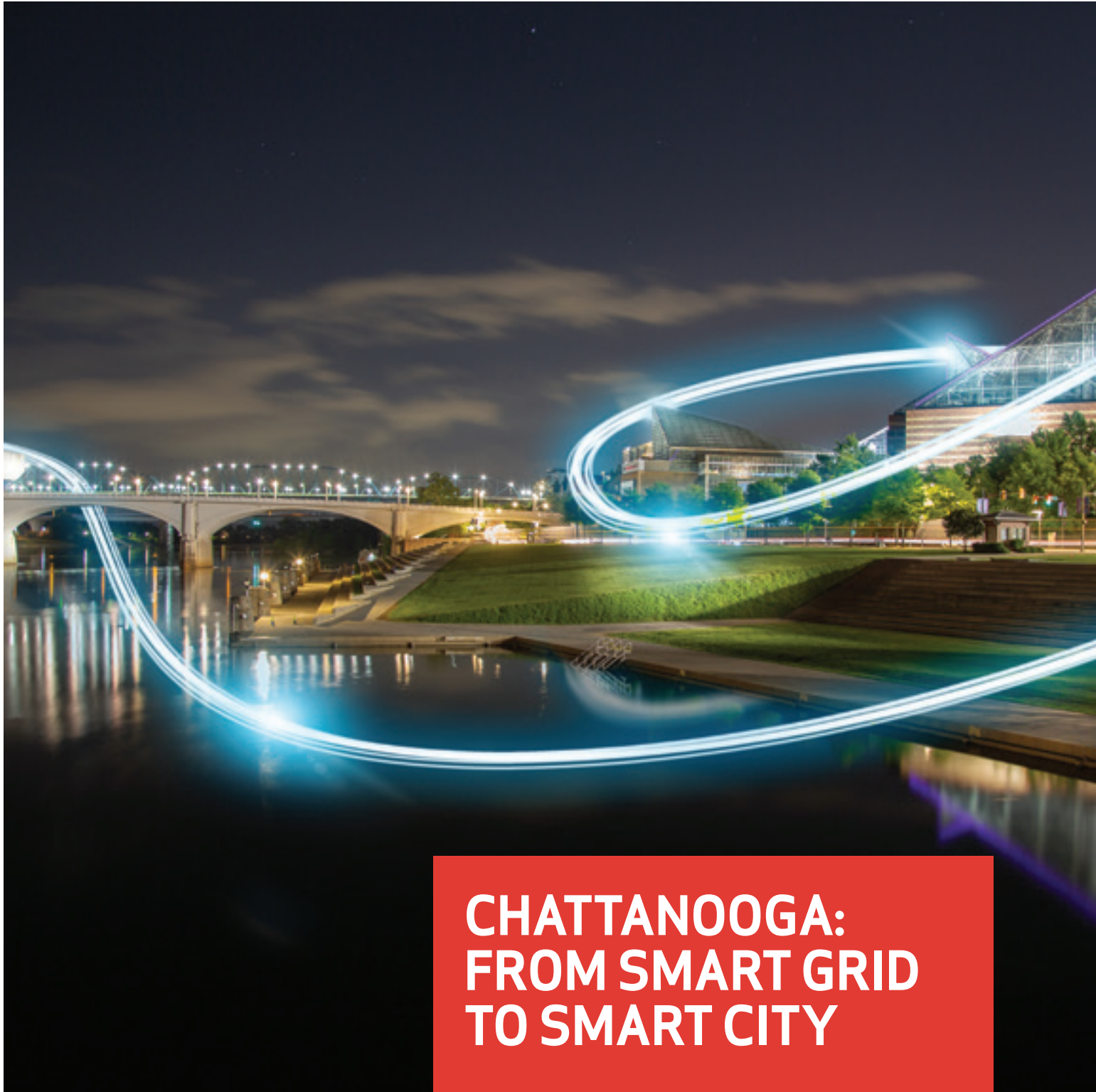


EET&D MAGAZINE

Quarterly Issue 1, 2021 – Volume 24



**CHATTANOOGA:
FROM SMART GRID
TO SMART CITY**



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THE BIGGER PICTURE

WORLDWIDE UTILITIES 2021 PREDICTIONS

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Around the world, 2020 was not an easy year for electricity, gas and water companies. Nevertheless, the industry has demonstrated resilience and has not stopped its ongoing transformation journey. For the next five years, utilities will have to accelerate the reinvention of their core businesses while deploying new business models to get new revenue streams.

