacing or improving. All of this requires time and money.

Another obstacle utilities face on the road toward a modernized grid is the cost of and data associated with –investing in and maintaining assets such as sensors, cameras and other connected devices. Today's modern utilities find themselves handling more assets than ever, and those assets generate significant amounts of data that utilities will need to collect, analyze and manage.

Regardless of the challenges the electric energy sector faces, utilities must find cost-effective solutions to address them. Ahart breaks down why utilities must find these solutions. He also offers steps utilities can take to save time and money.

Real-life examples

Also featured in this issue are case studies from Omaha Public Power District and AES Power Company. By teaming up with industry partners, these utilities have achieved early success in their navigation toward a modernized grid.

Not only does this issue feature industry experts' insights on challenges utilities face, but it also includes case studies to show how two utility providers have navigated some of these obstacles successfully.

Like every other electric energy provider, Omaha Public Power District, the 12th largest public power utility in the U.S., has experienced a surge in electricity demand. In his article about OPPD's effort to streamline field operations for a digital future, Kevin Egan with Panasonic Connect shares a case study on how his company partnered with OPPD.

Egan explains how his team helped OPPD improve operational efficiencies and customer communication and their efforts to assist with the power company's transition from outdated systems to digital platforms.

Quoting Scott Marshall, manager of Application Services at Omaha Public Power District, Egan shares the broader vision behind OPPD's digital transformation. "Our shift to a digital utility company is not just about modernization," says Marshall. "It's a commitment to addressing our customers' present needs while innovating for their future challenges. Through the integration of technology and a focus on customer-centric solutions, we are empowering our communities to thrive."

Our second case study in this issue comes from AJ Hall with AES – a global energy company – and Jonathan Marmillo with LineVision, a Boston, MA – based power transmission solutions company. Hall and Marmillo set the scene for their column by talking about how the growth of electricity demand has created an abundance of opportunities. But, the antiquated condition of most infrastructure in the U.S. is so dated that it can't accommodate the increased need for electricity.

AES recognized it needed to act immediately to improve its grid capacity, which is why the company partnered with LineVision to deploy Grid-Enhancing Technologies – specifically Dynamic Line Ratings – across five… five transmission lines in Indiana and Ohio. At the time, this was the largest deployment of DLR in the U.S.

Hall and Marmillo discuss why DLR is an ideal "here-and-now" solution because, as they write, "The traditional means of upgrading grid infrastructure would be to install new transmission lines, which must be part of the solution, but new lines can take up to ten years and cost millions of dollars per mile…." DLR, on the other hand, "can create near-immediate improvements in grid efficiency upon installation."

By deploying DLR, AES saw significant expansion in its grid capacity across its transmission lines in Indiana and Ohio. In addition to showing how DLR proved to be an affordable solution that can provide transmission lines, the findings of this case study also demonstrate that DLR has the potential to benefit electric utility providers and consumers alike.

As we approach the year 2030, the existing challenges of modernizing the grid will continue to mount, and no doubt, those who work in the electric energy sector will encounter new obstacles as they endeavor to transform the electric grid. The team at EET&D appreciates the thoughtful discussions that each of our subject matter experts has shared with our readers over the past year, and we look forward to seeing where the next phases of the conversation take us.

As always, if you would like to contribute an article on an interesting project, please email me:

Elisabeth@ElectricEnergyOnline.com

Elisabeth

EMBRACING IMMEDIATE SOLUTIONS

TO AN AGING ELECTRICAL GRID

AJ HALL AND JONATHAN MARMILLO

As the global energy sector pushes to reach net zero CO_2 emissions by 2050, grid infrastructure continues to age and become outdated. In this Q4 Grid Transformation Forum section, AJ Hall with AES and Jonathan Marmillo with LineVision share a case study on the role Grid Enhancing Technologies – specifically Dynamic Line Ratings – play in improving grid efficiency quickly. They partnered to deploy DLR sensors across AES transmission lines in Indiana and Ohio, which significantly expanded grid capacity in those locations.

The world is electrifying. Between the increased adoption of electric vehicles, new manufacturing facilities and the energy-hungry data centers that are powering the AI revolution, electricity demand is increasing at unprecedented rates.

Amid all of the opportunities that our electrified economy brings, it's crucial to keep in mind one thing that could derail all of this progress: an insufficient electrical grid. The U.S.'s century-old transmission infrastructure can't handle today's soaring electrical demand, and the resulting bottlenecks could significantly hinder economic growth and our decarbonization goals. Unless the U.S. more than doubles its regional transmission capacity, the backlog of renewable projects will only increase with growing electricity demand.[1] Connecting clean energy projects to the electrical grid is vital to meeting the demand for renewable energy and overall climate goals – including the Paris Agreement's goal of a 43% reduction of greenhouse gas emissions by 2030 – but outdated grid infrastructure is holding us back. There were 2.6 terawatts (TW) of generation and storage capacity stuck in interconnection queues at the end of 2023, 95% of which is renewable energy. The average project takes five years to connect and is burdened by increasing interconnection costs.[2] On top of all of this, utilities are racing to meet customers' demand for capacity to feed data centers needed to power rapidly evolving cloud computing and AI technologies, whose applications are multiplying to touch every aspect of our technological lives.

Our lack of grid capacity isn't a problem of tomorrow; it's something we're facing here and now that must be addressed with appropriate urgency. The traditional means of upgrading grid infrastructure would be to install new transmission lines, which must be part of the solution, but new lines can take up to 10 years and cost millions of dollars per mile.[3] Utilities must use every tool in their toolbox and consider every means of increasing grid capacity, lest we fail to meet both our demand for electricity and our decarbonization goals while ensuring a reliable energy delivery system. →

[1] Grid Strategies: The Era of Flat Power Demand is Over

[2] Berkeley Lab EMP: Queued Up: Characteristics of Power Plants Seeking Transmission Interconnection

[3] Department of Energy: National Transmission Needs Study

AES lineworkers install a LineVision non-contact sensor on a transmission tower. Source: LineVision.

Lineworkers secure a LineVision non-contact sensor on an AES transmission tower. Source: LineVision.

Thankfully, there is an affordable, here-and-now solution to this problem: Grid Enhancing Technologies (GETs). GETs are devices and software that can make the most of existing grid infrastructure to increase electrical throughput. One particular GET, Dynamic Line Ratings (DLR), can create near-immediate improvements in grid efficiency upon installation. If one were to picture the current electrical grid as a congested highway, with countless impatient cars struggling to merge and get to their destination, then DLR implementation would be the equivalent of creating an entirely new lane, alleviating stress and significantly speeding up traffic.

AES, a global energy company, recognizes the grid capacity challenge and has partnered with DLR provider LineVision to deploy. the technology at scale. AES and LineVision recently released a case study on the deployment of 42 of LineVision's DLR sensors across five diverse AES transmission lines in Indiana and Ohio, which, at the time, was the largest deployment of DLR in the United States. AES chose LineVision's DLR for a number of reasons, including DLR's affordability, the speed with which it can be installed and the valuable data it provides about grid assets in the field and their ability to carry power. LineVision's DLR sensor monitors can be installed directly onto transmission poles within minutes, without the need for scheduled power outages or expensive installation equipment. These sensors offer visibility into transmission line capacity and conductor health, and proactive monitoring alerts for real-time identification of potential safety threats. By calculating transmission line ratings based on real-time environmental conditions, AES found an increase of over 60% for deployments on 345kV lines.

AES had four goals when deploying LineVision's DLR for this case study. The first was to validate the benefits of DLR through quantitative evidence affirming its effectiveness. The second was to increase the efficiency of AES' existing grid, which all GETs – including DLR – are inherently equipped to do. The third was to ensure the reliable and safe delivery of electricity. The final objective was to establish a variety of proof points on DLR across a number of different asset types and customer-use cases.

Both AES and LineVision aimed to choose a set of transmission lines that would sufficiently demonstrate the efficacy and versatility of DLR. AES believed that the lines that could validate DLR customer benefits were those with known or expected constraints, reliability risk or planned investment. With this in mind, the two organizations chose five transmission lines for DLR deployment, located in a mix of urban and rural areas. Total installation time took less than two weeks with an average sensor installation time of approximately 30 minutes, excluding travel time.

It is incontrovertible that DLR should play a vital role in the future of the electric grid.

Early results from the case study underscore the potential for DLR to greatly enhance real-time monitoring, which would improve grid operations and strategic investment in assets. Extra high voltage transmission lines were shown to be well-suited for DLR because of their wider rights of way, taller structures and greater tension equalization between spans. With DLR installed, these lines consistently exhibited a much higher electrical capacity than their counterparts utilizing static ratings and ambient adjusted ratings (AAR). The final major finding was that DLR provided improved situational awareness and opportunities for informed decision-making in all five deployments, which will determine the next steps for each line. For example, DLR revealed how highly vegetated areas can limit the cooling effects of wind and impact the carrying capacity of transmission lines. DLR surfaced capacity constraints on a 69kV line that travels through a narrow vegetation corridor, restricting the cooling effect from wind. This insight enabled AES to consider vegetation management or targeted reconductoring to raise the line capacity.

The enhanced capacity that DLR can provide transmission lines, coupled with the lessons learned, exhibit the potential for DLR to bring about substantial benefits to customers and utilities alike. These projected benefits include reduced energy and upgrade costs, lower congestion, improved reliability, cleaner energy and faster connection of large customer loads such as data centers. For all the promising discoveries that were made, this is only the beginning. AES is committed to continuing the study of DLR and providing further data on its uses. It is incontrovertible that DLR should play a vital role in the future of the electric grid. But more than that, given the urgency brought about by increased electrical demand, they must be a part of a modernized grid right here and now.

Other studies have found similar promising results from GETs. The Department of Energy (DOE) recently concluded that deploying DLR and other advanced grid technologies overnight could increase the capacity of the existing grid to support 20-100 GW of incremental peak demand when installed individually, with significant additional capacity potential when installed in strategic combinations.[4] This could help defer an estimated $5-35 billion in transmission and distribution infrastructure costs over the next five years.

Given the clear evidence from deployments across the U.S. of the benefits of GETs, one may wonder why they aren't more universally adopted by utilities. Some barriers to the wide adoption of GETs exist. The first barrier is a lack of general knowledge among utilities, policymakers and everyday ratepayers. Due to a lack of overall awareness, there simply are not enough people in relevant spheres of influence who know about the potential for GETs to modernize the aging electric grid.

The second barrier to adoption is a lack of viable financial and regulatory incentives for GET installation. Utilities are operating within century-old regulatory frameworks that were designed when the country and our power needs were vastly different than they are today. State and local electricity regulators designed these regulations to incentivize the construction of large infrastructure. One solution is to incentivize GETs adoption the same way regulators promote energy efficiency programs. The cost savings of deploying a GET solution over traditional poles and wires can be shared between the customer and the utility.

While there has been some headway in regulatory action involving GETs, more remains to be done. The most pro-GETs regulatory framework can be found in Federal Energy Regulatory Commission (FERC) Order 1920, which advises utility companies to "consider" using GETs like DLR as a way of creating a more efficient, cost-effective regional transmission planning process. While FERC's demonstrated interest in the advantages of DLR is a positive development, GETs are a win-win that can immediately give the electrical grid a much-needed boost and should be prioritized as an integral part of the future of electricity instead of merely being "considered." Similar to the requirement from FERC for the use of Ambient Adjusted Ratings (AAR), action from FERC on the use of DLR is appropriate and represents the next best step forward in optimizing our existing assets. →

A LineVision non-contact sensor is installed on an AES transmission tower. Source: LineVision.

There are many ways in which GETs deployment is stifled, but there are also viable solutions to these obstacles. It all starts with educating the right people on the impact of GETs. Case studies on GETs must be amplified and shared among policymakers, regulators, utilities and customers. Once GETs are universally recognized as the low-hanging fruit grid solution that they are, policies and incentive structures should be reformed to reflect this fact. FERC must go beyond advocating for the "consideration" of GETs and advocate for, if not require, their implementation. On top of that, state regulators need to provide the same impetus for installing GETs as they currently do for constructing new transmission lines. If and when those critical steps are taken, a modernized grid with superior capacity will begin to transition from a goal to reality.

FERC must go beyond advocating for the "consideration" of GETs and advocate for, if not require, their implementation.

Our current approach to grid modernization is expensive and takes years to complete. Simply sticking with the status quo will not give us the grid we need today to power an increasingly electric tomorrow. DLR is a proven solution that provides near-term grid enhancement, and this technology must be implemented on a larger scale. To that end, AES is committed to further using and analyzing DLR and sharing insights through subsequent studies in the hope that these findings will encourage the acceleration of DLR adoption throughout the United States.

> **GETs must become universally embraced as an effective, innovative means of increasing grid capacity and this effort begins by educating key decision-makers on their benefits.**

This case study provides a positive example of the solutions possible when utilities, regulators and policymakers work together to ensure our grid's sustainability. GETs must become universally embraced as an effective, innovative means of increasing grid capacity and this effort begins by educating key decision-makers on their benefits. Once this occurs, regulatory and business incentives must be modified to foster GET adoption.

In addition to the findings of this partnership, there is momentum in other arenas that give reason to be hopeful about the future of this technology. FERC Order 1920 has given DLR key recognition among federal regulators, and the Biden Administration recently announced an effort to mobilize the public and private sectors to upgrade 100,000 miles of transmission lines over the next five years through the use of GETs such as DLR. These developments are working together to provide the positive inertia through which key decision-makers can further the goal of driving innovation, enhancing grid resilience, maintaining customer affordability and paving the way for a cleaner energy future.

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AI-READY RUGGED MOBILE COMPUTING IN T&D: TAKING ON ELECTRIC ENERGY'S MOUNTING CHALLENGES

Rugged mobile laptops supporting artificial Intelligence applications bring sophisticated functionality to T&D engineers. Source: Durabook.

SASHA WANG

The electric energy industry is facing monumental challenges on multiple fronts; part of the solution may come from new capabilities realized by deploying rugged mobile computing advancements with other emerging technologies in Transmission and Distribution (T&D) field services. This article examines advances in rugged mobile computing, especially in Artificial Intelligence (AI) – ready mobile devices, implemented in electric energy T&D fieldwork and the resulting benefits to the electric energy industry.

The influence of higher technologies in rugged computing

Digitization, grid modernization and incorporating renewable and regenerative power sources, decarbonization, grid security threats from a multitude of ever-changing and invisible sources, evolving destruction from climate change and energy demand that is expected to double, or even triple, by 2050 count among the daunting list of trials faced by electric utility companies.

Simultaneously, however, many technologies are rapidly developing and emerging that may be used to help address these trials, and no technology has a brighter spotlight on it right now than AI. AI churns Big Data into meaningful and actionable information. It powers the Internet of Things (IoT) and animates digital twins.

Just as IoT signaled the coming intelligent edge, the fifth generation of mobile network technology (5G) laid the way for AI applications in communications. Mobile rugged computer manufacturers with their eyes on these impending developments prepared their devices with more powerful processors, more robust connectivity and longer battery life to support advancements in the field, making field personnel more efficient and more powerful in their abilities. AI and its offshoot Generative AI, aboard AI-ready rugged mobile laptops delivering up to 100 TOPS (Trillions or Tera Operations per Second), and in combination with other emerging technologies including drones, AR/VR and the next generations of cellular networks will help the electric energy industry take command of its continuing challenges. →

An increasing need for rugged 5G smartphones, tablets and laptops was to be expected. However, the deployment of 5G technology and AI aboard rugged devices is a game-changer for the rugged mobile computing market and the industries that use them. It brings about a whole new level of connectivity and data transfer capabilities that are essential with current cloud-based data and will only become more prominent as intelligence is moved to the edge. Integration of 5G and IoT technologies into these devices makes them increasingly crucial tools in the field where they help people make faster, better, data-driven decisions that can increase efficiency, revenue and profits.

What can't a drone do?

These small-ish unmanned flying machines are proving to be the darlings of many industries and are a boon in the T&D world, as well. A drone can help a utility set up its field IoT network by installing sensors and then, it can monitor grid hardware for faults or damage. For an electric utility, being able to see its grid is essential and it needs views of multiple angles from up high and up close. So, getting high-resolution pictures, video and imagery of all kinds is an integral part of T&D work.

T&D field technicians and engineers may use artificial intelligence application predictive maintenance to save time and costs on process documentation and repair. Source: Durabook.

Drones may be equipped with a variety of cameras to take pictures and videos of the grid for normal monitoring and security purposes, or to provide updates to a digital twin model of the grid. Sending a drone to the top of a transmission tower keeps field personnel safer, and it's faster and easier to get images from a variety of angles. A mobile rugged tablet or laptop may be used to program the drone's flight path or control it directly from the device's keypad, cutting down on the number of devices a professional in the field must carry.

AI comes into play in both the drone itself and in the laborious task of scanning images taken by them. It is a little bit of a chicken-and-egg scenario, where AI can be used to scan the images that the drone captures, and then, those images can be used to inform the algorithm of an AI-powered drone about what a vulnerable segment of a tower or cable looks like.

EPRI, the Electric Power Research Institute, has undertaken a project to help forward AI modeling. It's likely some data review tasks can be automated by leveraging machine vision, machine learning (ML) techniques and AI. Still, the model developers formulated needed training data to create these systems. The Institute saw that today, there is very little overhead inspection imagery publicly available to support academic, private industry and utility research on the area. EPRI is addressing that industry gap by collecting, cleaning, labeling and sharing utility inspection imagery. To date, they have collected over 150,000 images of utility infrastructure mostly from an aerial perspective.

Utilities may use all the varieties of gathered data from IoT points, imagery and other functional information as the basis for a digital twin of the business and its T&D grid. They then may use AI to analyze the data. This living model enables the utility to simulate different scenarios and solutions and conduct everything from planning and allocation of resources to grid management and weather and outage prediction, which will be a major contributor to addressing virtually their entire list of challenges. However, the digital twin model must continually be fed new data from the physical world – IoT devices and field computing – to stay relevant. Additionally, the model will be accessed from the field to help with real-time decision-making.

But the weather...