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Although she wasn't sure which area of science she was going to pursue, Melissa Carmine-Zajac knew from the time she was in elementary school that she was going to be a scientist. She also says it was a series of happy accidents that led her to the work she does today for Doble.



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ELECTRIC ENERGY MAGAZINE IS PUBLISHED 4 TIMES A YEAR BY:

JAGUAR EXPO INC

PO Box 50514, Carrefour-Pelletier, Brossard, QC Canada J4X 2V7

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DISCOVER HOW TRANSMISSION INVESTMENTS CAN PAVE THE WAY TO A CARBON-NEUTRAL FUTURE

To reduce the nation's carbon footprint and meet greenhouse gas (GHG) emission goals, utilities will not only need to increase their reliance on large-scale, carbon-free energy sources, but will also need to develop a robust transmission network to get the energy from where it is generated to where it is needed in a reliable and economic way. Discover strategies for the planning and implementation of large-scale transmission projects to help utilities and grid operators more effectively integrate renewable energy sources, reduce GHG emissions and achieve their sustainability goals.

Learn more by downloading our free whitepaper at
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XCEL ENERGY PROPOSES MAJOR TRANSMISSION SYSTEM EXPANSION TO ENABLE 80% RENEWABLE GENERATION FOR COLORADO CUSTOMERS

Estimated \$1.7 billion investment in rural Colorado unlocks 5,500 megawatts of renewable resource potential

March 2021

Xcel Energy-Colorado, along with its energy partners in the state, today (March 2) announced Colorado's Power Pathway - a proposal to significantly upgrade Colorado's high-voltage transmission system to bring more renewable energy onto the grid, improve the reliability and flexibility of the electricity system, and provide economic and clean energy development opportunities.

This \$1.7 billion proposal supports the company's Clean Energy Plan, announced Feb. 24, that will add 5,500 megawatts of new generation, primarily renewables, to the Xcel Energy-Colorado system and deliver by 2030 an estimated 85% reduction in carbon dioxide emissions from 2005 levels. The Clean Energy Plan will reduce carbon emissions by amounts greater than required by the Paris Climate Agreement, and deliver electricity derived from more than 80% renewable sources to customers while maintaining affordable and reliable energy service. This transmission investment will also enable us to better integrate all available resources to help ensure a resilient electric system and help utilities maintain low-cost, reliable energy service even in extreme weather conditions.



“Investments in our transmission systems increase grid capacity, strengthen reliability, help us continue our clean energy transition and provide the best possible service for our customers and local communities,” said Alice Jackson, president, Xcel Energy-Colorado. “This new transmission line will support our vision to reduce carbon emissions and deliver 100% carbon-free energy by 2050 and will result in much-needed economic and generation development in the region.”

85%
REDUCTION
IN CARBON DIOXIDE
EMISSIONS

The proposed 560-mile, 345-kilovolt transmission line will include five new segments to connect the Front Range to areas of north central, eastern and southern Colorado. These rural counties are rich with renewable energy resource development potential, but do not currently have a network transmission system that can integrate new resources needed to meet the state's clean energy goals. This series of projects will drive significant economic development, and provide good-paying jobs, tax revenues and investment in Colorado's rural plains for years to come. The increased use of renewable energy will also significantly drive down our use of both natural gas and coal, which diversifies our energy sources and reduces exposure to changing fuel prices. →

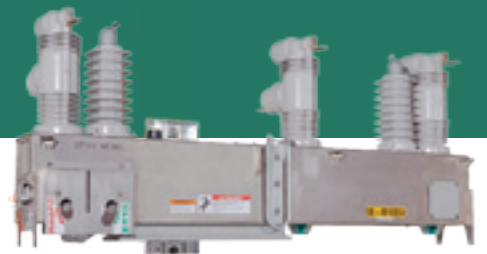
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To make this transmission line a reality, Xcel Energy is working with energy partners across the state whose plans support the access to low-cost renewable energy in Colorado to achieve our carbon-reduction goals.

\$1.7 BILLION

“Utility partnerships deliver the benefits of a more robust transmission system at lower costs to consumers,” said Duane Highley, CEO of Tri-State Generation and Transmission Association. “For Tri-State and our members, the benefits of a joint project include greater reliability and more capacity to deliver power across our interstate transmission system, while providing the ability to connect the additional renewable resources needed to achieve our clean energy and emissions reduction goals while driving investment in the rural communities we serve.”

“We appreciate Xcel Energy and their collaborative approach to building a transmission system that will benefit consumers in Colorado as we collectively transition our energy portfolios,” said Jason Frisbie, general manager and CEO of Platte River Power Authority.

“This collaborative approach to building major transmission projects will help shape Colorado’s energy future,” said Colorado Springs Utilities CEO Aram Benyamin. “Partnering with other utilities across the state allows us to keep costs low, enhance system reliability and support renewable energy growth.”

“The Colorado Power Pathway project is an exciting opportunity for Black Hills Energy and utilities across the state to deliver more, cost-effective renewable energy options for customers,” said Vance Crocker, Black Hills Energy’s vice president of Colorado operations. “This potential partnership represents a thoughtful and innovative approach to advancing our state’s clean energy objectives.”

The Colorado Public Utilities Commission will review the proposal to determine whether it is necessary and in the public interest as a first step toward development. Decisions on routes, sites and other factors will be made later in this process.

Tri-State Generation and Transmission Association is working to reach an agreement on its participation in the proposed project, which would benefit its member distribution systems and advance the clean energy goals in Tri-State’s Responsible Energy Plan. With an agreement, Tri-State would make a related filing with the Colorado Public Utilities Commission with the next 45 days.

If approved, construction of the transmission line is estimated to begin in 2023, with the first segments of the line potentially in-service by 2025, followed by other segments in 2026 and 2027.



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CPUC PROPOSAL WOULD CONTINUE EFFORTS TO HELP ENSURE GRID RELIABILITY THIS SUMMER

March 2021

The California Public Utilities Commission (CPUC), in ongoing efforts to ensure safe and reliable electric service to Californians, today (March 5) issued a proposal that would require utilities to implement a suite of programs to decrease energy demand and increase energy supply during critical hours of the day to ensure reliability in the case of an extreme heat event in the summers of 2021 and 2022.

Today's proposal is the most recent action in a proceeding the CPUC opened in November 2020 in response to the mid-August 2020 extreme heat event that required the California Independent System Operator (CAISO) to initiate rotating power outages to prevent sustained, widespread service interruptions. To ensure grid reliability this summer, the CPUC is proposing the following new initiatives and enhancements to existing programs:

- **New Demand Response Programs:** Demand-side resources, such as demand response, are a critical element of the CPUC's plan to ensure reliability. To lower energy demand during the peak and net peak usage hours during a grid emergency, the CPUC is proposing Pacific Gas and Electric Company (PG&E), Southern California Edison (SCE), and San Diego Gas & Electric (SDG&E) pilot an Emergency Load Reduction Program, which would give demand response providers, and other companies providing new services to manage electricity demand, the ability to demonstrate how their innovative programs can support the grid. The pilot program would compensate customers for voluntarily reducing demand on the power system when called upon to do so by the CAISO in the event of a grid emergency. This program would serve as a layer of insurance on top of existing resource adequacy plans and would give grid operators a new tool among the existing demand management programs to address unexpected power system conditions.