Climate change impacts on T&D include damage from more powerful, more frequent storms and new climate-related events including previously unknown phenomena like atmospheric rivers, rising heat indices and resulting heat emergencies, prolonged droughts and more widespread, wildfires. NOAA reports that, as of August 8, 2024, in the U.S. there have been 19 confirmed weather/climate disaster events with losses exceeding $1 billion each. These include 15 severe storm events, one tropical cyclone, one wildfire event and two winter storm events. The aftermath of these weather and climate events brings more technicians out into the field to survey and repair damage. One of the field tech's allies is the sophisticated but rugged computer that will persevere through more than the USPS - rain, sleet, snow, heat, hail and being dropped from height – to help the tech keep their appointed rounds.

Proactively, utilities will want to gather as much storm and climate event data from recent past weather and climate disasters to help them forecast impending harsh weather to improve preparedness.

Where is humanity?

With the dizzying array of powerful technologies capable of performing increasingly sophisticated and complex tasks, it is tempting to wonder where is humanity in all of this. The need for human touch and human intelligence will not only still be required but will increase. Pervasive digitization brings increased cybersecurity risks, which signals an increased need for security measures that include in-person infrastructure monitoring. And, as utilities continue to build out smarter, more distributed grids and microgrids, more field technicians will be needed to support T&D. In fact, there is more likely to be a shortage of T&D field personnel than the risk that technologies would replace them. The application of evolving technologies and mobile rugged computers that support them gives the field technician a new opportunity to do less repetitive or potentially dangerous work and instead creatively apply these tools and technologies to field T&D tasks. →

To date, they have collected over 150,000 images of utility infrastructure mostly from an aerial perspective.

A camera-equipped drone may be controlled by a mobile rugged tablet or laptop and flown around a transmission tower for regular monitoring or to capture pictures and videos. Source: Durabook.

An example: By enabling AI application predictive maintenance, AI can assist T&D field technicians and engineers by saving time and costs on process documentation and repair. Field-based professionals may implement ML to teach rugged mobile computers how to perform tasks and make predictions based on data and patterns that emerge from the data. The computer can then forecast a system fault and take proactive measures to avoid failure. On a more mundane level, a field engineer may institute a program where vegetation and tree growth may also be anticipated and interference with T&D sites prevented.

Deloitte, in its 2024 Power and Utilities Industry Outlook*, paints a picture of saving time and boosting efficiency in the field with a generative AI-enabled voice assistant that can provide guidance and investigate maintenance history while leaving the employee's hands free to perform tasks and resolve technical issues. These applications can lead to speedier maintenance, improved performance and less downtime.

Valuable human resources assign tedious, repetitive tasks to newly available technology tools while using their skills, knowledge and creativity to conceive of new systems and applications. So, human expertise does not get replaced by AI; it is further informed by it.

Consider this segment from an article written for the 2024 IEEE PES T&D Conference, "Given the complexity of the multifaceted energy industry and the niche knowledge necessary for certain tasks, leveraging AI and ML isn't as straightforward as it is in several other fields. From the T&D perspective, AI is much, much more complicated. It's not as simple as 'build and train an algorithm, get a result, make a decision. You have to combine subject matter expertise with data science. It's an art," said Abder Elandaloussi, T&D innovation manager at Southern California Edison (SCE). An art performed by knowledgeable humans.

Conclusion

High technology has never been so close to so many everyday people at home and work across industries. You might even say it has never been so down to earth. The intelligence might be artificial. We may send more and more power and compute capabilities to that rugged computer at the edge and devices used in the field may become quite sophisticated, but they must still be built for a rugged world. Even as they crunch an algorithm for grid management, they may be out in torrential rain, glaring sun, or in the hands of a field engineer trying to juggle one too many things and the computer is the one that drops to the ground. There is a bit of poetry in a rugged device out in the field, supporting the latest technologies to perform complex computing under harsh conditions. Ultimately, each new, exciting technology and each enabling tool will be marshaled to the benefit of the business where it is deployed and to the people who work there, simply supporting humanity.

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ACCELERATING INVESTMENTS

IN LOW-CARBON HYDROGEN

PETER WARREN

Climate change is an increasing concern for governments, people and industries across the globe; 2023 broke records for greenhouse gas levels, surface temperatures, ocean heat and glacier retreat, among other markers. And 2024 is shaping up to end similarly. Extreme weather events accompanying climate change, such as heat waves, floods and wildfires, are also disrupting daily life and, oftentimes, business continuity. In response, many companies and organizations are putting enormous effort and investment into "going green." In most cases, the specific goal is primarily to achieve net zero, which generally refers to limiting the amount of carbon emitted while offsetting those emissions that are unavoidable.

The energy sector faces unique challenges in responding to the climate crisis. Currently, 75% of greenhouse gas emissions and nearly 90% of carbon emissions come from fossil fuels. Because of this, the industry is deeply motivated to address the issue and demonstrate effective solutions. There is also a substantive effort to support the growth of clean energy creation. In the United States, clean energy and transportation investments have reached record levels, hitting $71 billion in Q1 of 2024. Globally, the amount spent on clean energy technology is on track to surpass $2 trillion in 2024 – twice the amount spent on fossil fuels.

In response to this demand, energy companies are turning to hydrogen as an answer, due to its unique potential to decarbonize a wide range of industries, primarily consisting of those in which emissions have been historically challenging to limit such as steel, manufacturing and long-haul shipping.

Supply and infrastructure: Responding to increasing demand

Despite the promise of hydrogen, there is a major roadblock: the lack of an available supply of quality, low-carbon hydrogen. This is primarily due to limitations around the method used to create "green hydrogen." The first is that the machines used in the process, which are called "electrolyzers," are incredibly expensive and there is a limited number of them currently available. The second is that renewable energy from solar or wind is not available at all times of the day and night, which limits the time the electrolyzers can be run. There is also a compounding issue of the amount of renewable energy sources not meeting the necessary demands for creating hydrogen energy, which can be massive. →


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For example, two different steel companies undertaking projects in the Southern United States and Midwest regions are facing similar hurdles: The existing infrastructure of renewables is not sufficient to power the planned projects. A facility under development in Mississippi would require more than a 500% increase in renewable energy sources currently in the state. Likewise, the Midwestern facility would require roughly two times the amount of wind and solar power currently installed in its home state of Ohio. This is not an impossible battle to win, but it will require dedicated, creative solutions to build new sources or import energy from other states. This will likely require new infrastructure for delivery in addition to production.

Regardless of the industry, the supply issue is impossible to ignore. The majority of hydrogen energy, as with all global electricity, is created using fossil fuels. This means the coveted low-carbon hydrogen is a subset of an already limited source – 0.01% of all hydrogen produced as of 2023. The majority was created using natural gas without carbon capture, utilization and storage. Another significant portion was created by burning coal. These types of hydrogen energy, sometimes referred to as "black," "brown" or "gray" hydrogen, depending on the specific method of production, are the most detrimental in terms of emissions. They are, in fact, the total opposite of the ideal low-carbon or "green" hydrogen. The cost of electrolyzers and renewables is decreasing, which may boost their proliferation. Until that day, the current lack of supply is an opportunity for creative solutions, such as utilizing data exchange to inform global hydrogen trading or implementing digital twin technology to optimize performance.

In other cases, a limited supply of hydrogen is an auxiliary factor tacked on to a laundry list of tangentially related issues. In Germany, a fleet of first-of-its-kind hydrogen-powered trains ran into a multitude of problems. The issues were partly due to infrastructure: Germany has a more established system of non-hydrogen green energy trains and struggled to pivot. However, some of them could be pinned to logistical snags. These included the unexpectedly long time required to train the conductors and engineers to operate the trains, as well as issues with fuel stations. Funding for the project was ultimately cut, which led to the eventual replacement of the trains with other models, which were electric or battery-powered.

This option was feasible for Germany because it already has an infrastructure suitable for electric and battery-powered trains. This is due to the lines that need to be decarbonized having charging stations that are relatively close together and an industry preference for maintaining batteries over hydrogen fuel cells. However, one of hydrogen's strong points is its ability to quickly refuel for long-haul trips. For regions where it would be ideal for trains to travel long distances without stopping to refuel, low-carbon hydrogen can be key to decarbonization. This is especially true for areas like California, where many railroads are owned by private companies that are resistant to installing the overhead wiring required for electrification. Investing in hydrogen-powered trains and the fueling infrastructure they require enables people and goods to travel longer distances while creating the lowest possible level of emissions.

Transportation challenges and potential solutions

It is important to remember that this is still an evolving area for the energy industry. These examples can be learned from as the energy industry pivots to low-carbon hydrogen. Production, transmission and distribution are all still areas of development and experimentation. The challenges experienced by these rail and steel projects are natural growing pains, and other industries considering turning to low-carbon hydrogen should examine these early projects as case studies.

Currently, the primary method of transporting hydrogen is via vehicular transport, by way of either trucks or trains. Hydrogen's natural composition creates challenges for other distribution methods such as pipelines. This is because it is a sticky molecule that can pull atoms from the steel, plastic or other materials commonly used for pipelines. The molecule also tends to escape containment because of its small size, necessitating a careful system for transportation and delivery to avoid leaks. Its size can also contribute to the embrittlement of pipelines, which is when the hydrogen erodes the steel in gas pipelines, potentially causing leaks. These features of hydrogen do not preclude pipelines as a method of transportation – they will, in fact, be necessary for large-scale distribution. However, it will require ingenuity and investment.

Given that this would be a costly overhaul, many gas distribution companies are still evaluating the impact of adding hydrogen to their offerings.

To make existing infrastructure compatible with transporting hydrogen alone, it must be updated to resist hydrogen molecules' tendency to escape and harm incompatible materials. This could include building new pipelines out of material better suited for containing hydrogen, such as fiber-reinforced polymer, or retrofitting older distribution lines. Given that this would be a costly overhaul, many gas distribution companies are still evaluating the impact of adding hydrogen to their offerings. These companies are weighing the benefits of hydrogen against the potential harm to their current assets.

Alternatively, some companies are in the proof-of-concept stage and conducting trial programs with specific supply lines, including a percentage of hydrogen mixed in with their natural gas products. Interestingly, transporting hydrogen in a blend is not a new idea. Before the widespread conversion to natural gas, "town gas" was widely used throughout the United Kingdom and other parts of the world. This gas, produced from coal gasification in the 19th and 20th centuries, contained a mixture of carbon monoxide and hydrogen as its burnable components and up to 60% hydrogen by volume. As companies revitalize this Industrial Revolution-era idea with new technologies, projects like these will expand as companies gain confidence and increase their learning.

One piece of these proof-of-concept projects that cannot be neglected is tracking the carbon intensity of the hydrogen sources and any applicable certificates. Since hydrogen can be produced along any point of the gas network with the right combination of factors to create and inject it into the pipeline, gas distribution companies must manage the pipeline itself. They will need to track and measure the source, record the carbon intensity of the supply and certificates and report to their stakeholders.

Because various injection points are mixed in the pipelines transporting hydrogen or storage tanks holding it, accounting and auditing carbon is more complex than when shipping via truck, boat or train. However, carbon intensity is vital to maintain awareness, as many stakeholders, including consumers, want to know the carbon implications of hydrogen production and delivery for their environmental, social and governance (ESG) reporting. Since environmental concerns are a motivating factor for the pursuit of hydrogen power, proving the efficacy of decarbonization efforts is essential for showcasing the return on investment. →


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Finally, there are early-stage deployments of distribution lines built for hydrogen-specific point-to-point production and supply purposes. While limited in their present availability and usage, there are plans to expand availability around the globe. Europe is leading the way in this endeavor, with 1,600 km of pipelines that have already been constructed and a further 3,300 km of pipelines that will span Austria, Germany and Italy. And that is only the beginning. There are plans to expand to multiple countries with tens of thousands of pipelines, in addition to an undersea delivery channel and a connecting line to North Africa. In the near future, Latin America, the United States and Canada plan to implement their own pipelines.

The potential of point-of-use production

While pipelines are being built or updated to transport hydrogen, point-of-use production provides an alternative solution. To some degree, it is also a natural alternative due to the current lack of transport networks. In the United States, for example, much of the current hydrogen is produced at or near the point of use due to the lack of transmission infrastructure. As hydrogen continues to become more affordable and able to be produced by end consumers, it may bypass existing supply chains entirely. This method of hydrogen production will likely continue to expand in the coming years and must be considered part of the future of the clean energy landscape.

Data centers are another potential candidate for on-premises (on-prem) hydrogen as a primary power source. Their already substantive power consumption is projected to skyrocket with the recent boom in artificial intelligence (AI). As technology usage continues to expand, so too will the corresponding energy required. Point-of-use hydrogen could be the key to offsetting and, ideally, reducing the resulting increased emissions. Even those who rely on hydrogen created with fossil fuels or fossil fuel sources directly to deal with surges could have net negative carbon and greenhouse gas emissions by introducing low-carbon hydrogen as their primary power agent.

Bespoke point-of-use hydrogen power is both an opportunity and a threat to traditional energy distributors that must be considered and responded to in order to stay ahead of the curve. The proliferation of on-prem systems could limit the amount of hydrogen that needs to be moved. However, these systems will need backups and fail-safes to remain functional during surges or other irregularities. Transmission and delivery companies and professionals are well suited to be the solution to these problems.

The number of challenges facing the world and the energy industry is daunting but represents an opportunity for positive change that will benefit the world. Prioritizing low-carbon hydrogen power may be the key to capping emissions and accelerating the race to net zero. However, the infrastructure needed to produce green hydrogen is not yet in place, nor are the systems required to transmit and distribute it once it is produced. Energy professionals have an opportunity to face these challenges head-on to achieve global climate goals and provide a return on the large – and increasing – investments in low-carbon hydrogen.

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POWERING THE FUTURE:

THE DIGITAL TRANSFORMATION OF THE ELECTRIC UTILITY INDUSTRY

SCOTTY BUOY

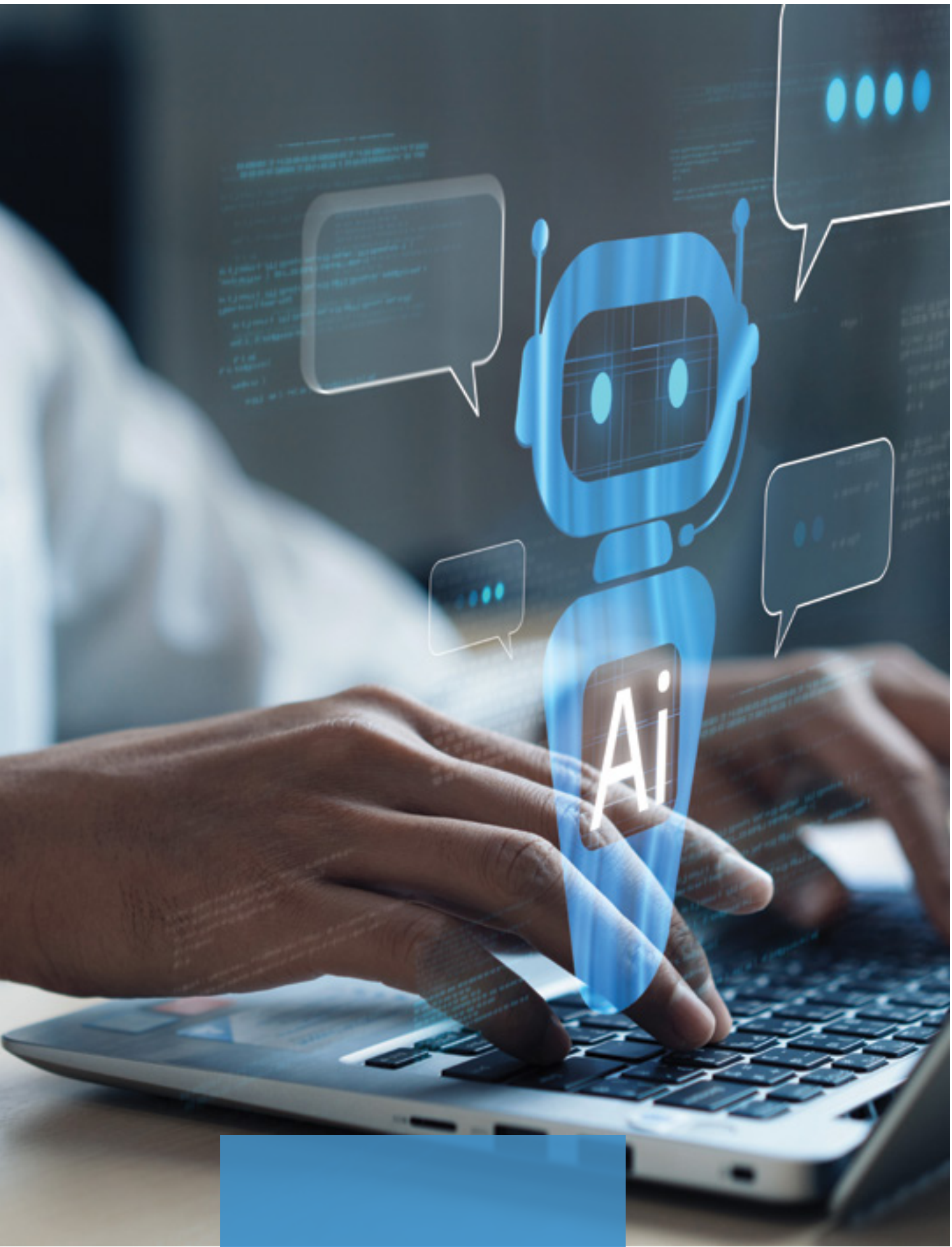
As energy consumption rises, the electric utility sector is facing intense pressure to enhance operational efficiency and improve the customer experience to meet evolving demands. With automation and an array of other technological advancements being implemented globally, electric utility companies must innovate to meet customer expectations. This traditionally regulated sector must now navigate the complexities of digital transformation to avoid the risk of falling behind. While this transition requires significant time, planning and buy-in, the adoption of digital tools is essential for maintaining operational resilience and meeting the evolving energy needs of customers.

Enhancing customer service

One of the key reasons electric utility companies should embrace digitalization is to enhance customer service. Because consumers rely so heavily on electricity, electric utilities are expected to deliver robust, exceptional customer service in real-time. This is an essential priority for the sector, with about 16% of the top 25 utilities already in the initial stages of integrating generative artificial intelligence (AI) into their operations to improve customer service, along with a multitude of other operational enhancements. Electric utility companies must embrace the implementation of automated and AI technology to keep pace with the customer service being delivered by competitors.

To meet the pressure from customers for better digital options, electric utility companies can implement self-service automation tools such as chatbots, which offer instant, personalized interactions and reduced response times. These tools are particularly effective for routine and less complex issues such as outage status updates or billing inquiries, where chatbots can provide immediate responses by accessing customer data.