- **Improved Rate Plans to Encourage Conservation:** The proposal would also require utilities to modify their Critical Peak Pricing programs, which charge a higher price for electricity consumption during peak hours on selected days. The proposal orders several modifications to the Critical Peak Pricing programs to ensure the program is more effective and responsive to the critical hours of a grid emergency, including shifting the Critical Peak Pricing event window for residential and non-residential customers to the hours of 4 p.m. to 9 p.m., increasing the maximum number of Critical Peak Pricing events allowed per year, and providing customer education with a focus on increasing participation.
- **Improving Existing Demand Response Programs:** The proposal also makes modifications to existing demand response programs to expand participation, including temporarily allowing year-round enrollment in utility "interruptible programs" that allow for industrial and large commercial customers to pay a lower rate in exchange for allowing the utility to curtail their energy usage when energy demand is high and the reliability of the electric grid is threatened. The proposal would also increase demand response program enrollment incentives to attract new customers, as well as allow SDG&E to expand and enhance its AC Saver program by allowing residential net energy metering customers to enroll, as well as incentivizing smart thermostat manufacturers to increase the number of participating thermostats. →



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- **Flex Alert:** The proposal would reinstate the Flex Alert paid media program to educate consumers about the positive impacts of conservation, help customers understand grid conditions, and inform customers of the need to conserve when energy demand is high.
- **Increasing Overall Procurement Requirements for the Utilities:** To help ensure enough electricity resources are available to serve customers during times of peak and net peak energy use, the proposal would direct utilities to procure a minimum of an additional 2.5 percent of resources for all customers in their territories, representing an effective increase of the planning reserve margin from the existing 15 percent to 17.5 percent. This change would result in minimum demand- and supply-side resource targets for this summer of 450 megawatts (MW) for PG&E, 450 MW for SCE, and 100 MW for SDG&E. For supply-side resources, the proposal orders utilities to give preference to storage contracts and upgrades in the efficiency of existing generation resources, and for contract terms that are shorter in duration.

This proceeding follows other actions the CPUC has taken to ensure utilities can reliably serve customers, including:

- In November 2019 the CPUC ordered utilities to procure 3,300 megawatts of new, non-emitting electricity resources, and make 10-year, long-term investments in new in-state generation that maintains reliability and keeps California on its present trajectory toward meeting its greenhouse gas emissions reduction targets.
- In August 2020, the CPUC approved seven clean energy contracts for PG&E to meet its 2021 Integrated Resource Plan incremental procurement requirements of 716.9 MW of resource adequacy capacity, at least 50 percent of which must come online by August 1, 2021. To ensure reliability for customers of SCE, the CPUC authorized the procurement of 770 MW of energy storage to satisfy the procurement requirements ordered by the CPUC in its Integrated Resource Plan proceeding.



- In February 2021, the CPUC ordered utilities to immediately contract for energy resources that can be online in time to serve peak and net peak demand this summer. The Decision focused on utility procurement of new generation resources, setting up today's proposal that is focused mainly on increasing the amount of "demand-side resources."

8,000 MEGAWATTS

These actions along with other orders from the CPUC will result in more than 8,000 MW of new clean energy resources being developed over the next three years.

In mid-August 2020, the western U.S. experienced an unprecedented, prolonged heat wave that ultimately required the CAISO to initiate rotating power outages to prevent sustained, wide-spread service interruptions. On January 13, 2021, the CPUC, CAISO, and California Energy Commission issued a final Root Cause Analysis on the August rotating outages, which outlined short-term and longer-term actions to mitigate electricity shortages and ensure delivery of clean, reliable, and affordable energy. Among the recommended actions is expediting the regulatory and procurement processes to develop additional resources that can be online by 2021 and ensuring that the generation and storage projects that are currently under construction in California are completed by their targeted online dates.



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GOVERNMENT INVESTING TO ELECTRIFY TRANSIT SYSTEMS ACROSS THE COUNTRY

March 2021

The Government of Canada is working to secure the health and safety of Canadians, rebuild businesses, and promote jobs and growth as we build toward economic recovery and a net-zero emissions future.

Better public transit helps people get around in faster, cleaner, and cheaper ways. Helping communities invest in zero-emission transit options ensures cleaner air for our kids, creates jobs and supports Canadian manufacturing.

On March 4, Infrastructure and Communities Minister Catherine McKenna and the Minister of Innovation, Science and Industry François-Philippe Champagne announced \$2.75 billion in funding over five years, starting in 2021, to enhance public transit systems and switch them to cleaner electrical power, including supporting the purchase of zero-emission public transit and school buses. This funding is part of an eight year, \$14.9 billion public transit investment recently outlined by Prime Minister Justin Trudeau, and will also support municipalities, transit authorities and school boards with transition planning, increase ambition on the electrification of transit systems, and deliver on the government's commitment to help purchase 5,000 zero-emission buses over the next five years.

This investment will create more well paying jobs in Canada's robust and growing electric vehicle manufacturing sector. Nova Bus in Saint-Eustache, Lion Electrique in Saint-Jérôme, GreenPower in Vancouver and New Flyer in Winnipeg are great examples of innovative companies that have been delivering zero-emission transit solutions.

Infrastructure Canada will ensure coordination between this investment and the Canada Infrastructure Bank commitment to invest \$1.5 billion in zero-emission buses and associated infrastructure as part of its three year Growth Plan.

To date, Infrastructure Canada's funding programs have already supported the purchase of over 300 new zero-emission buses, and we expect this trend to accelerate. Today's announcement is another step forward for smart public transit funding that delivers triple bottom line results: jobs and economic growth, a cleaner environment, and more inclusive communities. Canada has global leaders in clean technology and supply chains, and public transit investments will help promote confidence in a scalable and stable domestic market.

QUOTES

"Better public transit, cleaner air, quieter streets, and a planet safe for our kids - that's the goal of our investment in zero-emission buses across Canada. By making this investment, we're tackling climate change while creating good jobs and supporting manufacturing right now, here at home. Canada's infrastructure plan invests in thousands of projects, creates jobs across the country, and builds cleaner, more inclusive communities."

– The Honourable Catherine McKenna,
Minister of Infrastructure and Communities

"Ensuring that Canadians have access to clean transportation options like zero-emission public transit is an important part of our plan to create cleaner, healthier communities. Today's announcement will create manufacturing jobs and support the economy, while cutting pollution across the country."

– The Honourable Jonathan Wilkinson,
Minister of Environment and Climate Change

"Today's announcement is important to help make Canada a leader in zero-emission vehicle transportation. The Government is committed to ensuring that Canadian businesses have the tools, support and conditions to become world leaders in a growing economic sector. With this investment, the government is helping these Canadian manufacturers address a growing need here at home to successfully pivot to new, greener products."

– The Honourable François-Philippe Champagne,
Minister of Innovation, Science and Industry

"We welcome this Government of Canada funding announcement that will help cities and transit authorities across Canada transition to cleaner and more sustainable transit. From our local perspective, we are rolling out four electric buses on our roadways this fall as part of a pilot project. Today's funding opportunity announcement allows our staff to explore how we can speed up the electrification of the OC Transpo fleet. This would further support our Climate Change Master Plan objectives of reducing Ottawa's carbon footprint and greenhouse gas emissions."

– Jim Watson, Mayor of Ottawa



“As part of its \$10 billion Growth Plan, the Canada Infrastructure Bank (CIB) is committed to investing \$1.5 billion in zero-emission buses. We will help create jobs, reduce greenhouse gases and make commutes cleaner. This will contribute to quality of life in communities. Today's announcement of new government funding complements the CIB's innovative financing and accelerates the opportunity for municipalities to collaborate with us and to switch to zero-emission buses.”

– Ehren Cory, CEO, Canada Infrastructure Bank

“Today's investment by the federal government will allow transit agencies across the country to expedite the decarbonization of our transit systems to meet Canada's ambitious climate goals. Zero-emission buses (ZEBs) will benefit Canadians by creating manufacturing and energy jobs in the low-carbon economy, while also transporting Canadians in a way that is safe, green, healthy and sustainable. Transit agencies and municipalities in Canada are ready for electrification, and the funds announced today will empower them to move forward towards the goal of 5000 ZEBs.”