Mobile technologies, such as self-service apps, further elevate the customer experience by providing real-time access to usage data, putting critical information at customers' fingertips and allowing them to conveniently check outage status, report issues and manage billing. The ability to monitor and report outages directly in the app not only empowers customers but also helps electric utilities by receiving immediate feedback from customers, which can help the company identify issues more promptly. Mobile apps also can provide additional channels to communicate with companies through live service agents and/or chatbots, saving time for both the company and the consumer. Additionally, mobile apps offer valuable insight into how customers interact with the company, which will allow the utility to cater to individual customer needs and improve its services. →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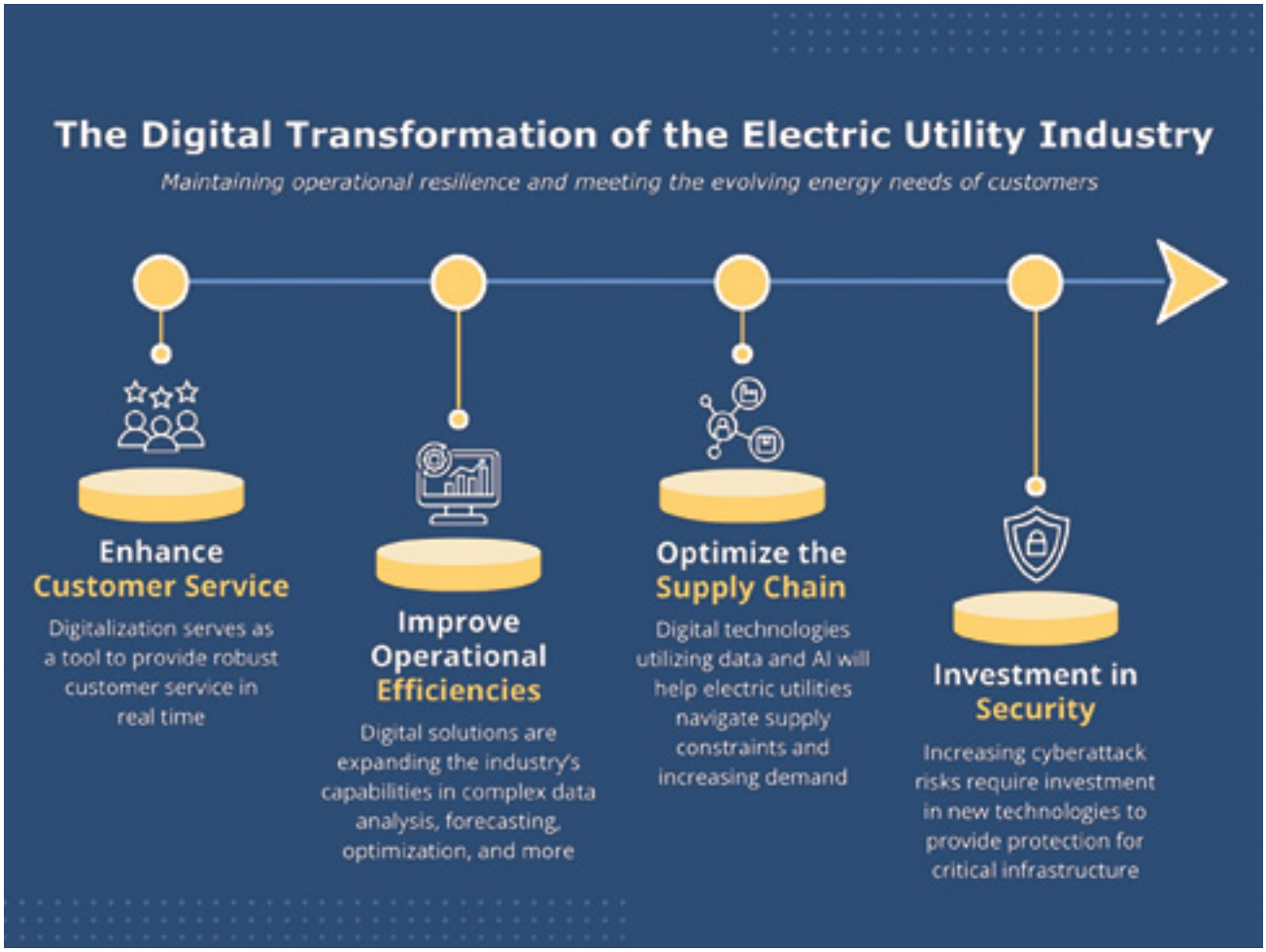


Source: Sendero Consulting.

It's also important for electric utility companies to offer specialized tools tailored to the needs of each type of customer, extending their focus beyond just residential customers. For example, municipalities manage critical infrastructure such as traffic lights, schools, jails and hospitals, requiring more in-depth data tools to make informed decisions. By providing municipalities with customized solutions like individual portals, aggregated accounts, detailed usage data and specialized map views to visualize larger service areas, utilities can help cities operate more efficiently and cost-effectively. This, in turn, benefits residential customers by improving the delivery of public services. Similarly, commercial customers, such as airports, can use these specialized tools to enhance their operations, especially during storm situations. By offering tailored tools that address the unique needs of all types of customers, electric utility companies build goodwill and trust and support the resilience of critical infrastructure during emergencies.

These digital tools are not only useful in providing instant resources for customers but also allow employees to focus on more sophisticated issues or tasks, making utility operations more efficient.

Operational efficiencies

Another critical objective for electric utilities to adopt digital technology is to enhance operational efficiencies. Specifically, predictive AI solutions minimize downtime and costs by using performance data to predict equipment failure and availability, allowing companies to avoid expensive repairs by identifying issues early. This allows for more regular maintenance, reducing the need for costly emergency repairs and preventing major service disruptions. Additionally, data from smart meters enable companies to improve decision-making when forecasting, including predicting the potential impact of upcoming weather events.

Looking ahead, generative AI and other automated models are expected to expand the industry's capabilities as they are used for complex data analysis, forecasting, optimization and more to help address some of the major issues that plague electric utility companies.

Leveraging mobile technology not only improves the customer experience but also enables efficiencies for employees who work on the front lines of the utility organization. Mobile apps designed for the field allow employees to improve response times, manage assignments and update work status in real time. These apps streamline the scheduling of appointments, provide arrival updates and collect customer feedback, offering a personalized experience tailored specifically to each employee.

Other digital tools, such as Internet of Things (IoT) sensors, allow field workers to remotely monitor and perform diagnostics. For the electric grid, IoT enables real-time monitoring and can alert workers about possible issues before they happen, helping prevent major blackouts and accidents. Geographic Information System (GIS) technologies are also valuable, permitting utilities to maintain comprehensive records of assets, including for transformers and distribution points while providing asset data, personnel locations and detailed geographic information. In order to ensure field workers can effectively utilize these digital tools, electric utility companies must ensure their workforces are equipped with the right hardware. Whether that is tablets, rugged laptops, internet in trucks, etc., field workers must be equipped with devices to take advantage of these digital tools that enhance complex operational processes and improve the overall field experience.

Optimize the supply chain

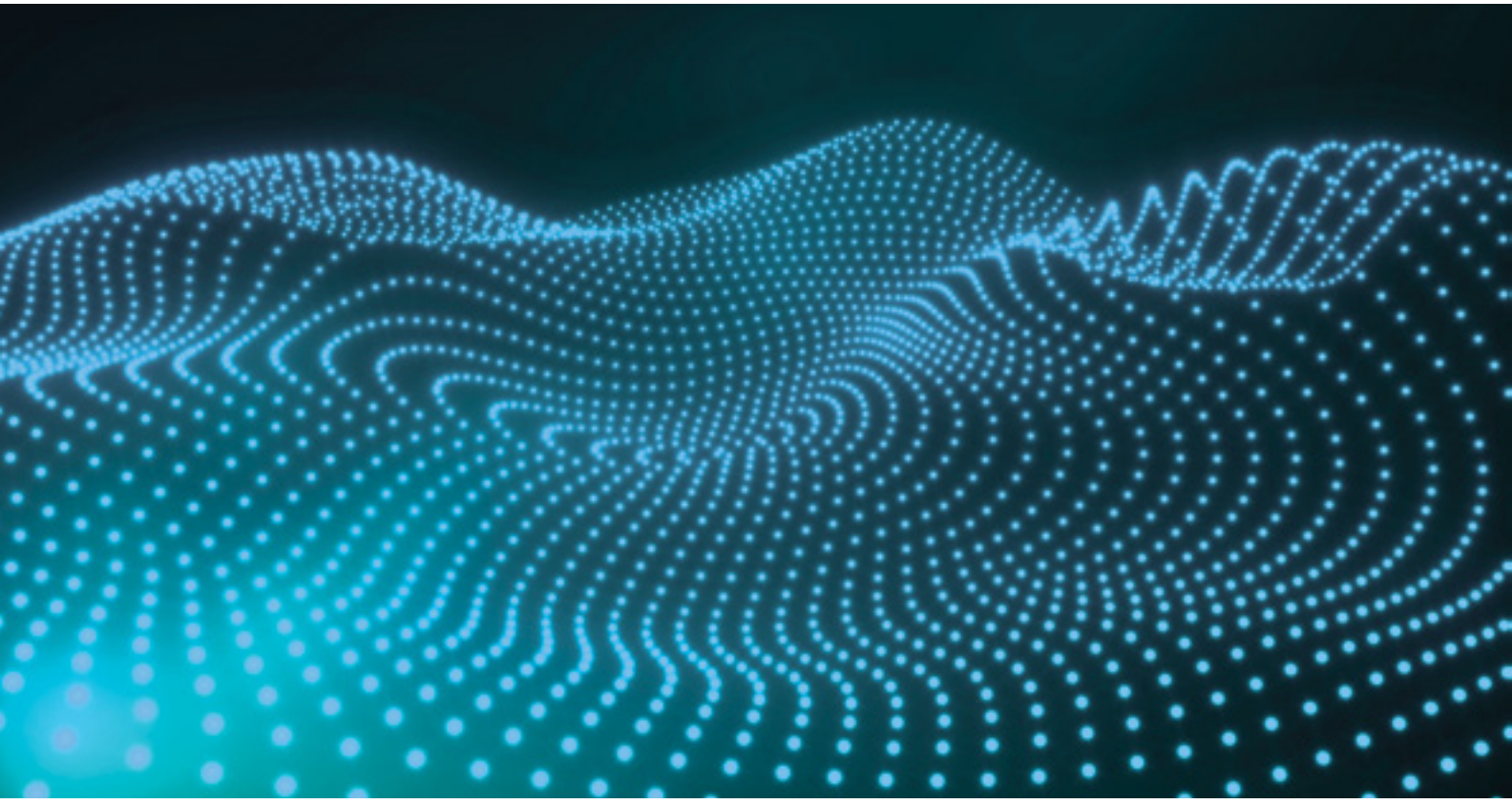
As the electric utility industry is experiencing unparalleled demand due to population growth and increased electrification, utility companies are challenged to build out necessary infrastructure to keep up with this rising demand. The post-COVID era has also brought significant volatility to global supply chains, making it that much more difficult for utilities to effectively manage their operations. Since the pandemic, the electric utility industry has seen an increase in lead times and rising equipment costs driven by supply constraints due to heightened demand and geopolitical instability. As electric utility companies look to upgrade their equipment, for some equipment, the average lead time for delivery has tripled from what it was two years earlier, reaching 52 weeks in some cases. Additionally for necessary equipment such as transformers, prices have almost doubled since January 2022. Electric utilities must adapt to these new market dynamics while ensuring that they can continue to meet the evolving needs of their customers. →

Along with supply chain challenges, climate change presents another significant obstacle for the electric utility sector. The increasing frequency and severity of devastating weather disasters – such as hurricanes, wildfires and flood – pose a direct threat to utility infrastructure and global supply chains. These catastrophes can cause suppliers to be offline or significantly delay shipments, further exacerbating the supply chain volatility that the industry is already facing. This increasing risk of natural disasters puts significant pressure on utilities to optimize their supply chains to ensure they can withstand these challenges and leverage technology to adapt quickly to changing supplier landscapes. As electric utility companies continue to face more frequent and severe weather events, their ability to maintain continuous service is paramount, and the reliance on digital technology is even more critical.

Given the growing complexity of the supply chain in the utility industry, electric utility companies must turn to digital technologies to optimize their operation and safeguard themselves against future challenges. Digital technologies can help utilities navigate supply constraints and increasing demand by effectively utilizing data and AI technologies, allowing them to optimize their supply chain processes and improve decision-making in an era of unprecedented market volatility.

One key technology for supply chain optimization is the use of data lakes, which give utilities the capability to break down the silos between different internal departments and operations. Data lakes allow utilities to centralize and integrate data from across the supply chain, including data from procurement, logistics, operations and finance. This then provides a comprehensive view of the company's supply chain performance enabling the utility to monitor and evaluate key indicators in real-time. This holistic view allows utilities to make data-driven decisions that will help reduce risks and address any bottlenecks before they become a larger issue.

Another technology that can transform supply chain optimization is AI, particularly in the realm of decision intelligence. Technologies like machine learning and predictive analytics can process large amounts of data from multiple sources, which provides actionable insights to help utilities identify improvement opportunities. Decision intelligence takes this a step further by automating decision-making processes, so employees can rely on this technology to make smaller optimizations while focusing on more complex supply chain operational decisions. For example, AI can analyze supplier performance patterns, forecast demand and predict potential disruptions based on external factors like weather events stemming from climate change. This then allows electric utilities to adjust their procurement strategies,



find alternative suppliers and allocate resources effectively, while at the same time minimizing downtime and reducing costs. Leveraging AI and data analytics gives electric utility companies a competitive edge in today's volatile market, empowering them to build more resilient and agile supply chains. As the industry continues to navigate the challenges stemming from today's supply chain landscape, adopting digital tools and these technologies are pivotal in achieving long-term success.

Investment in security

While digitalization offers numerous benefits, it also increases the risk of cyberattacks. With technology driving utility operations, a cyberattack against critical infrastructure, especially the power grid, could cause catastrophic consequences. With the recent increase in vulnerabilities, the grid's virtual and physical weak spots grew to a range of 23,000 to 24,000 last year from 21,000 to 22,000 by the end of 2022. That increase demonstrates why there is a great need for the industry to invest in new technologies to protect from these mounting threats. Securing the electric grid is a top priority for the sector and electric utility companies must invest in advanced digital tools to protect their infrastructure and ensure resilience against emerging threats. Utilities can implement tools such as automation, AI and machine learning to fortify their organizations and safeguard against cyberattacks.

Automation enables faster threat analysis, allowing utilities to swiftly identify and respond, potentially saving the utility from data breaches and significant financial losses. Automation can streamline routine security tasks and address threats in real-time through analysis engines that detect unusual traffic patterns and data flows. Automated security technologies, as well as AI, also help reduce human error, which is crucial as professionals try to keep up with the increased volume of attacks. AI can quickly identify threats and monitor a wide range of potential cyber issues efficiently. Additionally, machine learning algorithms can continuously decipher data patterns and network behavior, identifying inconsistencies that signal a potential cyberattack.

The need for digitalization will only intensify as energy demand increases, and the electric utility sector must work to keep up with the pace of a world that not only consumes more energy but also expects advanced technological operations and experiences. While embracing evolving technology may seem daunting, electric utility companies should focus on the long-term benefits for customers and employees. The positive outcomes will ultimately outweigh concerns, enabling electric utilities to meet and exceed these growing expectations.

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Scotty Buoy brings 12 years of management consulting experience to Sendero Consulting's senior leadership team. His areas of expertise include systems integration, business process improvement, mobility and cloud projects.

He has a particular depth of experience in working with clients in the utilities, healthcare and government sectors. He earned a BS in electrical engineering and an MBA from the University of Texas at Austin.

THE CRITICALITY OF HIGH-PERFORMANCE COATINGS FOR POWER INFRASTRUCTURE

HOW ADVANCED COATINGS ARE ENHANCING DURABILITY, PERFORMANCE IN A STRAINED ENERGY SECTOR

MARIA LAMOREY AND BARRY POWELL

Due to the rapid expansion of data centers, the electrification of HVAC/manufacturing processes and the build out of electric vehicle infrastructure, the electrical consumption for the United States is forecast to grow more than 25% by 2050, according to the U.S. Energy Infrastructure Administration (EIA). This is in stark contrast compared to 2000 through 2020, when electrical demand across the United States barely increased.

The situation in Texas is even more dramatic, where the Electric Reliability Council of Texas (ERCOT) is forecasting a near doubling of demand from 85GW to 150GW by 2030. The biggest contributors to this increase are oil and gas operators electrifying their Permian Basin operations and the impending boom in Artificial Intelligence (AI) data centers, which will consume significantly more power relative to traditional data centers.

Texas already consumes more electricity than any other U.S. state and the grid faces additional challenges related to extreme heat and weather events. On one side, excessive summer temperatures led to 11 statewide requests for energy consumption last year. On the other side, a series of February 2021 winter storms crippled the Texas grid, resulting in the loss of power to 4.5 million homes and 246 deaths across 77 counties.

In response to this forecasted demand increase, the Texas Energy Fund recently doubled its allocation to $10 billion, offering 3% interest loans to fund the construction of gas-fueled power plants. They are also offering further incentives to companies that connect these plants to the main Texas grid by 2029. Furthermore, ERCOT expects to strengthen the Texas grid through the deployment of massive banks of batteries, increasing the grid energy storage capacity from 5.1GW to 11GW through 2024. To date, there has not been as much public focus on downstream distribution equipment investment relative to power generation and upstream transmission.

Both switchgear and transformer manufacturers have ramped up capacity in response to this rapid expansion in demand, but complex supply chains several levels deep have struggled to increase output at the pace of demand growth, leading to excessive lead times. Long wait times are now the norm with no signs of easing. Currently, lead times for medium voltage switchgear are at more than 52 weeks and utility scale transformers at more than two years on average. →

As the lead times and equipment challenges persist, they highlight a broader issue affecting the entire U.S. power grid. With growing electrical demand driven by new industries and heightened electrification efforts, the nation's aging infrastructure is experiencing increased strain, creating vulnerabilities for power equipment across the country.

The limited inventory of parts, along with aging infrastructure, poses risks to critical systems that power vital networks, such as hospitals, communication networks, water and waste management and even military bases.