– Dr. Josipa Petrunic, President and CEO, Canadian Urban Transit Research & Innovation Consortium

QUICK FACTS

- Since 2015, the Government of Canada has approved \$13.6 billion in funding towards more than 1,300 public transit projects across Canada. These investments have helped build more than 240 km of new public transit subway and light rail line, create over 380 km of active transportation trails, bike and pedestrian lanes, and already supported the purchase of over 300 zero emission buses.
- The Canada Infrastructure Bank has a long-term target to invest \$5 billion in public transit, including \$1.5 billion over the next three years specifically for zero emission buses and associated infrastructure as part of its Growth Plan.
- On February 10, the Prime Minister announced \$14.9 billion in new public transit funding over eight years. Of this, the \$2.75 billion investment in zero-emission buses announced today will be allocated over the next 5 years starting in 2021.
- In the Fall Economic Statement, the Government of Canada proposed to support the economy's clean and competitive transition by providing grants to help Canadians make their homes greener and more energy efficient. It will provide additional funds for the installation of new charging and refueling stations for zero-emission vehicles and provide more support for large-scale clean power transmission projects.
- The Strategic Innovation Fund - Net Zero Accelerator will drive essential, near-term greenhouse gas reductions to ensure Canada exceeds its 2030 target. It will create and maintain immediate, good-paying, middle class jobs to support Canada's economic recovery; bolster innovation and encourage the development of disruptive technologies in all industrial sectors, including the automotive manufacturing sector, to ensure Canadian businesses stay competitive in a global economy that increasingly demands low-carbon products.

NOT QUITE THERE



ELISABETH MONAGHAN
Editor in Chief

Most of the articles we've published in the past few issues of *EET&D* have focused on the pandemic. In this issue, only about half of our contributors write about recovering from the impact of COVID-19 or how to ensure we are prepared for the next major event that could negatively impact the power grid. Chances are, we will be talking about the pandemic for years to come, but with each passing month, utilities and energy consumers are getting a better grip on our current reality.

The Bigger Picture section of this issue features an article by Roberta Bigliani with IDC in which she shares the top four of 10 predictions she and her fellow Energy Insights analysts compiled for 2021. In her article, Bigliani talks about shifts that are happening now and will continue to happen as a result of the pandemic and refers to the "next normal," as life post-pandemic.

Over the years, I've heard several references to the "new normal," but the "next normal" is a term I came across only recently. Curious when that term became a part of people's vernacular, I did a quick internet search and discovered that McKinsey & Company coined the term last spring as a way to talk about life post-pandemic.

As challenging as the COVID-19 outbreak has been, our industry seems to have reached a phase where those who invested time and money into infrastructure and innovative technology are reaping the benefits of their proactivity.

In their "*Green Ovations*" article titled "2020: One Star. Would Not Recommend," Prasenjit Shil, Ph.D. with Ameren and Mike Smith with SAS report that despite the disruption the COVID pandemic has caused, we are seeing more silver linings around difficult situations, showing that all is not lost. Rather than expecting readers simply to take their word for it, Shil and Smith address how the electric energy's resiliency has paved the way for a number of positive outcomes. An example of their hopeful outlook is this passage: "Every bit of good news that is helping keep people alive and economies afloat all have the underpinning of an energy infrastructure that did not fail to accomplish its mission through operating conditions that seem like they were dreamed up by a creative movie producer in Hollywood" As proof, the authors list examples of rapid responses to the pandemic that have kept utilities running, while safeguarding assets, crews and customers.

As I wrote in my introduction, utility companies have a reason to be hopeful at this stage of the pandemic, but it will require utilities and industry partners to embrace the next phase with foresight and planning, an innovative approach to building, updating or maintaining infrastructure and a sizeable budget that can support investing in more efficient operations.

For this issue's *Grid Transformation Forum* column, we spoke with David Wade, president and CEO of EPB, the electric power distribution and telecommunications company owned by the City of Chattanooga, TN. Recently, EPB has received several accolades for infrastructure projects like their community-wide fiber optic network and the smart grid they began building in 2008.

In our discussion with Wade, he explains that with Chattanooga's fiber optic network in place, EPB was able to respond quickly when the pandemic resulted in schools switching to online teaching. EPB worked with Hamilton County Schools and other state and local partners to launch HCS EdConnect, a fiber optic broadband internet service. Not only has that fiber optic network made it possible for students to attend classes remotely, but the internet service is provided free of charge to the homes of economically challenged families with K-12 students.

In 2014, the U.S. Department of Energy designated Chattanooga's smart grid as a living laboratory. Since then, EPB has partnered with Oak Ridge National Laboratory and other national organizations to test new energy technologies.