The U.S. Department of Commerce reports that the average age of transformers in use is 38 years – approaching the end of their expected lifespan – with 70% older than 25 years.

In light of the scarcity of new equipment, refurbishing and maintaining existing transformers has become crucial. Restoring and updating these components, including their exterior protection with high-quality industrial coatings, can help to address the growing demand.

Although it might seem inconvenient to update coatings systems that have not yet failed, now may be an ideal time for manufacturers to reassess their protective technologies and consider newer, more effective solutions before a more widespread problem occurs.

A key part of this process is fortifying the exterior durability, including sanding, priming and painting with a resilient industrial coating engineered to defend against corrosion. This is important because outdated coatings systems may not be as durable, particularly under harsh weather conditions. This vulnerability can lead to power service disruptions and equipment failures, which can be life-threatening, particularly in the current climate with rising temperatures worldwide.

Corrosion protection for the future of power

When it comes to the metal components on a transformer, corrosion is public enemy number one.

Metal electrical equipment parts corrode for any number of reasons. Some factors include the intersection of two metals with different corrosion thresholds, continuous or repeated exposure to high temperatures and humidity from decades in the field, damaging pH (acid) levels, electrolytes, chemicals and ultraviolet rays from sunlight.

Selecting the proper coating materials to help preserve power generators, transformers, switchgear and more is the first line of defense. The right coating system that offers durability and resilience at every layer of protection – from pretreatment through finish coat – can extend the service life of the part and reduce the risk of coatings-related equipment failures.

Reevaluating paint specifications for longevity

While most electrical equipment has a minimum life expectancy of 20 years, many components are expected to survive 50 years or more. Harsh elements can accelerate corrosion and leave sensitive instrumentation vulnerable and potentially unreliable.

Unfortunately, many manufacturers still combine old "cut-and-paste" specifications that date back 20 to 30 years with current industry-standard regulatory requirements written by IEEE, UL, CSA and ASTM when painting and protecting new equipment.

On average, finished electrical components are composed of about 70% metal and 30% non-metal substrates, yet nearly 100% of electrical equipment manufacturers view painting metal as beyond their core competency. An average-sized switchgear manufacturer running 10- to 15-million square feet of coated metal through its facility is staking a lot of its reputation on work considered outside of their scope.

If the goal of an electrical equipment manufacturer is to build next-generation components that exceed performance mandates while protecting its brand reputation, paint specifications should be reviewed and updated regularly.

In addition to product scope and substrate type, manufacturers should consider the following when developing their specifications:

• Coating type

Coating manufacturers offer a variety of resin chemistries to improve resistance to corrosion and UV exposure, including epoxies, polyesters, urethanes and acrylics, as well as hybrid coatings that incorporate a combination of resin chemistries. Each has its strengths and weaknesses.

For instance, epoxies are ideal for chemical resistance and mechanical properties but are lacking in UV resistance and weatherability.

Polyesters, urethanes and acrylics all offer exceptional weathering characteristics, but each offers a different benefit, such as great physical properties for polyesters; chip, scuff and mar resistance for urethanes; and exceptional surface appearance for acrylics.

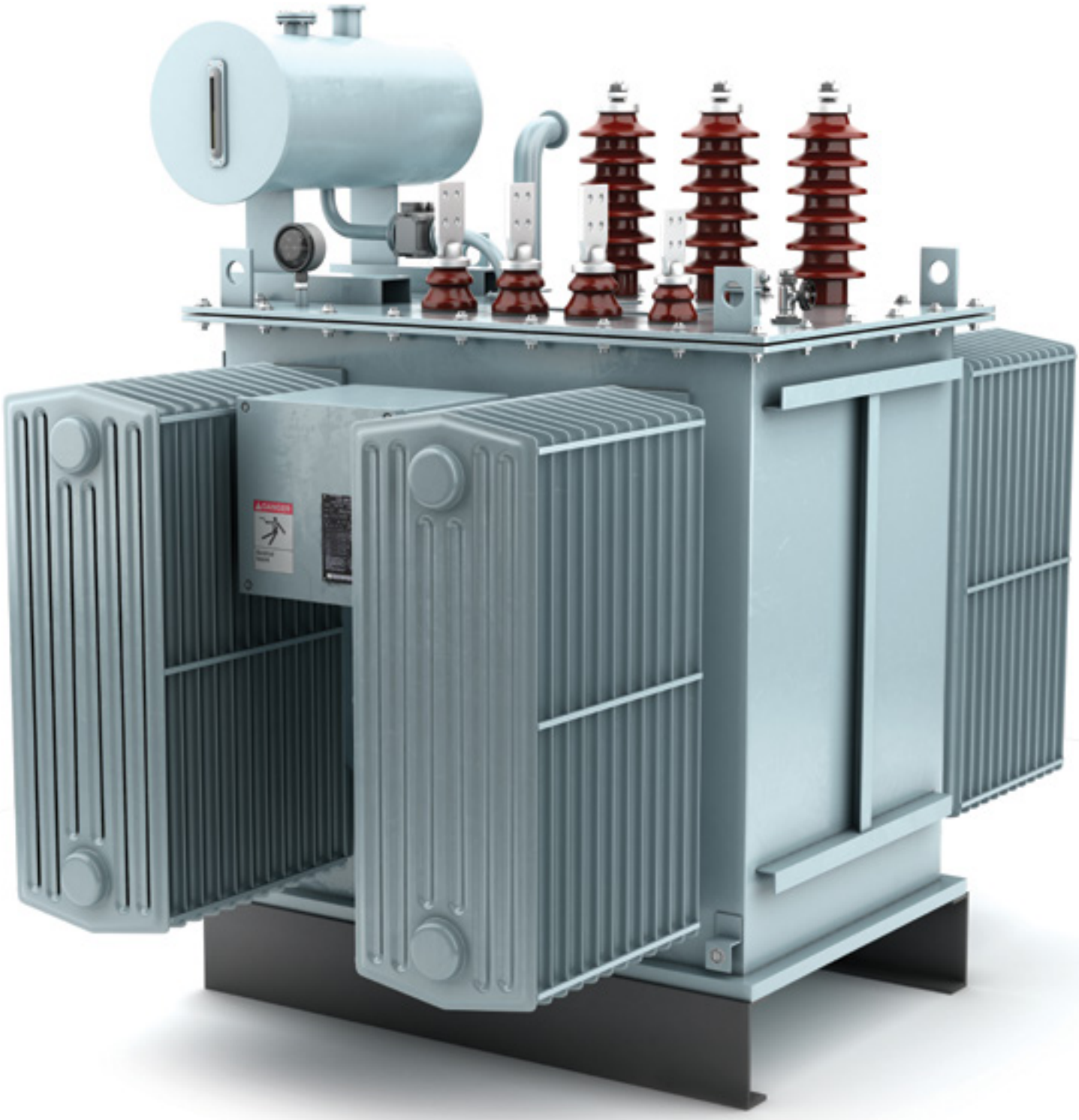
• Product codes

Electrical equipment producers should avoid using a specific paint manufacturer's product code. Codes can be ambiguous or difficult to find, as they often change or may be unique to a specific customer. Instead, detail the specific coatings technology the equipment demands (pretreatment, liquid, powder or electrocoat); then detail the resin chemistry of the desired coating.

• Color

Establishing and maintaining a standard color can be challenging. It is important to detail an acceptable range of color variation and use a proven and consistent method for determining that the color of a painted part falls within specification.

Pantone, RAL, Munsell and ANSI are color-cataloging systems commonly used for these purposes, although some equipment manufacturers choose to create their own in-house standards. Maintaining color standards is a separate topic, so it is best to work with a reputable paint manufacturer to understand the intricacies of creating a color standard and how to detail its parameters in the specification. →



• Gloss
Like color, the gloss range specification can have a big impact on a product's finished appearance. It is important to provide a specific gloss range in a paint specification, as variations in gloss can cause the same color on a piece of equipment to appear as different shades.

• Texture
In the electrical industry, some orange peel (minor paint dimpling) in the finish is considered preferable, as it tends to hide flaws and wear well over time. Regardless, standards for texture types and variation should be written into the paint specification.

• Product handling and storage
Manufacturers suggest specific rules for handling and storage in their product data sheets, including an acceptable range of temperature exposures and fixed expiration dates to ensure inventory is properly rotated.

• Performance
Regulatory standards such as UL or IEEE should be detailed in the paint specification. These standards are written to include a range of acceptable results for products undergoing laboratory-based performance tests, which have been agreed upon by the industry for their ability to mimic real-world performance environments.

Key performance tests to ensure reliability of coatings systems

While many coatings systems are sufficiently robust to pass industry-accepted performance tests, they can fail in the field because the real-world conditions are often more challenging.

For that reason, it is critical to include the tests that most accurately reflect a product's ability to fulfill a warranty or an expected service life in the paint specification. For example, does a specific impact test predict paint chipping once installed in the field? Or does an accelerated weathering test depict the real-world color fade or breakdown of a coating?

Performance testing must also correspond to field troubleshooting. If a coating fails in the field, correlating the failure to a specific testing method will enable the equipment and paint manufacturers to identify the reason for the failure, which can lead to quicker corrective actions.

Some of the most common performance tests written into an electrical equipment paint specification are detailed below:

• Salt spray
This is the most commonly specified test in the electrical industry. UL1332 requires 600 hours of salt-spray exposure for electrical enclosures and switchgear. Many transformers require between 1,000 and 2,000 hours of exposure.

• Ultraviolet accelerated weather testing (QUV)
In this test, coated panels are exposed to ultraviolet (UV) light of varying types, resulting in "maintain X% specific gloss level after X number of hours" rules as detailed in a specification. These tests are designed to predict how a coating will fade outdoors over time.

• Simulated corrosive atmospheric breakdown (SCAB)
In this test protocol, painted panels are scribed, then cycled through exposure conditions produced in the following environments: an oven, a freezer, immersion in an NaCl solution, room temperature and high humidity. The IEEE test for SCAB requires 15 total cycles with prescribed times in each area. This testing is designed to predict how well a coating will maintain its integrity when subjected to a succession of regular and extreme performance environments.

• Humidity testing
During this test, painted panels are typically placed in a chamber for 1,000 hours, and then examined for evidence of blistering or softening. This testing is designed to predict how well a coating resists water.

• Impact resistance
For this test, panels are exposed to an array of impact hazards, measured according to pounds. Transformers are typically tested at 80 pounds of impact. This testing is designed to predict how well a coating will resist force from an object, such as a tool or machine. It also may predict a coating's resistance to chipping when a bolt or other fastener is tightened onto its surface.

• Cross hatch adhesion
In this test, a tool is used to cut a lattice pattern into a metal substrate. A quick pass/fail rating is assessed for the full coating system to gauge its ability to adhere to a substrate. →

• Gravelometer
Road gravel is air-blasted into coated panels, which are then placed into a salt-spray chamber to assess the corrosion resistance of the exposed parts. This test is designed to predict a coating's chip resistance and ability to withstand road gravel.

Other tests that are occasionally used and built into specifications for electrical equipment include:

• Pencil hardness
During this test, a pencil is pressed through the surface of a coating to measure its adhesive strength.

• Adhesion testing
This test method involves applying tape across a painted surface in a cross-cut method, and then removing it to determine how effectively the paint sticks to the surface.

There also are many types of chemical tests, including an insulating fluids test to determine a coating system's ability to resist exposure to certain types of chemicals.

Optimizing coating technology

Is your current coating technology utilizing the latest coatings advancements and the most sustainable options?

Liquid coatings use solvents or water and are applied to pretreated metal with electrostatic spray, dipping and other conventional methods before being air-dried or force-cured.

When used as part of an integrated primer, pretreatment and topcoat system, liquid coatings offer exceptional resistance to corrosion and chemicals, excellent sag resistance and strong adhesion. The newer product offerings in waterborne liquid technologies can offer a more sustainable option as part of an integrated coating layer.

Powder coatings are formulated for applications that require the ultimate combination of corrosion resistance, weathering performance and operational attributes. These coatings are typically formulated with specific resins combined to provide excellent corrosion and chemical resistance, as well as all-around application versatility.

Since powder coatings are made without solvents, they generate virtually no volatile organic compound (VOC) emissions, which can help to achieve environmental compliance and reduce material usage, energy consumption and maintenance costs thanks to a first-pass transfer rate of up to 85%.

Breakthrough in zinc-rich powder primer protection

Due to their advantages in sustainability, edge coverage and durability, powder technologies are growing in global prominence, including zinc-rich powder primers. While zinc is renowned for its corrosive fighting properties, its density poses challenges during application.

Recently, scientists achieved a breakthrough by formulating a zinc-rich primer with optimized zinc content. This patent-pending innovation boasts higher transfer efficiency, thanks to its lower specific gravity compared to standard zinc-rich primers (2.0 vs. 3.6). The reduced density makes it easier to apply, achieving an impressive 85% transfer efficiency. Although it contains less zinc by volume than traditional zinc-rich primers, it meets rigorous ISO C5 corrosivity standards, making it suitable for high-humidity and aggressive environments.

This well-balanced primer offers exceptional edge, face and scribe corrosion resistance, semi-conductivity and excellent adhesion on both smooth and blasted steel. Its robust bond withstands peeling, chipping and degradation. In lab testing, the primer even surpassed 10,000 hours of salt spray performance on blasted steel.

Key takeaways

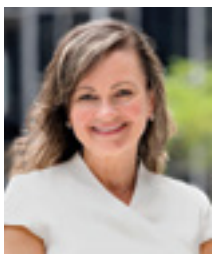
When creating a paint specification, it is critical to correlate a component's expected operating environment and service life to the testing methodology that most rigorously replicates the performance challenges it will face. Not only will this help to ensure that a product performs reliably throughout its lifetime; but it may also lessen overall maintenance requirements.

Equipment manufacturers should evaluate their paint specifications on a regular schedule to ensure that they always incorporate the most targeted and technologically advanced coating systems and testing methodologies for their specific application.

They may also want to consider partnering with paint and pretreatment suppliers in the design process as early as possible, preferably with a proven coatings company that can offer both pretreatment and paint capabilities as an integrated package.

Integrated, full-service coatings suppliers typically have a deep understanding of the coatings process from start to finish, along with a wide range of products and resin chemistries that have been tested according to industry-standard criteria.

These coatings suppliers can act as partners in identifying potential vulnerabilities to corrosion and help customers to select the best products to prevent it. Most integrated coatings suppliers also have dedicated lab resources so they can recommend the best test methodologies to measure a product's potential service life and troubleshoot general coatings-related production problems.



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Maria Lamorey is the commercial strategy manager – Americas for PPG. With more than 20 years of industry experience, Lamorey plays a leading role in PPG's commitment to delivering high-performance coatings products across a variety of general industrial applications. She is a certified instructor for a nationally PDH accredited course on material science in electrical equipment design and has been an active member of the IEEE Transformer Committee and National Electrical Manufacturers Association (NEMA).

Barry Powell has spent nearly 20 years at Siemens in leadership roles, where today he is the regional CEO/North American head of the Electrical Products business unit within Siemens' Smart Infrastructure division. He currently serves as teasurer/head of the Finance Committee for the National Electrical Manufacturers Association (NEMA) and as the associate chair for the George W. Woodruff School of Mechanical Engineering at Georgia Tech. He has also recently completed board executive roles for the Electrical Safety Foundation International (ESFi).

OMAHA PUBLIC POWER DISTRICT AND RUGGED DEVICES:

STREAMLINING FIELD OPERATIONS FOR A DIGITAL FUTURE

KEVIN EGAN

Omaha Public Power District (OPPD) was founded in 1946 and has grown to become the 12th-largest public power utility in the nation. Covering more than 5,000 square miles in eastern Nebraska, OPPD serves a customer base exceeding 400,000 customers – and electricity demand in the territory is growing at an unprecedented rate, leading OPPD to seek additional solutions to help keep up with demand and keep customers happy.

To accommodate this growing demand for electricity, OPPD embarked on a transformative journey toward becoming a digital utility company. This strategic shift involved integrating sophisticated data management systems and robust communications networks to allow OPPD to collect, store and analyze electricity usage data in real-time. The goal was to enhance operational efficiencies and improve customer communication.

To help facilitate the transition, OPPD sought a reliable solution to replace outdated consumer-level devices that were increasingly prone to inefficiencies and operational limitations. These limitations included connectivity delays, bottlenecks and compatibility issues, which hindered OPPD's ability to operate at peak efficiency. The company also needed to transition from dated manual and paper-based systems to digital platforms, ensuring accurate data capture and seamless accessibility in the field.

After evaluating various solutions, OPPD chose to deploy 200 semi-rugged devices across multiple units within the organization, including meter technicians, troubleshooters, line crews and system protection and automation personnel. Serving as the central hub for information and task execution, these devices enabled field personnel to smoothly receive work orders, conduct digital asset inspections, access real-time location data and input crucial information into the database – all from a single, robust device. →

Source: Omaha Public Power District.

Brent Saltzman, manager of Endpoint Engineering at Omaha Public Power District, emphasized the importance of these devices: "Our field personnel work tirelessly every day to address customer needs, so having technology that can keep up with their job demands is paramount."

The semi-rugged devices are especially helpful for troubleshooters who work on a demanding 12-hour rotation and rely on their rugged devices to keep them informed of new and existing jobs throughout the day. For example, if a customer loses power, a troubleshooter will receive the location details of the outage through OPPD's computer-aided dispatch (CAD) software and then drive to the location to start their work. With data transmitted directly to their devices in real-time, troubleshooters can understand the situation even before they arrive on site, ultimately helping them restore power more quickly and efficiently.

The semi-rugged design of the laptop makes it ideal for withstanding the bumps and drops prone to fieldwork and challenging weather like rain or snow. Field personnel also appreciate the device's 14" screen size and high brightness levels, which ensures optimal visibility, even in direct sunlight. And, the device's backward compatibility allows seamless integration with existing hardware and software infrastructure, eliminating the need for cumbersome adaptors that field personnel must carry around from job site to job site.

With multiple connectivity options, field personnel gained access to real-time geographic information system (GIS) data, facilitating remote asset inspections and expediting response times. Personnel could quickly pinpoint the location of a power outage and dispatch the closest repair crew. Rapid access to data also streamlined job navigation, with maps to the location of the next task sent directly to the device, so field personnel could easily transition seamlessly between assignments.