While Wade talks about how the Chattanooga community will continue to benefit from EPB's foresight, he also offers lessons-learned to prepare other utilities working or embarking on similar projects.

IDC's Bigliani suggests that as we move towards a post-pandemic reality, "utilities' executives will have to continue balancing resiliency and reinvention, keeping their hands in the present and eyes on the future." EPB demonstrates what balancing resiliency and reinvention looks like, and why such an approach is worth the investment of time, money and human resources.

It may not be until the pandemic is long behind us that we can appreciate the resourcefulness and resilience of our industry. It certainly will take a while to feel our lives are back on track, but today, we can work towards whatever the "next normal" might be and acknowledge that regardless of scale, any progress is good enough, at least for now.

Note: As the *EET&D* editorial staff is finalizing this issue, Texans are facing the aftermath of a brutal winter storm. While there is much finger-pointing over whose fault it is, many are working to get basic supplies to the people of Texas. The causes of and responses to the ERCOT grid's weaknesses are likely to be studied for years to come, and I imagine some of our industry partners will offer their insights into recovery and prevention going forward. My hope is we also will see even greater examples of just how resilient and resourceful the electric energy community is. For now, we are keeping the people of Texas and all of the rest of those around the globe experiencing extreme weather in our thoughts.

If you would like to contribute an article or if you have an idea about interesting technology, solutions, or suggestions, please email me at:

Elisabeth@ElectricEnergyOnline.com

Elisabeth

CHATTANOOGA: FROM SMART GRID TO SMART CITY



Amid the ongoing pandemic, electric energy providers around the world have spent nearly a year assessing their policies and business practices. While some utility companies have discovered they will have to overhaul their operations, several have benefitted from investing in technology and innovations they put in place before COVID-19 entered the scene. One of those utilities is EPB, formerly EPB of Chattanooga. Recently, the electric power distribution and telecommunications company owned by the City of Chattanooga has experienced some impressive “wins” for the company, its employees and its customers.

We wanted to kick off our Q1 issue by spotlighting EPB and the excellent work they are doing. Following is our discussion with EPB President and CEO David Wade.

EET&D: A recent study shows Chattanooga’s community-wide fiber optic network and smart grid produced \$2.69 billion in community benefit during the first 10 years since EPB built it. What kind of infrastructure has EPB deployed and why?

DW: We started with the idea of deploying an advanced, highly automated, self-healing smart grid distribution system. As a municipal utility with a mission to enhance the quality of life for the people of the Chattanooga area, we knew that this kind of smart infrastructure would yield tremendous benefits for the people we serve. Of course, one of the first decisions we had to make was how to provide a communications network for the smart switches and other automated smart grid equipment we planned to deploy across our system. The problem with most network technologies is that they become obsolete very quickly, and in many cases, upgrading the network means starting over from scratch.

That’s what sets fiber optics apart. Since nothing is faster than the speed of light, a fiber optic network is a lasting asset. Once the fiber optic lines are in place, you can improve the speed and capacity of the whole network by upgrading the optical signaling equipment to the latest technology, and that’s much more cost-effective than replacing everything.

Once we began to focus on building a fiber optic network as the communications backbone for the smart grid we envisioned, we realized we would still have ample capacity for launching fiber optic internet, telephone and TV services.

Starting in 2008, EPB began building a comprehensive community-wide fiber optic network accessible by all of the 170,000+ homes and businesses in our 600-square mile service area. The result is a Gigabit Passive Optical Network that utilizes a backbone of fully-redundant rings, each having multiple 100 Gbps links and more than 9,000 miles of fiber optic lines.

That allowed us to launch America’s first Gig-speed internet service in 2009.

Next, we built out Chattanooga’s smart grid. Today, we have more than 200,000 smart devices deployed across the system including more than 1,200 IntelliRupter™ smart switches, smart meters on every premise, and a variety of sensors and other devices. We’ve also installed a number of cutting-edge technologies that we’re testing through our partnership with Oak Ridge National Laboratories and other national researchers. →





EET&D: How has Chattanooga's Smart City infrastructure created additional benefit for the community?