Source: Omaha Public Power District.

Source: Omaha Public Power District.

OPPD found that the devices fit harmoniously within their ecosystem, making both the devices and operating system familiar and easy for OPPD's IT team to set up and deploy, and for field personnel to use on day one. Thanks to the infrared webcam built into the devices, field personnel can log in using facial recognition technology, which eliminates the wasted time workers spent recalling and entering long passwords.

Scott Marshall, manager of Application Services at Omaha Public Power District, highlighted the broader vision behind the company's digital transformation: "Our shift to a digital utility company is not just about modernization; it's a commitment to addressing our customers' present needs while innovating for their future challenges. Through the integration of technology and a focus on customer-centric solutions, we are empowering our communities to thrive."

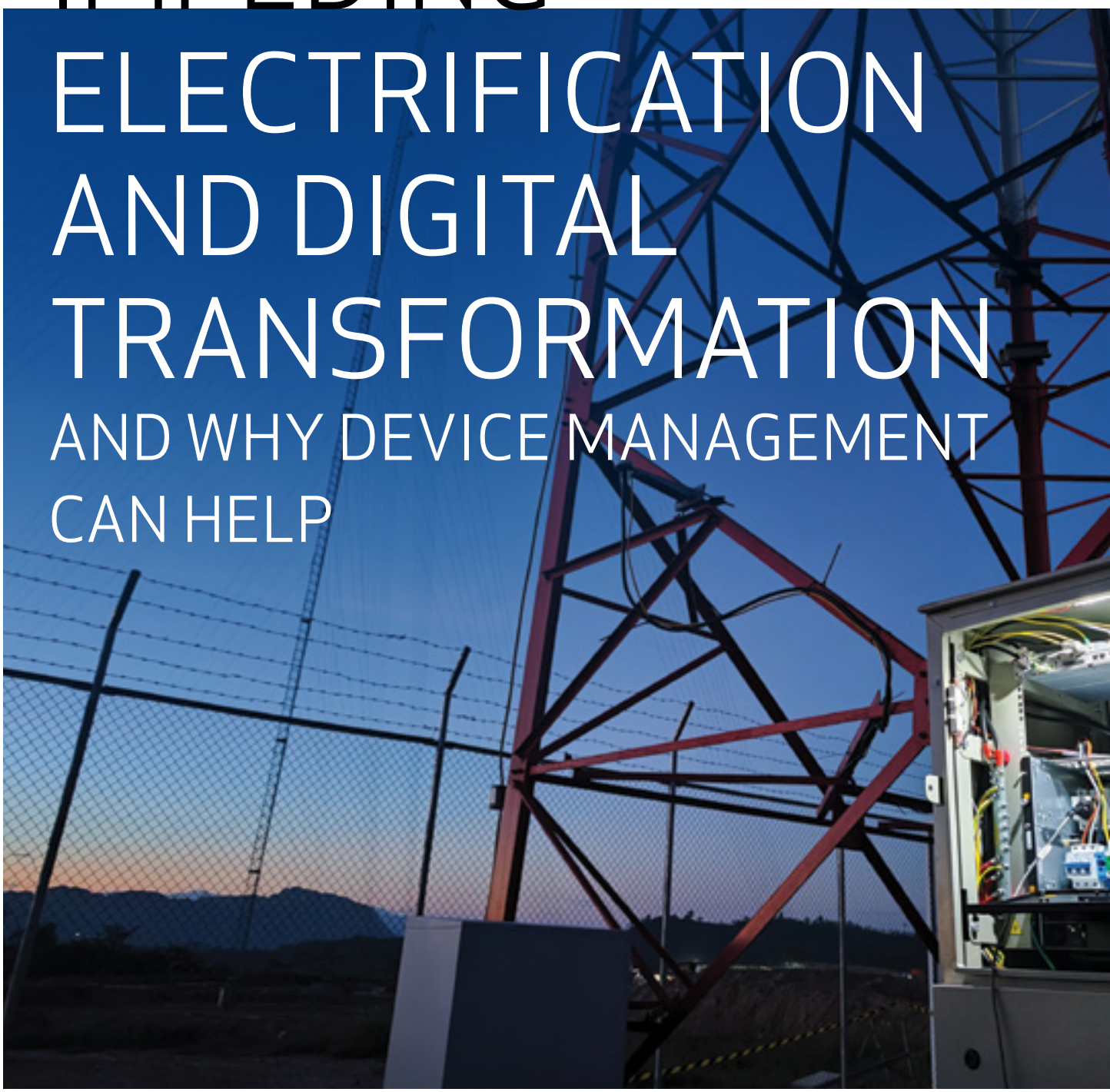
By choosing to implement semi-rugged devices, OPPD was able to meet the evolving needs of its field workers, enhancing productivity and flexibility. This strategic move also positions OPPD to advance into a digitally-driven future for their customers and community.

ABOUT THE AUTHOR:

Kevin Egan serves as regional sales manager in the Central US for Panasonic Mobility and is responsible for coordinating sales and technical resources to meet the needs of energy, utility, oil & gas and telecom markets. He is focused on consulting with enterprise customers on how best to leverage mobile technology to improve the productivity of employees and increase operational efficiencies for their respective companies. Egan holds a Bachelor's Degree in chemical engineering from Washington University in St. Louis and a Master's Degree in business administration from the University of Houston

CHALLENGES IMPEDING ELECTRIFICATION AND DIGITAL TRANSFORMATION

AND WHY DEVICE MANAGEMENT CAN HELP



CURT AHART

Electrification continues to ramp up globally as part of the larger push to move away from fossil fuels to alternative energy, including wind and solar. While electrification and other modernization efforts, like digitalization, are admirable and necessary endeavors, electrical utility companies and most other utilities, for that matter, face several major challenges that impede progress.

Unsurprisingly, these challenges often boil down to finances. Case in point: several years ago, California bit off more than it could chew in renewable energy projects, resulting, in part, in rolling blackouts. The takeaway is this: For modernization and environmentally-conscious initiatives to become a reality, utilities must find cost-effective solutions funded through rate cases and regulatory approvals.

Legacy infrastructure

At the center of these environmentally-driven electrification initiatives is the need for grid modernization. Today, many utilities operate on outdated infrastructure that cannot sufficiently support modern technologies or digital solutions. Most of the U.S. electric grid was built in the 1960s and 1970s, and although it has undergone enhancements, this aging infrastructure is struggling to handle modern electricity needs. For example, renewable energy resources and electrification – namely, electric vehicles (EV) – put considerable strain on the capacity and function of existing grids. →

In the U.S., many states are undertaking initiatives with specific electrification goals, such as mass adoption of EVs among consumers and electrification of other consumer appliances like stoves and mowers. Nevertheless, the aging grid can't support these assets from both a usage and supply perspective. On the usage side, problems will abound if multiple EVs in the same neighborhood charge at a specific time (say, right after work), because the grid cannot handle so many EVs charging simultaneously in the same area. From a supply perspective, just as the grid is not fit for the load going out to support EVs, it cannot handle the incoming load from EV batteries, solar from residential, neighborhood, community, etc. and other power-generating systems.

Updating this legacy infrastructure can be costly and time-consuming, which is why many electrical utility companies are moving slowly when fully embracing Industry 4.0. Those utilities still have a lot of legacy equipment like meters and capacitor banks that they aren't in a hurry to replace due to the huge investments they've already made. Plus, many of these assets have long lifespans, up to 20 years, and the utilities want to maximize these assets rather than disable them prematurely.

Managing assets and data

Utilities must manage more assets than ever, sometimes upwards of tens of thousands of assets, including sensors, cameras, meters and other connected devices. Maintaining always-on visibility and control over equipment and devices at a reasonable cost will require utilities to connect them remotely to a central system. While utilities could easily pull fiber to equipment like substations, wireless is the only practical solution to connect tens of thousands of distribution assets. As such, a crucial choice utility companies must make is which type of wireless network they will deploy – public cellular, private cellular or a combination of technologies – to connect to their assets in the field remotely.

With a public network, a utility must pay a monthly fee to the cellular carrier to connect to these devices. Payments to mobile operators are OPEX expenses that are difficult for utilities to cover in their CAPEX-oriented business, which is dependent on ratepayers and public utilities commission approvals. If the utility decides to use a private LTE network, it will need to erect its own towers, buy radios and buy and manage its core and network infrastructure, making it the network owner and eliminating monthly fees. Although private LTE may save money from recurring payments, the utility will often require help from contractors to manage these systems, thereby falling outside the typical capital expenditure (CapEx)-related use cases.

Utilities will also generate vast amounts of data from their assets. Managing and analyzing this data effectively is essential for optimizing operations and decision-making. However, collecting huge amounts of data from different places – especially at the edge – will always be difficult. Harder still than collecting the data is determining which data is the most important, e.g., differentiating between current and outdated data, classifying data (revenue vs. safety data), establishing where data needs to go within the organization, etc. Unfortunately, many utilities struggle with data integration, quality and analysis. However, by leveraging technologies like artificial intelligence and edge computing, they can become more efficient from a data management perspective, saving costs simultaneously.

Regulatory compliance and cybersecurity

The utility industry is heavily regulated, and modernization efforts must comply with various regulatory requirements. Navigating these regulations while implementing new technologies can be complex and require significant resources. Utilities must also navigate challenges concerning public safety. Currently, different utilities in Texas, California and the West Coast are being held accountable for wildfires. PG&E had to pay approximately $5.36 billion in settlement awards to compensate survivors of the 2015 Butte, 2017 North Bay and 2018 Camp Fires. Berkshire Hathaway Energy's (BHE) PacifiCorp unit faces billions of dollars in potential liabilities from wildfires that have burned hundreds of thousands of acres in California and Oregon. As of April 30, 2024, BHE projected $2.4 billion in wildfire losses but said that number could increase to $8 billion. Should a wildfire occur suddenly, utilities need the ability to shut down infrastructure instantly to prevent the spread and protect themselves from financial penalties, which can be particularly difficult when many of these wildfires are the result of natural phenomena or acts of nature.

Regulatory compliance is also closely intertwined with cybersecurity compliance. With the adoption of digital technologies increasing the risk of cyber threats, the writing is on the wall that utilities must soon comply with stringent cybersecurity standards. Famously, in the oil and gas sector, Colonial Pipeline suffered a ransomware cyberattack, resulting in fuel shortages, panic buying and even American Airlines changing flight schedules temporarily. More than anything else, the attack revealed how poor existing security was for critical infrastructure services. While the TSA issued security directives for pipeline owners and operators, regulators will likely impose similar rules on other utilities.

Electrical utility companies must ensure their systems are secure from potential cyberattacks, requiring significant investment in cybersecurity measures and constant monitoring. For example, utilities must harden and secure different elements, including the data delivered on platforms and systems, the hardware and networks (cellular and fiber), switches and routers and physical elements like facilities and data centers. Also, many utilities have built their own security plan and then audit themselves against that plan. However, these plans tend to be elaborate with multi-layer contingencies, which can severely tap existing capabilities and limited human resources.

Workforce challenges: Upskilling and retirement

Workforce challenges will be another roadblock that electrical utility companies will encounter amid electrification and other modernization efforts. Implementing digital transformation requires a workforce with the necessary skills and a culture to embrace change. Nevertheless, utilities may face challenges in upskilling their employees and fostering a culture of innovation and collaboration.

Today's workforces often lack some of those technical skills required to realize the shift to Industry 4.0 and electrification. Almost every solution, whether a backup power system or uninterruptable power supply, has a management component, meaning employees have to be experts, capable of logging into these platforms, understanding how to set things up, troubleshooting, etc. Managing these different solutions becomes even more difficult as digitalization increases.

Additionally, electrical utility companies note their most veteran and skilled leaders and workers continue to retire in droves. In fact, over the next five to ten years, many utilities will lose 50% of their current workforce to retirement. Unfortunately, there aren't enough skilled workers entering the industry to balance the number of those leaving. For example, over the last 15 years, colleges and universities witnessed a 50% drop-off in graduating engineers. In light of these labor realities, it is paramount that utilities invest in tools that can automate as many routine and monotonous processes as possible.

Automating device management, improving security

As electrical utility companies pursue electrification and digital transformation, they must implement cost-efficient solutions. One of the most effective ways utilities can prioritize CapEx is by leveraging automation to minimize human labor costs while improving productivity, specifically via device management. Utilities should make upfront capital investments in these technologies to cover the cost over 8 to 10-year spans. A best-in-class device management platform with comprehensive tools will streamline the deployment and monitoring of remote assets. The ability to manage devices en masse in an automated way using a management platform not only enhances efficiency but also saves resources during labor shortages, allowing personnel to focus their attention on more value-added projects.

Without the ability to fully automate, utilities would have to monitor thousands of devices manually. For example, it would be unrealistic for human personnel to investigate every alert from each device every time an issue gets reported. However, with a management platform, human workers would only need to review the top 2% or 1% of critical issues depending on the devices and importance of the data, e.g., revenue-grade data. Leading management platforms can also auto-resolve issues like rebooting routers and reconstructing communications without human intervention. →

Likewise, automated device management and monitoring platforms help secure the edge of the OT network, which is particularly crucial as utilities bring more assets online, consequently expanding the attack surface. Some leading device management providers will further bolster security at the edge by leveraging complementary software from their partners. Because cybersecurity is an ever-evolving landscape, these providers and their partners are an invaluable resource for utilities as they strive to comply with regulations and avoid fines.

Top-class providers usually have value-added services that can run alongside their management platforms, bringing other enhancements to electrical utility companies as they modernize. For instance, containerized services allow utilities to run any sort of software at the edge, eliminating the otherwise expensive alternative of buying additional industrial PCs. Containerized services also accelerate communications, meaning that computation occurs at the edge. By processing at the edge, utilities can avoid shuffling everything up to a cellular network at a central location, processing and then sending it back.

Pursuing change cost-effectively

To recap, electrical utility companies must engage in electrification and modernization efforts like digitalization to meet modern energy requirements and the demands of shareholders and government regulators who want to move toward more environmentally friendly methods. Nevertheless, there are several glaring challenges in the way, which amount to monetary and labor cost issues. Electrical utility companies must stretch the money they have to address these challenges.

Thankfully, leading providers of device management platforms with productivity tools can boost operational efficiency while enabling utilities to minimize people and operational costs – especially as it pertains to operating the network and the ever-growing number of connected assets. Moreover, some providers offer added services and partners that can further enhance security at the edge, including other operational processes. Of course, not all device management platform providers are equal, and electrical utility companies must exercise scrutiny when selecting the right solution provider.

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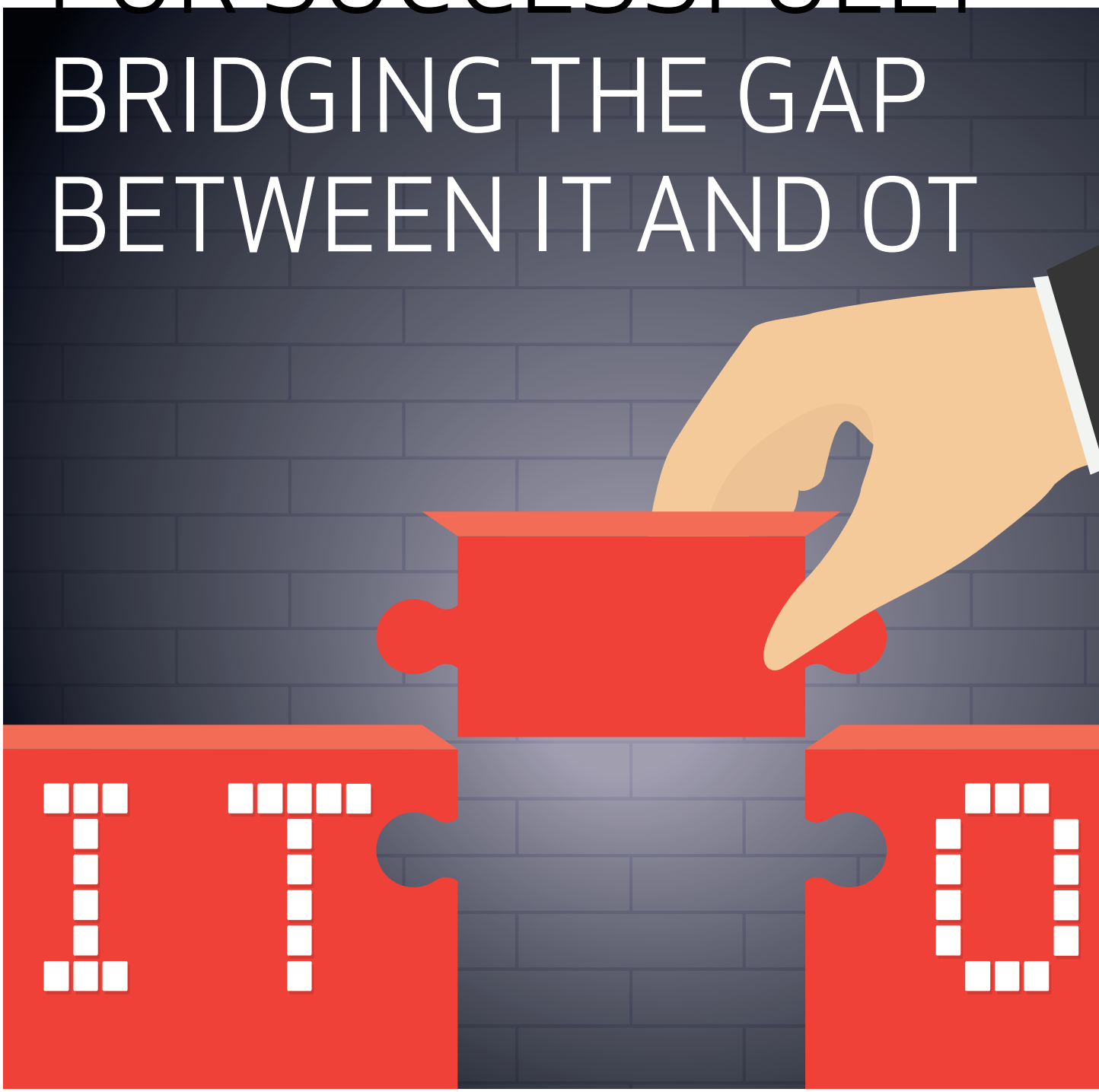
Curt Ahart is a senior IoT executive with an entrepreneurial approach and passion for customers, new product innovation and business growth. He has more than 35 years of successful experience in technology. Ahart has served in these roles with startups to Fortune 50 companies. He has deep knowledge of wireless technologies, cloud services and IoT applications.

THREE KEY STEPS FOR SUCCESSFULLY BRIDGING THE GAP BETWEEN IT AND OT



BEN DWINAL

In the last issue of Electric Energy T&D Magazine, my colleague Craig Cavanaugh discussed a topic that should be on the radar screen of every utility: the importance of breaking down the walls between IT and OT systems. His article, "Bridging the Gap Between OT/IT: A Critical Step for Navigating a Perfect Storm of Challenges," makes a compelling case for why the separation between IT and OT systems has become an enormous hindrance to utilities. As he puts it so well in his commentary:

> *"Maintaining that gap between OT and IT may once have been a recipe for reliability, but today it is a liability in the face of the massive changes facing utilities. To solve the multi-faceted challenges that the industry is confronting, utilities must build a bridge between these systems as a foundation for success."*

Cavanaugh then discusses the critical role that convergence of IT and OT plays in unlocking the ability of utilities to respond effectively to challenges such as grid resilience, climate change, rapid electrification of the economy, graying of the workforce and more. His article ends with a call to action for utilities to start bridging the gap between those two technological systems.

Once an organization understands that urgency and wants to take action, what is the right strategy for moving forward? It's a question I am asked regularly, and the answer I give usually surprises people. One might assume that the conversation about such a technology issue is all-encompassing, and utilities need to start by taking a 50,000-foot view of all the IT and OT systems that a utility uses. I understand the instinct to take a macro view by thinking about bits and bytes of data. It may be counterintuitive but getting down close to data in this way will give your organization clarity about how to shape your overall strategy. →

In the IT/OT convergence initiatives my team and I have worked on with utilities, three guiding principles emerge when you take this micro view:

- Enabling continuous, real-time data flows is critical
- Cleaning and enriching data sets should not be overlooked
- Ensuring data access at work sites is another critical success factor

Let's start with data flows. Legacy IT and OT systems typically perform data aggregation, reporting and analysis periodically. Rather than being moved continuously through the system to support real-time operational needs, data often sits and sits and sits. A piece of data from a sensor or a piece of equipment may sit in a holding pattern for 12 hours, an entire day, or even a full week, until a pre-determined system schedule time. Periodic execution of batch processes to synchronize data across the enterprise may have made sense in the past, but it is a massive obstacle today for the kind of real-time, continuous reporting and analysis of data that is needed for managing smart grids, preventing outages, supporting real-time decision-making by field crews, and much more.

I should note that the negative impact of this is not just on big IT/OT initiatives. It also produces huge operational inefficiencies that cause headaches, slows down workflows, interferes with decision-making, increases truck rolls and adds to operational costs. Addressing this need for continuous, real-time data flows therefore delivers significant and impactful efficiencies in addition to giving utilities a foundation for solving the big challenges that Craig previously discussed.

Focusing on continuous, real-time dataflows should be the guiding principle that drives the strategy for IT/OT convergence. When you begin examining your technology systems to see what stands in the way of real-time aggregation, reporting and analysis of data, it becomes very clear what changes need to be made. As you follow data from where it originates to where you want it to go, your strategy should be to systematically remove the barriers that stand in the way of faster dataflows. This will drive key decisions the organization will make about hardware, software and cloud architecture at the macro level.

The second guiding principle for the success of IT/OT convergence is that data quality matters. Having real-time, continuous dataflows is critical, but the accuracy and richness of the data are just as important. That is particularly true for location-based data, such as the layers of data that are embedded in digital maps and GIS databases. To maximize the insights that utilities can derive from data, accuracy and richness are all critical. But not all data is created equal. A significant amount of data in utilities' IT and OT systems needs to be scrubbed, made more accurate and enriched. Flawed data is no secret to those who work with it every day at utilities, including crews in the field and GIS professionals. It creates operational inefficiencies that slow down mission-critical decision-making and the process of completing projects daily. And it also stands in the way of any large-scale initiative to bridge IT and OT systems.

Enhancing the accuracy and richness of utility data has traditionally been a time-intensive process that makes it difficult and costly to do at scale. But that is changing thanks to AI. AI-driven "data conflation" is being successfully used to automate the process of assessing the quality of data, correcting inaccuracies and enriching the data to bring it up to the standards needed by the applications across the organization. This "data conflation" topic could fill up an entire article on its own, so I won't go into too much detail here. The key takeaway is that the process of data enhance ment can be automated in ways that remove one of the obstacles to IT/OT convergence and solving the macro challenges that my colleague mapped out in his article.

The last guiding principle for your IT/OT strategy is to look closely at data in a very specific environment: in the field where work crews need to put it to use on-site. The tablets that field crews use for processing IT and OT data typically have onboard GPS and mapping engines. That means that data and processing can be performed at the device level filtered by exact location, not in a centralized data center. In many cases, that work is executed offline because work sites may not have adequate connectivity. For these reasons, back-end systems need to be very deliberate about what information is delivered to work crews. Too much information would overwhelm the tablets and the apps. Not enough information would interfere with workflows and even cause a project to be delayed. Outdated, inaccurate information also leads to confusion and delay.

Looking closely at data accessibility in the field will steer you through important decisions about how to bridge the gap between IT and OT. Evaluating role and workflow-specific data needs for your field teams can reduce data volumes making offline analyses and access to information more achievable. Using a device's current location as a data filter to reduce the amount of data being processed, presented, and refreshed can be another strategy that will enable critical field workflows to be executed without overwhelming device resources or back-end systems. The use of geospatially enabled applications and map-centric interfaces can be a key enabler in allowing real-time, operational data to be delivered to field crews and business leaders improving decision-making abilities, reducing inefficiencies, and increasing organization-wide awareness of on-the-ground conditions.

By getting up close to your data in these ways, there are clear lessons that come into focus for successfully bridging IT and OT. But as you saw with each of the examples above, there are also significant operational efficiencies beyond supporting a successful IT/OT strategy. The steps you take to improve dataflows, data quality and data accessibility in the field will also allow you to eliminate inefficiencies, reduce the time it takes to successfully complete workflows and accomplish more with the team you have. The benefits are not just on the horizon. They are immediate and impactful.

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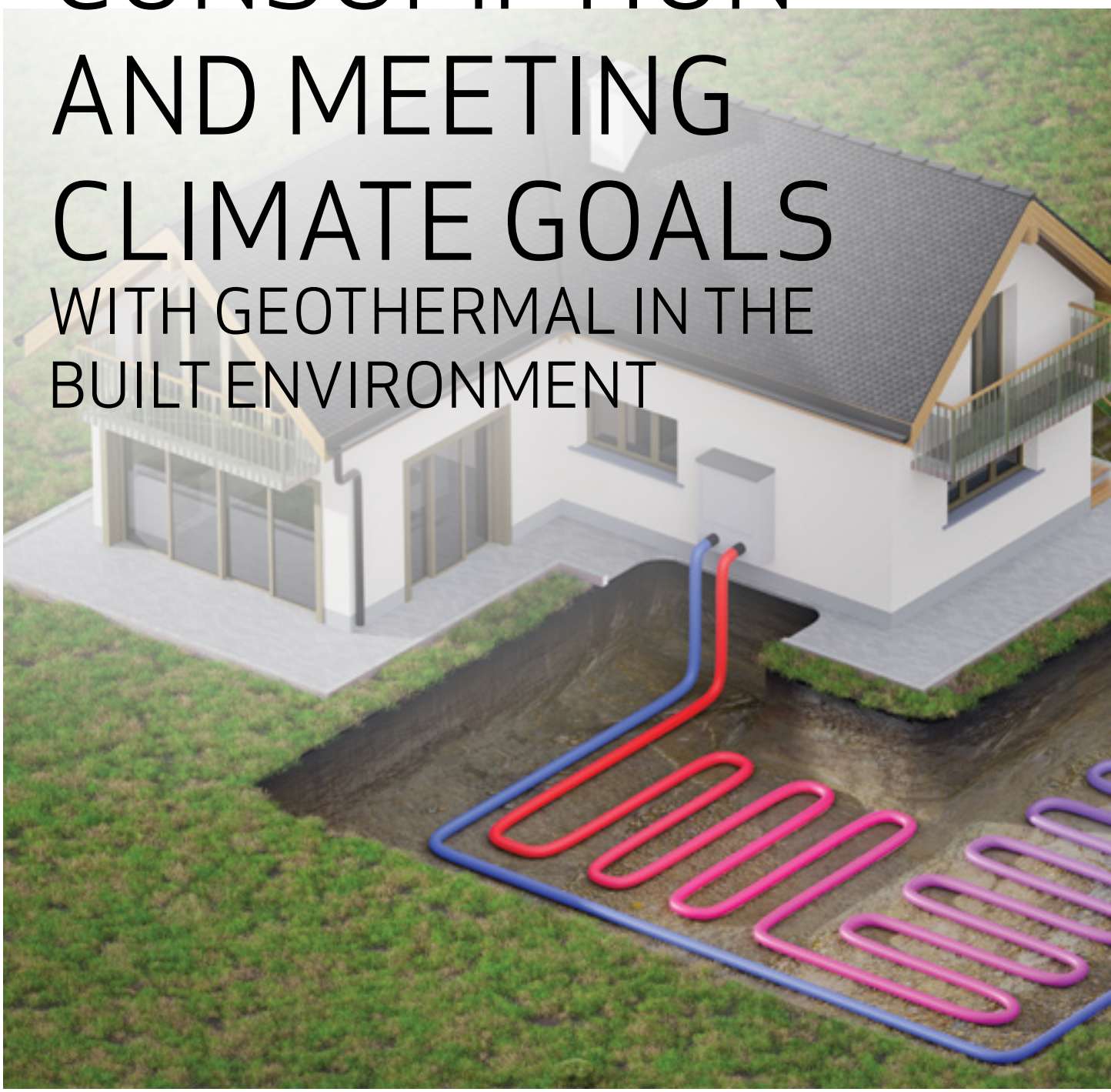
Ben Dwinal is the vice president of Solution Architecture at TRC. Dwinal is an experienced solution architect with over 25 years of experience in remote sensing, geospatial intelligence, application development and related technologies. His background includes 12 years in military and defense technologies and more than 13 years of work in the GIS electric and gas utility industry. He earned his degree from the University of Maine.

REDUCING ENERGY CONSUMPTION AND MEETING CLIMATE GOALS

WITH GEOTHERMAL IN THE BUILT ENVIRONMENT



WYATT ROBERTS

President Joe Biden's administration put forth an unprecedented and uncompromising initiative to achieve a 50-52% reduction from 2005 levels in economy-wide net greenhouse gas pollution by 2030. It's an ambitious but much-needed plan to combat climate change realities that increasingly impact people's lives across the country and around the world. When coupled with strategies to eliminate fossil fuels as a source of energy generation by 2035, it's clear that we still have a lot of work to do – and fast.

To move quickly with impact and precision, we should look to the built environment to make substantial changes to our carbon footprint and environmental impact.

Specifically, geothermal heat pumps need to become standard installations, replacing traditional, fossil-fuel-burning furnaces and becoming the appliance of choice in new construction to maximize efficiency and scalability. →

Advancing the built environment with geothermal heat pumps

The built environment, including residential homes, multi-family dwellings and commercial buildings, is an enormous energy consumer, accounting for 37% of total emissions. It's a pivotal place for improving climate outcomes, providing many opportunities for forward-thinking policymakers, developers and consumers to meaningfully improve their carbon footprints related to the built environment.

One McKinsey & Company analysis found that 22 "levers" or built environment components have "particularly strong potential due to their high abatement potential, cost-effectiveness and applicability across archetypes and regions."

Space conditioning tops the list, doubling the next most influential lever we can use to reduce home energy consumption and reach ambitious energy goals critical to achieving energy independence and climate outcomes. In addition to space heating, finding new renewable energy sources for air conditioning is essential as well.

Geothermal heat pumps address both challenges, providing an efficient and effective way for builders, buyers and policymakers to address climate change.

Geothermal heating and cooling rely on the steady below-ground temperature to provide consistent heating energy in the winter and cooling capacity in the summer. These systems use an electric-powered heat pump to take advantage of this naturally occurring constant, harnessing the steady temperature surrounding any home to heat or cool it as needed.

The ground source heat pump inside the home transfers warm air to the home in the winter and into the ground in the summer, replacing gas-powered furnaces and conventional air conditioning equipment with quiet, efficient, electric-powered heat pumps.

Why choose geothermal heat pumps

Geothermal heat pumps can be deployed in any climate and environment and work effectively everywhere, from small starter homes to large structures like schools, apartment complexes and office buildings.

Four differentiating factors separate geothermal heat pumps from other heating and cooling solutions.

1. Performance

Geothermal heating and cooling is the least energy-intensive solution humanity has developed to date. It's a win-win-win for owners, policymakers and the environment. It's the best way to future-proof buildings, providing the electric heating and cooling solution the built environment demands.

The EPA explains, "Geothermal heat pumps are the most energy-efficient, environmentally clean and cost-effective systems for heating and cooling buildings."

With regulatory and utility support making it accessible to more people and the Inflation Reduction Act adding significant financial incentives for installing geothermal heating and cooling solutions, this technology is now more affordable and accessible at every stage of the building process.

2. Durability

Geothermal heat pumps are built to last and the ground loops that enable the seamless transfer of warm and cool air will last a building's lifetime, future-proofing it for the long term rather than just addressing an immediate need.

These heat pumps outperform traditional and innovative heating and cooling technologies, making the products themselves and their functions more sustainable. For instance, as The Department of Energy (DOE) succinctly explains, "Relative to air-source heat pumps, they are quieter, last longer, need little maintenance and do not depend on the temperature of the outside air."

3. Efficacy

Geothermal heat pump adopters will not experience a compromise in performance or comfort compared to their fossil fuel counterparts. Instead, homeowners can expect energy savings, enhanced comfort and increased property value.

The Environmental Protection Agency (EPA) recently updated the Energy Star New Homes program. People building or buying a new home can receive an EnergyStar label for the entire home, not just its appliances. At the same time, businesses experience operational efficiency, cost savings and regulatory compliance. Similarly, government entities can expect reduced environmental impact, alignment with climate goals and sustainable urban development when they adopt geothermal heat pumps in new construction.

With the DOE recently releasing guidance that newly constructed federal government buildings be fossil fuel-free, there are tremendous opportunities for geothermal heating and cooling in federal buildings, ranging from housing on military bases to office buildings and national park visitor centers.

4. Compatibility

Meeting our climate goals means we must electrify everything. We need a more capable (and more expensive) energy grid to do that. However, we can't wait for this infrastructure to arrive before we start changing our carbon footprint. Geothermal is the only electrified solution that doesn't create peak energy-load spikes like in the way that air source heat pumps and other electric heating and cooling systems do.

Leveraging geothermal to make this electrified transition for space heating and cooling buys the U.S. utilities and the national grid infrastructure much-needed time to upgrade and transition to support our fully electrified future.

A solution for today to impact energy for tomorrow

Geothermal heating and cooling isn't a gimmick or new technology being sold to alarmed people fearful of the repercussions of climate change. It's a tried-and-true solution that's ready to go right now.

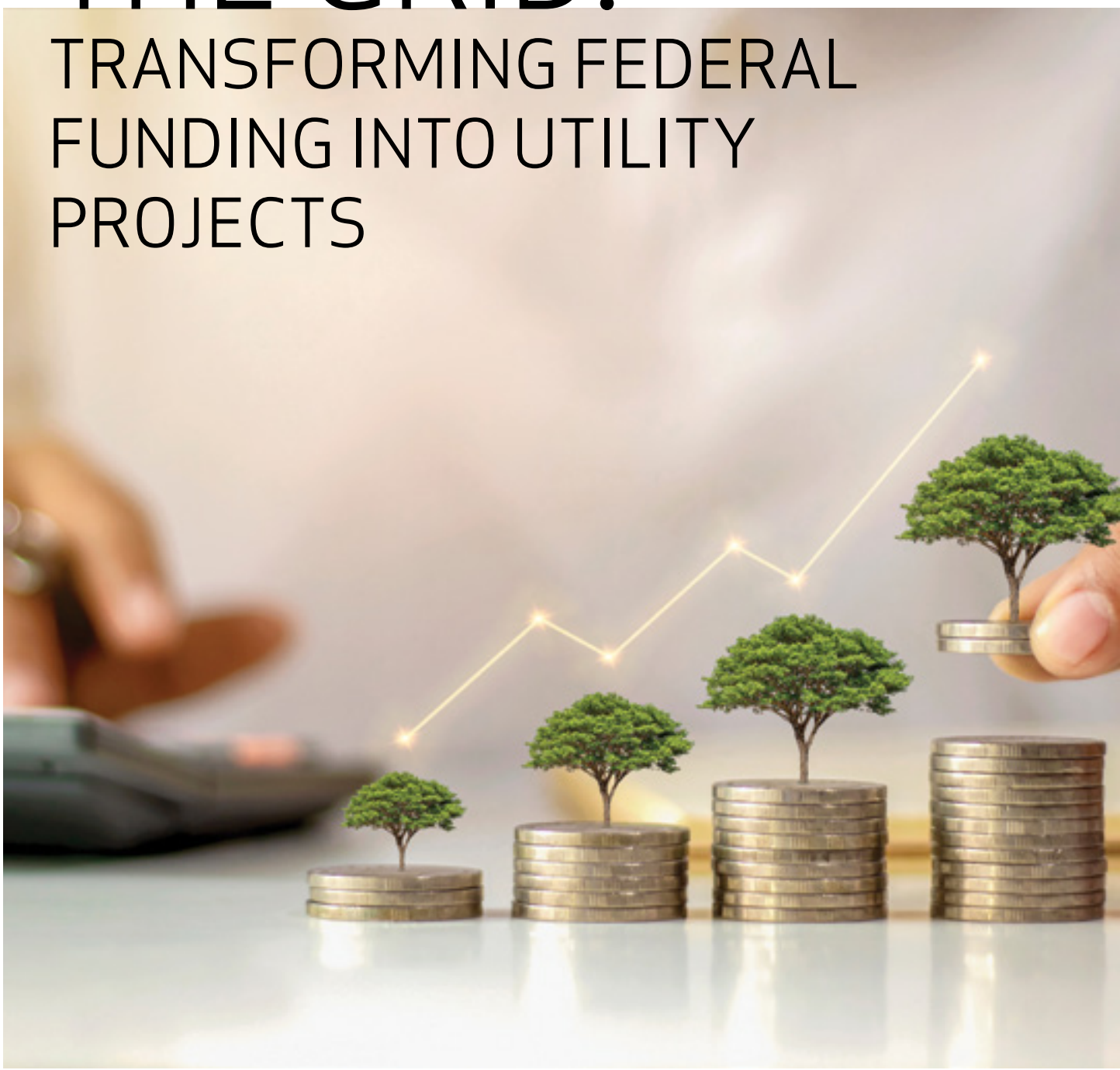
We know we must stop using fossil fuels as soon as possible. Many people may not want to sacrifice comfort, experience, or cost to fight climate change alone, but geothermal heat pumps allow us to do so without compromise. It's a save-the-planet-ready solution that every new construction project should consider making geothermal heat pumps a part of the built environment moving forward.

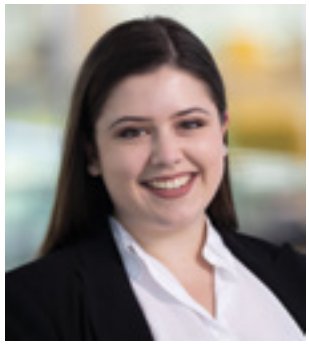
ABOUT THE AUTHOR:

Wyatt Roberts is head of Channel Development for Dandelion Energy. He is a builder and a building scientist and is passionate about reducing the impact of our built world on the global environment. He is also a Certified Passive House Designer (CPHD). Roberts is a veteran in the building industry, and before joining Dandelion, he specialized in high-performance home construction in upstate New York.

NAVIGATING THE GRID:

TRANSFORMING FEDERAL FUNDING INTO UTILITY PROJECTS





EMILY ROTH

The Bipartisan Infrastructure Law and Inflation Reduction Act represent significant milestones in the federal government's commitment to modernizing and fortifying the nation's utility infrastructure – particularly the electric grid. With substantial allocations earmarked for various programs and initiatives, including those targeting grid resilience, rural electric cooperatives and transmission expansion, these legislative efforts signal a concerted push toward enhancing reliability, efficiency and sustainability within the utility project sector.

Federal funding programs serve as the lifeblood of transformative endeavors, providing crucial financial support to catalyze projects that range from grid modernization to renewable energy integration. Yet, navigating the path from funding announcement to project fruition is a journey fraught with complexities and challenges. With the much-nuanced interplay between government priorities, industry dynamics, technological adaptation and regional considerations, we seek to examine how to empower stakeholders with actionable insights into how federal funding can be maximized to drive meaningful (and tangible) transformation within the utility infrastructure landscape. The right choice in connectivity can make a difference when thoughtfully designed for the power grid, so partners who understand the industry's requirements and processes are critical during this time of rapid industrial development. →

Industry dynamics beyond conventional perceptions

While traditional perspectives may focus solely on utility providers and infrastructure developers, the reality is much broader. Suppliers of equipment and materials, technology innovators driving efficiency gains, consulting firms offering specialized expertise and even community advocacy groups, all play integral roles. Because components are part of the larger ecosystem, understanding and engaging across industry dynamics allows for identifying synergies, mitigation of potential conflicts and harnessing collective expertise.

Grant allocations to the manufacturing sectors increase the interconnected nature of such efforts. Many investments today stimulate activity across supply chains, from raw material suppliers to final assembly plants. By increasing domestic manufacturing capabilities through federal funding initiatives broader objectives – such as job creation and industrial competitiveness – can be unlocked.

Identifying federal funding programs

Identifying relevant federal funding programs, such as Grid Resilience Grants, Transmission Facilitation Program, Transmission Facility Financing, Rural Electric Cooperative assistance and others administered by the Department of Energy, marks the first step in the process of modernizing utility infrastructure. Monitoring the announcements illuminates avenues for potential project implementation and readies us to help our customers win bids to help bolster utility systems.

Each program has specific requirements, eligibility criteria and application instructions provided by the administering agency. Potential applicants must assess their eligibility status and align their project proposals with the outlined requirements. From states and tribes to utilities and local governments, eligible entities must compile comprehensive application materials, including project details, budget estimates and environmental assessments, tailored to meet the unique demands of each funding opportunity.

Navigating the process

Transitioning from announcement to project completion entails a process that spans multiple stages that demand technical expertise and strategic foresight to anticipate and navigate potential challenges. With federal funding opportunities, practical considerations, such as the CHEAP Act – which stands for the Cybersecurity and Emerging Analytics Pipeline Act – with legislation that proposes improvements to the nation's pipeline system against cyber threats to protect the transportation of energy resources, various agencies and industry stakeholders influence the timeline and implementation of projects, shaping the trajectory from concept to execution.

This type of legislation, alongside other regulatory frameworks, sets the parameters within which projects must operate, impacting everything from budget allocations to project timelines. Adhering to these practical constraints requires careful planning and

negotiation, often involving collaboration with legal experts, financial advisors and policymakers. Navigating the process requires balancing the need for efficiency with compliance with regulatory standards, and it can be a delicate yet essential aspect of project management, ensuring that federal funding is utilized effectively and responsibly. Collaboration with regulatory bodies and committees plays a crucial role in fostering transparency, accountability and alignment with realistic requirements and standards.

A look at government priorities and efficiency

In utility infrastructure modernization, government priorities play a major role in shaping funding allocation strategies; initiatives are crafted not only to bolster the efficiency and resilience of the grid but also to foster sustainable development at the regional level. Through targeted investments, government programs aim to enhance the reliability of utility systems and stimulate economic growth by promoting localized sourcing and manufacturing. By prioritizing projects that align with these objectives, funding initiatives can serve as catalysts for broader ecosystem development, amplifying their impact beyond the confines of utility infrastructure. The Bipartisan Infrastructure Law (also referred to as the Infrastructure Investment and Jobs Act) is injecting $660 billion over five years into critical infrastructure for transportation-related projects. The program is projected to create 700,000 jobs across supporting sectors, including positions in construction, manufacturing and transportation.

Important components of government programs include both localized sourcing and manufacturing requirements, reflecting a commitment to nurturing regional economies and fostering long-term sustainability. By mandating the incorporation of local suppliers and manufacturers, funding initiatives ensure that investments contribute to the vitality of local communities, providing social equity while also fostering resilience in supply chains.

Technological adaptation

In response to evolving grid demands, utilities are navigating significant technological shifts. This includes the implementation of advanced grid management systems, smart metering technologies and distributed energy resources to optimize grid operations and accommodate the increasing penetration of renewables. As utilities embrace innovative solutions such as energy storage systems and demand response programs to enhance grid flexibility and resilience, emerging technological advancements not only improve the efficiency and reliability of the grid but also pave the way for a more sustainable energy future. →

For example, the rapid installation of substations plays a pivotal role in supporting the seamless integration of renewable energy sources into the grid infrastructure.

As renewable energy generation experiences exponential growth, the need for robust substation infrastructure becomes increasingly critical to facilitate the efficient transmission and distribution of power. Serving as vital nodes in the grid, substations enable the connection of renewable energy projects to the broader electricity network while ensuring grid stability and reliability. Equipped with state-of-the-art control and monitoring systems, grid management capabilities can more readily adapt to evolving energy dynamics. In rural areas, where the electrification rate may be lower compared to urban centers, increased funding for substation installation helps address critical infrastructure needs and accelerates the transition towards a more electrified and sustainable energy landscape.

Another critical area of focus, including that of the BIL, is supporting infrastructure for clean technology, and beyond that, creating the EV charging station infrastructure to support electric vehicles. As our society forges ahead – both domestically and internationally – to reduce our reliance on fossil fuels, increase renewable energy sources and electrify components of our lives, grid reliability to support the growing demand gains increasing importance. Beyond electric vehicles, there are electric rail projects, carbon reduction goals to reduce climate change and its impacts and a reliable, resilient power grid makes all of that possible.

Regional considerations

Grid modernization efforts are not one-size-fits-all; rather, they must account for the unique challenges and opportunities present in diverse regions. Each region possesses its own set of geographic, demographic and economic characteristics that influence the trajectory of utility infrastructure transformation. For instance, regions like New York, with densely populated urban areas and a strong emphasis on environmental sustainability, require tailored approaches to address specific infrastructure needs. In New York's case, initiatives such as offshore wind integration are prioritized to capitalize on the state's coastal resources and reduce reliance on traditional energy sources. By recognizing and addressing regional nuances, policymakers and industry stakeholders can ensure that grid modernization efforts are both effective and responsive to local conditions.

Adapting to changing energy demands is particularly crucial in light of external factors ushered in by the COVID-19 pandemic, which has underscored the importance of diversified energy sources and resilient infrastructure. With its disruption to energy consumption patterns, the pandemic highlighted the need for flexible and adaptable grid systems capable of accommodating fluctuations in demand. Moving forward, prioritizing the integration of renewable energy sources, implementing demand-side management strategies and enhancing grid flexibility will be essential for ensuring energy security and sustainability in the face of evolving regional energy landscapes.

Collaboration and investment at the heart

At the heart of comprehensive utility modernization efforts lies collaboration between federal and state agencies, coupled with private investments. These partnerships serve as the cornerstone for driving innovation, facilitating knowledge exchange and pooling resources to address the multifaceted challenges of grid modernization. Committing resources to ensure these partnerships are successful is essential to see the awards through from pre-award, during allocation and following the distribution of funds. While the process from start to finish can take several years, with proper planning it should not slow the momentum of innovation.

Making change tangible

Federal agencies, such as the DOE, work hand-in-hand with state counterparts to align funding priorities, streamline regulatory processes and coordinate project implementation. The Environmental Protection Agency plays an indispensable role in advancing clean energy initiatives and bolstering broader sustainability goals. Through regulatory frameworks, incentive programs and technical assistance, the EPA actively promotes the adoption of clean energy technologies, emissions reduction strategies and environmental conservation practices within the utility sector. Similarly, private investments from utility companies, renewable energy developers and technology providers inject crucial capital into the modernization endeavor, fueling innovation and accelerating the transition towards a more sustainable energy sector. By fostering collaboration and investment, stakeholders can leverage collective expertise and resources to maximize the impact of federal funding and propel utility projects forward.

From identifying federal funding programs to navigating complex regulatory frameworks and embracing technological adaptations, stakeholders must work together to overcome challenges and capitalize on opportunities. As we navigate the complexities of utility modernization, we must recognize the importance of collaboration and investment – two fundamental aspects to realizing meaningful transformation.

ABOUT THE AUTHOR:

Emily Roth serves as the industry segment manager for energy and intralogistics at HARTING Inc., North America. She works to navigate these rapidly evolving markets, shaping the standards, strategies and technologies that make up the energy and industrial intralogistics space. With a background in systems engineering and STEM education, Roth believes in driving change through meaningful conversation and people-focused design.

INCREASED DISTRIBUTION GRID INVESTMENT IS ESSENTIAL

FOR REALIZING A CLEAN ENERGY FUTURE

ERNST SCHOLTZ

The United States has set a bold goal to create a greenhouse gas emissions-free power sector by 2035 and a net-zero emissions economy by 2050. Massive electrification of transportation and building energy use and a proliferation of renewable energy and distributed energy resources (DERs) are central to the strategy to achieve emissions reductions.

However, the strategies to reduce greenhouse gas emissions aren't being pursued in a vacuum. They disrupt the United States electric grid, particularly local distribution grids already being tested by increasing extreme weather (both in frequency and intensity). There's a clear case that distribution grids nationwide need additional investment to maintain and improve the resilience and reliability of the grid in the face of the growing added stresses of electrification, intermittent renewables and DERs. →

Distribution grids in the U.S. tend to share three things in common that have an outsized impact on total electric system reliability and efforts to transition to a clean energy future:

1. They are the location of most power outages.
2. They have been using technology from the last century. For decades, there has been an overwhelming lack of investment in distribution due to myriad reasons, such as their massive, sprawling nature and regulatory and ratepayer pressures.
3. Electrification, renewables and DERs are making them arguably the most critical infrastructure in the evolving electric system, and they are not ready for the job.

The case for improved performance

In its 2023 report "Electricity Grids and Secure Energy Transitions," the International Energy Agency (IEA) noted that the U.S. is one of four countries in the world where more than 90% of power system interruptions originate in the distribution grid. In the most recent national report of its kind, the Lawrence Berkeley National Laboratory evaluated 2014 system average interruption duration index (SAIDI) data from U.S. utilities. It determined that 94% of system interruptions, including major events, originated on the distribution grid.

On average, Americans spent eight hours without power in 2020 and 2021 – roughly double the rates seen in any year from 2013 to 2016. Major blackout events increased by more than 60% from 2015 to 2020.

Looking at 2022 SAIDI data on California's investor-owned utilities released by the California Public Utilities Commission, 88% average of interruptions originated in the distribution grid.

The plight of the distribution grid in California is particularly relevant to the United States as the state is well on its way to achieving ambitious renewable, DER and electrification goals. This is igniting a fierce debate on the need to invest more in distribution grid modernization to maintain reliability and build resilience in the face of increasingly frequent system disruption.

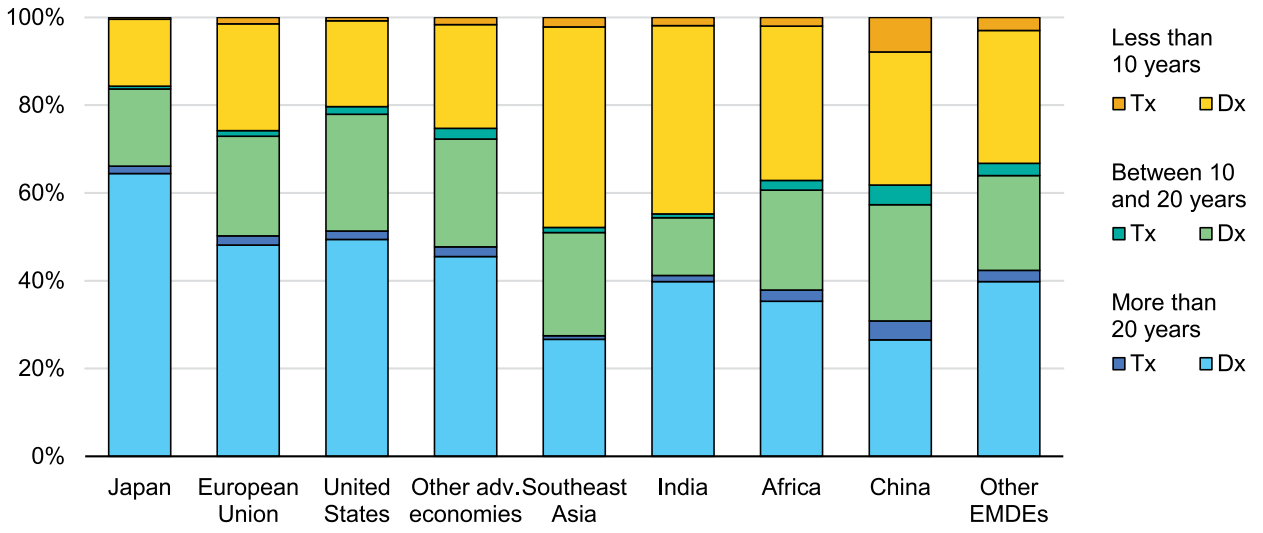
The case for more investment

According to the IEA's "Electricity Grids and Secure Energy Transitions" report, only 23% of distribution grid infrastructure in the United States is less than 10 years old, while more than 50% is more than 20 years old – in many cases, more than 50 years old. That reality led the agency to state: "There is a growing need to modernize this aging infrastructure to enhance efficiency and reliability and accommodate new energy resources."

	PG&E	SDG&E	SCE	PacifiCorp
2022 Total SAIDI (including Major Event Day)	*283.9*	*70.39*	*131.13*	*1037.1*
D SAIDI	240.6	69.48	129.98	608.7
D SAIDI %	**84.7%**	**98.7%**	**99.1%**	**58.7%**
T SAIDI	43.2	0.9	1.15	428.4
T SAIDI %	**15.2%**	**1.3%**	**0.9%**	**41.3%**
2022 Total SAIDI (excluding Major Event Day)	*213.5*	*70.39*	*101.03*	*126.41*
D SAIDI	184.5	69.48	100.29	96.7
D SAIDI %	**86.4%**	**98.7%**	**99.3%**	**76.5%**
T SAIDI	28.9	0.9	0.74	29.7
T SAIDI %	**13.5%**	**1.3%**	**0.7%**	**23.5%**

Source: California Public Utilities Commission.

Share of grid length by age by country/region, 2021



Notes: Tx = transmission lines; Dx = distribution lines, adv. = advanced.
Sources: IEA analysis based on Global Transmission.

Source: "Electricity Grids and Secure Energy Transitions", IEA, 2023

Despite utilities' steady efforts to improve distribution grid planning and performance, investments in that portion of the grid appear to be falling short of what is needed nationwide.

In a recent report, the American Action Forum estimated that preparing the U.S. grid for the coming wave of distributed solar PV adoption and EVs will cost nearly $1 trillion by 2035. That means utilities may need to spend upward of $61 billion annually through 2035 to prepare their distribution grids for solar PV and EVs. According to the report, utilities have been spending closer to $30 billion per year in recent years.

Many assume that massive electric power system investments approved in the Bipartisan Infrastructure Law (BIL) and Inflation Reduction Act (IRA) will end the underinvestment in the distribution grid. While those funds do more to move the needle, they still fall short. In the BIL-funded $3.5 billion first round of Grid Resilience and Innovation Partnerships (GRIP) Program grants announced by the U.S. Department of Energy in October 2023, only 50% was allocated to distribution improvement projects, with 50% to transmission projects.

Yet, in an era in which more than 90% of U.S. power interruptions happen on the distribution grid, a 50-50 funding split of modernization funds does not correspond to the need for a more resilient electrical grid.

Distribution grid underinvestment has a significant cost to society. The IEA reports that electric grid-related outages in the United States in 2021 had a $54 billion economic impact, most of which occurred on the distribution grid. →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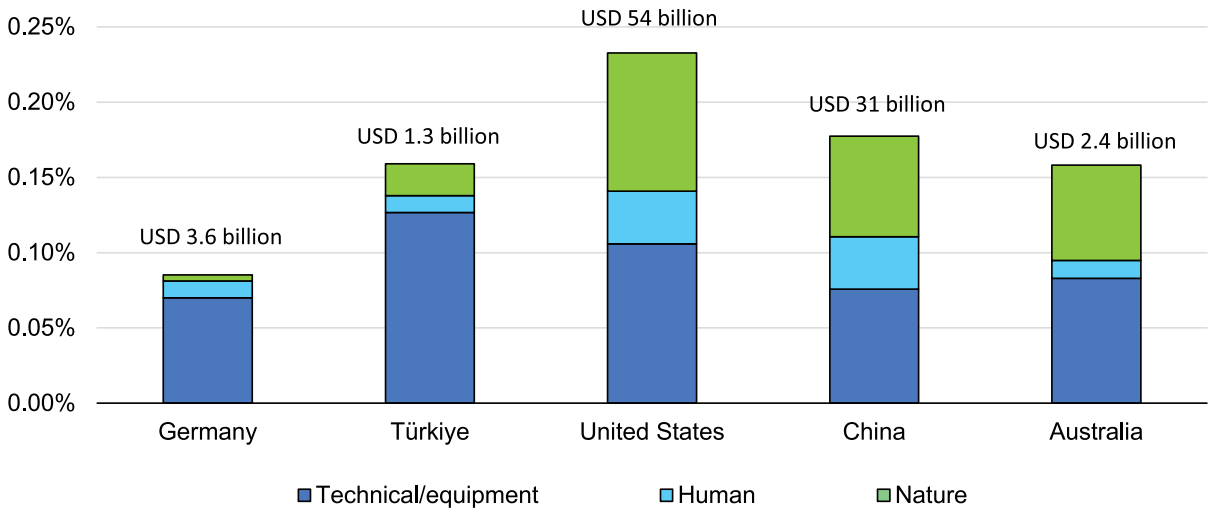
Estimated economic impact of grid-related outages by cause as a share of GDP in selected countries, 2021



Note: The reasons for outages can be grouped into three main categories: technical failures due to equipment, outages caused by human interference, and outages due to uncontrollable nature-related factors such as weather, animals, trees and natural catastrophes.

Sources: IEA analysis based on.Bundesnetzagentur (2021), Electricity Metrics; Epiaş Seffaflık Platformu (2021), Failure Information; Department of Energy (2021), Annual Summaries; Power Reliability Management and Project Quality Supervision Center, National Energy Administration (2022), 2021 National Electric Power Reliability Annual Report; AusGrid (2021), Past Outage Data; World Bank (2021), Value lost due to electrical outages (% of sales for affected firms).

Source: "Electricity Grids and Secure Energy Transitions," IEA, 2023

The case for better preparedness

Extreme weather is causing more power outages in the United States. Electrification is rising through the mass adoption of electric vehicles (EVs) and electrified building appliances, such as air source heat pumps and hot water heaters. Tax incentives in the IRA are boosting an already steady increase (due to conducive cost-driving adoption over the past decade) in large-scale wind and solar and DERs such as rooftop solar and battery energy storage systems. All those factors – extreme weather, electrification, intermittent renewables and DERs – put pressure on the distribution grid. They also necessitate a shift from an electric grid designed to serve power in one direction, from large, centralized power stations to one designed for distributed power generation and multidirectional power flow with more complex and less controllable supply and demand shifts.

Given the shifting reality, a status-quo approach to investment will leave the distribution grid unprepared for the future – prone to decreasing reliability, lacking resilience and trapping clean energy DER investments that can't connect and contribute to the clean energy future.

The IEA reports that grids are the element of the power system that is most vulnerable to climate impacts and the leading cause of climate-driven outages in many countries. At a local level, EVs are experiencing rapid growth, yet countless local segments of the distribution grid are at risk of failure if too many EVs start plugging in before upgrades are made.

The IEA also says the electric grid has become a bottleneck for transitioning to net-zero emissions, with 3,000 GW of renewable power projects stuck in grid connection queues globally. The IEA points to an unprepared distribution grid as a major cause. "To meet national climate targets, grid investment needs to nearly double by 2030 to over $600 billion per year after over a decade of stagnation at the global level, with emphasis on digitalizing and modernizing distribution grids," the IEA wrote. →

Changing the narrative

Experts agree that investment in the distribution grid must double annually globally and in the United States. For utilities facing myriad demands and pressure from customers and regulators to limit rate increases, proposing such a steep increase in spending can seem daunting.

But doubling spending is not the only answer. Utilities, state regulators and other distribution grid stakeholders can work together to pursue a multipronged strategy to optimize grid performance, investment and preparedness to achieve a reliable, active distribution grid needed for a clean energy future.

There are several tactics all utilities should consider developing to execute a successful, multipronged distribution grid planning strategy.

- **Focus on grid hardware:** The recent increased focus on distribution grid investment has drawn attention to digitalization efforts, such as the increased adoption and maturing of Advanced Distribution Management Systems. While these investments are undoubtedly an important piece of the puzzle, they should not overshadow the need for investments in distribution grid hardware.

When a storm hits, software cannot keep the system online or return it to service without capable actuators in the grid. More modern devices installed on the distribution grid allow the system to survive the storm and limit economic impacts on communities. When a highway truck stop wants to install the EV charging infrastructure to enable electrified long-haul trucking, which could spike peak power demand at the site from kWs to MWs, only hardware additions can prepare the grid to serve this new kind of load.

Realizing the vision for a reliable, clean energy future will require grid hardware. Ensuring no-regret investments in grid modernization will require improved distribution grid planning practices and tools, where the capability of innovative grid hardware is accurately reflected.

- **Communicate benefits:** Utility customers want to be able to plug in EVs, replace gas heaters with electric heat pumps and benefit from DERs. As they do so, electricity will become more important to their lives. Utilities should implement a communications plan that clarifies the link between distribution grid investments and achieving customers' desired future. To better communicate with regulators, utilities can update their metrics to reflect the full

reality of distribution grid performance. SAIDI, excluding major events, has been a key metric used by utilities and regulators for years. It tells a story about grid performance on blue sky days, but major events such as extreme storms are the new normal. Metrics that reflect the reality of decreasing reliability in the face of extreme weather can help regulators and policymakers understand the value of distribution grid spending, especially when coupled with data showing the negative economic impacts of outages on communities.

- **Continue to innovate:** Meeting the challenges of the future requires innovative technology that will help modernize distribution grids. Fortunately, much of this technology exists today and has been repeatedly proven to improve grid resilience and reliability. Utilities must be willing to invest in these proven technologies. In addition, utilities can pursue alternative means of funding, such as federal grant programs, to limit the cost to customers and advocate with policymakers for new funding programs that would best move the needle.
- **Advocate for a national standard on distribution grid resilience:** Industry stakeholders can join by using their collective voice to push for a federal standard for resilience. The standard could be as simple as measuring SAIDI and SAIFI, including storm days. This baseline requirement would set a minimum level of resilience that must be achieved in any part of the grid and allow flexibility to address different challenges in various parts of the country. A national resilience standard would focus on enhancing the grid and spur technology investment throughout the grid and down to the grid's edge.

The distribution grid can be the best supporting actor in the clean energy future

Increasing extreme weather, electrification of different sectors, intermittent renewable energy and DERs are all putting pressure on distribution grid performance, while simultaneously, the distribution grid is becoming more important to the economy (*e.g.* connecting clean power generation to the grid) and the average citizen's life (*e.g.* electricity is critical for connectivity, comfort, safety). At this moment, when the distribution grid is being asked to enable a clean energy future, it needs help to thrive amid those disruptive changes. The case for improved performance, more investment and better preparedness is clear.

Despite the above, much discussion and action remains focused on investments in transmission and renewable energy infrastructure. Utilities and grid stakeholders know the focus should be on the distribution grid. It is time to change the narrative and take a more aggressive approach to distribution grid investments so it can be ready for its role as the best supporting actor in the future of clean energy.

ABOUT THE AUTHOR:

Ernst Scholtz is S&C Electric Company's chief technology officer. He leads the company's Technology and Breakthrough Innovation (TBI) team, which focuses on technology-led innovations, knowledge creation and prototyping of future offerings. Before joining S&C, Scholtz spent 20 years at Hitachi Energy, formerly ABB, first as a scientist, then leading the corporate research organization. Scholtz is originally from South Africa and received a BEng and MEng from the University of Pretoria in South Africa. He relocated to the U.S. in 1999 to pursue his PhD in electrical engineering at the Massachusetts Institute of Technology.

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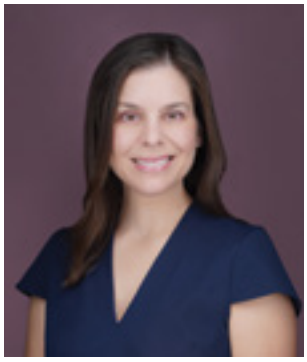

For our final Powherful Forces column of 2024, we are featuring Jennifer Sabetti, regional president, Trench & Metals for OldCastle Infrastructure. Here, Sabetti talks about her work in the power industry, what trends we should keep an eye on and where she thinks the industry is headed over the next five years.

Working in energy

As president overseeing the Trench and Metals business for OldCastle, I have full P&L ownership. Most of my team's products fall in the energy space; although some are also used in rail and communication projects, such as data centers. Everything we create is designed to connect communities and enhance the way the world operates.

When I first explored working at OldCastle Infrastructure, I was excited about the opportunity to lead in the organization's product manufacturing, but what truly captivated me was OldCastle's purpose. I feel fortunate to be part of an organization whose products are foundational to our everyday lives. Each day presents a learning opportunity as our team collaborates to find the best solutions for our customers through our expanding product portfolio, leveraging innovation to ensure our products work seamlessly together.

Initiatives in progress

I'm particularly excited about several projects that align with our commitment to sustainability and innovation. We are actively working on eco-friendly initiatives that encompass our entire operations, from manufacturing to daily practices. This involves revising our manufacturing processes to prioritize sustainable materials and methods, which is crucial in meeting the growing demand for environmentally responsible solutions.

Additionally, we're integrating new products and expanding our lines of business, which will enhance our existing offerings. The introduction of additional metal products is particularly exciting, as it allows us to create customized solutions tailored to our customers' unique needs.

Lastly, I'm eager to showcase the capabilities of our larger Infrastructure Products Group (IPG). This initiative aims to deliver more robust and comprehensive solutions, ultimately providing greater value to our customers and reinforcing our commitment to innovation in the industry.

Industry headwinds

Looking five years into the future, I believe the electric energy sector will face several significant challenges. First, with over 55,000 substations in North America, the need for maintenance and infrastructure upgrades is critical. Aging infrastructure requires urgent attention to ensure reliability and safety for both customers and communities.

Second, the unexpected surge in demand from data centers and electric vehicle (EV) charging stations is placing additional strain on existing, and in some cases, aging systems. This increase in load necessitates aggressive investment in technology to optimize the management of current substations while also expanding capacity to accommodate new facilities.

Overall, the dual challenges for energy utilities to maintain aging infrastructure and meet the rising energy demands will require strategic planning and substantial investment in the coming years.

Addressing challenges for a reliable grid

To effectively address these challenges, utilities and industry partners should prioritize automation and proactive maintenance of existing infrastructure to enhance grid reliability.

At the substation and data center levels, investing in essential trenching solutions can help protect and maintain the communications cabling necessary for automation, ensuring seamless operations. Additionally, implementing firewalls is crucial for fire containment in data centers, as even a single incident can result in substantial financial losses. Similar measures at substations will safeguard critical, hard-to-source transformers.

Recognizing the heightened infrastructure challenges at substations, we should leverage innovative modular solutions designed to contain live cables without disruption. This approach not only enhances safety but also streamlines maintenance processes, ultimately supporting the reliability and efficiency of the electrical grid.

Preparing for the future

Even though transformer lead times have reduced in the past year, the scarcity is concerning and it affects substation operations far and wide. Companies like the one I work for have the opportunity to help our customers prevent the spread of fire across multiple transformers in substations and also prevent intrusion and ballistic incursions which can damage and disable the entire site.

Additionally, we know that the added pressure from EV charging and AI on the grid cannot be discounted. We're seeing more and more data centers and battery electric storage sites come up across the country to support these pressures and we're poised to help our customers with everything from cable management to fire and security walls for separation and containment, along with vaults and enclosures for communication and power lines.

Finally, we're also tracking the twin demands for safety and sustainability. These calls to innovate on materials that not only reduce environmental impact but also enhance safety across the entire lifecycle.

Beyond the industry: Empowering tomorrow's leaders

What I like most about my work is the emphasis on talent development and diversity. I have the opportunity to build and collaborate with an incredible team, hiring people from across the country. The strong support from leadership empowers us to cultivate future leaders within the organization.

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ABOUT JENNIFER SABETTI

Jennifer Sabetti is the regional president, Trench & Metals, Oldcastle Infrastructure. Before joining Oldcastle Infrastructure, Sabetti spent three years at Siemens, where she developed and directed actionable strategies to win new customers and expand relationships with existing customers. Before that, Sabetti honed her skills for a decade at Honeywell, where she was general manager and directed the Honeywell Building Technologies (HBT) breakthrough innovation pipeline program. She received her BA from the University of Minnesota Morris and her MLIS from St. Catherine University.

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www.emspec.com

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www.ramtech-corp.com

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www.marmonutility.com

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SWITCHES - PADMOUNTED

G&W ELECTRIC CO.
Tel: 708-388-5010
www.gwelec.com

S&C ELECTRIC COMPANY
Tel: 773-338-1000
www.sandc.com

SWITCHES - REGULATOR, BYPASS

EMSPEC INC.
TEL: 450-430-5522
www.emspec.com

S&C ELECTRIC COMPANY
Tel: 773-338-1000
www.sandc.com

SWITCHES - SUBMERSIBLE

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Tel: 708-388-5010
www.gwelec.com

S&C ELECTRIC COMPANY
Tel: 773-338-1000
www.sandc.com

SWITCHES - SUBSTATION, DISCONNECTING

ABB INSTALLATION PRODUCTS
Tel: 1-800-326-5282
www.tnb.abb.com

ABB INSTALLATION PRODUCTS (CANADA)
Tel: 1-905-635-7855
www.tnb.ca.abb.com

EMSPEC INC.
TEL: 450-430-5522
www.emspec.com

MINDCORE TECHNOLOGIES
Tel: 450-477-5959
www.mindcoretech.com

S&C ELECTRIC COMPANY
Tel: 773-338-1000
www.sandc.com

SOUTHERN STATES, LLC
Tel: 770-946-4562
www.southernstatesllc.com

SWITCHES - THROWOVER, AUTOMATIC

ABB INSTALLATION PRODUCTS
Tel: 1-800-326-5282
www.tnb.abb.com

ABB INSTALLATION PRODUCTS (CANADA)
Tel: 1-905-635-7855
www.tnb.ca.abb.com

SWITCHES - TRANSMISSION DISCONNECT AND LOAD BREAK

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www.southernstatesllc.com

SWITCHES - VACUUM

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TEL: 450-430-5522
www.emspec.com

G&W ELECTRIC CO.
Tel: 708-388-5010
www.gwelec.com

SWITCHGEAR - ARC RESISTANT - MEDIUM VOLTAGE

G&W ELECTRIC CO.
Tel: 708-388-5010
www.gwelec.com

S&C ELECTRIC COMPANY
Tel: 773-338-1000
www.sandc.com

SWITCHGEAR - MEDIUM VOLTAGE RANGE UP TO 44 KV

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www.tnb.abb.com

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Tel: 773-338-1000
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SWITCHGEAR - METAL ENCLOSED

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Tel: 773-338-1000
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SWITCHGEAR - SF6

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Tel: 708-388-5010
www.gwelec.com

S&C ELECTRIC COMPANY
Tel: 773-338-1000
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Tel: 708-388-5010
www.gwelec.com

SYSTEMS INTEGRATOR

RAMTECH SOFTWARE SOLUTIONS, INC.
Tel: 651-342-1780
www.ramtech-corp.com

S&C ELECTRIC COMPANY
Tel: 773-338-1000
www.sandc.com

SISCO, INC.
Tel: 586-254-0020
www.sisconet.com

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TAGS

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www.almetek.com

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ALMETEK INDUSTRIES, INC.
Tel: 800-248-2080
www.almetek.com

TECH PRODUCTS, INC.
Tel: 718-442-4900 | 1-800-221-1311
www.techproducts.com

TAPE - UNDERGROUND MARKING

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Tel: 800-248-2080
www.almetek.com

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RTDS TECHNOLOGIES, INC.
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www.rtds.com

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VON CORPORATION
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www.voncorp.com

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VON CORPORATION
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www.hfgp.com

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HASTINGS FIBER GLASS PRODUCTS, INC.
Tel: 269-945-9541
www.hfgp.com

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www.voncorp.com

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www.doble.com

TEST EQUIPMENT - RELAY

DOBLE ENGINEERING COMPANY
Tel: 617-926-4900
www.doble.com

RTDS TECHNOLOGIES, INC.
Tel: 204-989-9700
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TEST EQUIPMENT - SLEEVE, RUBBER

VON CORPORATION
Tel: 205-788-2437
www.voncorp.com

TEST EQUIPMENT - TRANSFORMERS

DOBLE ENGINEERING COMPANY
Tel: 617-926-4900
www.doble.com

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DOBLE ENGINEERING COMPANY
Tel: 617-926-4900
www.doble.com

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RTDS TECHNOLOGIES, INC.
Tel: 204-989-9700
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TESTING - TRANSFORMERS, LIQUID

DOBLE ENGINEERING COMPANY
Tel: 617-926-4900
www.doble.com

TESTING SERVICES

KEMA LABS
Tel: 215-822-4200
www.cesi.it/labs/chalfont/

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Tel: 204-989-9700
www.rtds.com

S&C ELECTRIC COMPANY
Tel: 773-338-1000
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TESTING SERVICES - ELECTRICAL

KEMA LABS
Tel: 215-822-4200
www.cesi.it/labs/chalfont/

KINECTRICS INC.
Tel: 416-207-6000
www.kinectrics.com

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Tel: 773-338-1000
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TESTING SERVICES - OIL

DOBLE ENGINEERING COMPANY
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www.valmontutility.com

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DYNAMIC RATINGS, INC.
Tel: 262-746-1230
www.dynamicratings.com

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ALBARRIE GEOCOMPOSITES LIMITED
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