DW: As you mentioned, according to a recent study by Dr. Bento Lobo of the University of Tennessee at Chattanooga, the Chattanooga area saw \$2.69 billion in community benefit during the first 10 years after the fiber optic deployment. The study documents a range of positive results including a dramatic reduction in power outages, increased business growth, decreased environmental impact and significant enhancements to the support we provide for innovation and education.

One of the efforts that gives us the most pride at EPB is our work to bridge the digital divide for education. At the outset of the COVID crisis, when schools closed, we knew we had to do something to ensure that every student could continue their education remotely. In the initial weeks of the crisis, we deployed more than 130 free outdoor WiFi hotspots specifically targeted to provide support for the parts of our community where the families of many students don't have internet access, but we knew that wasn't enough.

Having Chattanooga's fiber optic network in place allowed EPB to join with Hamilton County Schools and other

local and state partners in launching HCS EdConnect, a fiber optic broadband internet service provided at no charge to the homes of economically challenged families with K-12 students. Through the program, students gain access to a 100 Mbps internet service with no data caps and symmetrical upload and download speeds. We also provide a router and assistance setting up their learning devices—all at no charge to their family. HCS EdConnect is at least four times faster than typical educational support internet options, and it offers ample speed and capacity for video-based learning and other bandwidth-intensive learning applications. Better still, families keep the service year-round. That means it's available to all members of the family, so HCS EdConnect can also provide support for job searches, remote work, telehealth and more.

Although the COVID crisis sparked this project, HCS EdConnect is designed to provide continuous access to all eligible students for at least 10 years. As a result, the project represents a lasting solution for bridging the digital divide among students, and we have plans to raise the funding needed to continue the effort permanently. Currently, more than 12,000 students have internet access to continue their studies from home through HCS EdConnect.

EET&D: What has the Chattanooga's Smart City infrastructure meant for business growth?

DW: Dr. Lobo's study shows how the fiber optic infrastructure directly supported the creation and retention of 9,516 jobs which is about 40 percent of all jobs created in Hamilton County during the study period.

In particular, Chattanooga's gig-network has been a boon for start-ups and innovation. Since the build-out, local entrepreneurs have raised \$1.2 billion in equity investment and crowdfunding with the study attributing \$244 million of that investment to support from the fiber optic infrastructure. Additionally, information from Kickstarter shows that Chattanooga has produced about 10 percent of the site's crowd funded projects during the study period, a higher percentage than any other Southeastern city.

EET&D: Has Chattanooga's Smart City infrastructure made a difference during the COVID pandemic?

DW: - It's made a huge difference. You may have seen that Zillow named Chattanooga the "Best Metro for Remote Work" in large part because of our community-wide fiber optic network.

As the COVID crisis began, we started working with local companies to increase their bandwidth, add call paths, and provide other connectivity solutions to help them transition to remote work. Because Chattanooga's fiber optic network was in place, we were able to increase the capacity of these services without having to roll trucks in many cases. As just one example, we were able to increase one company from a 1-Gig circuit to a 3-Gig circuit within hours of receiving their call.

According to Dr. Lobo's study, Chattanooga's fiber optic network has helped to keep Chattanooga's unemployment rate lower during normal times, and this effect has been magnified since the outset of the COVID crisis. According to the latest available numbers from the U.S. Bureau of Labor Statistics, Hamilton County's unemployment rate was 4.7 percent in November which is significantly lower than Tennessee's rate (5.3 percent) and two percentage points lower than the U.S. unemployment rate (6.7 percent) for the same period.

What's that look like on the network side? As national stories swirled about the possibility that the COVID crisis would "break the internet" and YouTube and other video providers actually reduced the resolution of their content in some markets, EPB's fiber optic network has proven more than equal to the challenge of transitioning to remote work, online education, and telehealth.

In comparing a typical pre-COVID day (March 4, 2020) to a typical COVID day (December 14, 2020), EPB has seen a 75 percent increase in the total volume of Internet Bandwidth Usage over the course of the day. In a very real sense, many companies (and schools) have "outsourced" the traffic that once flowed across their internal networks (and conference tables) to Chattanooga's community-wide internet.

EET&D: What kind of operational benefits have you seen from Chattanooga's smart grid and fiber optic network?

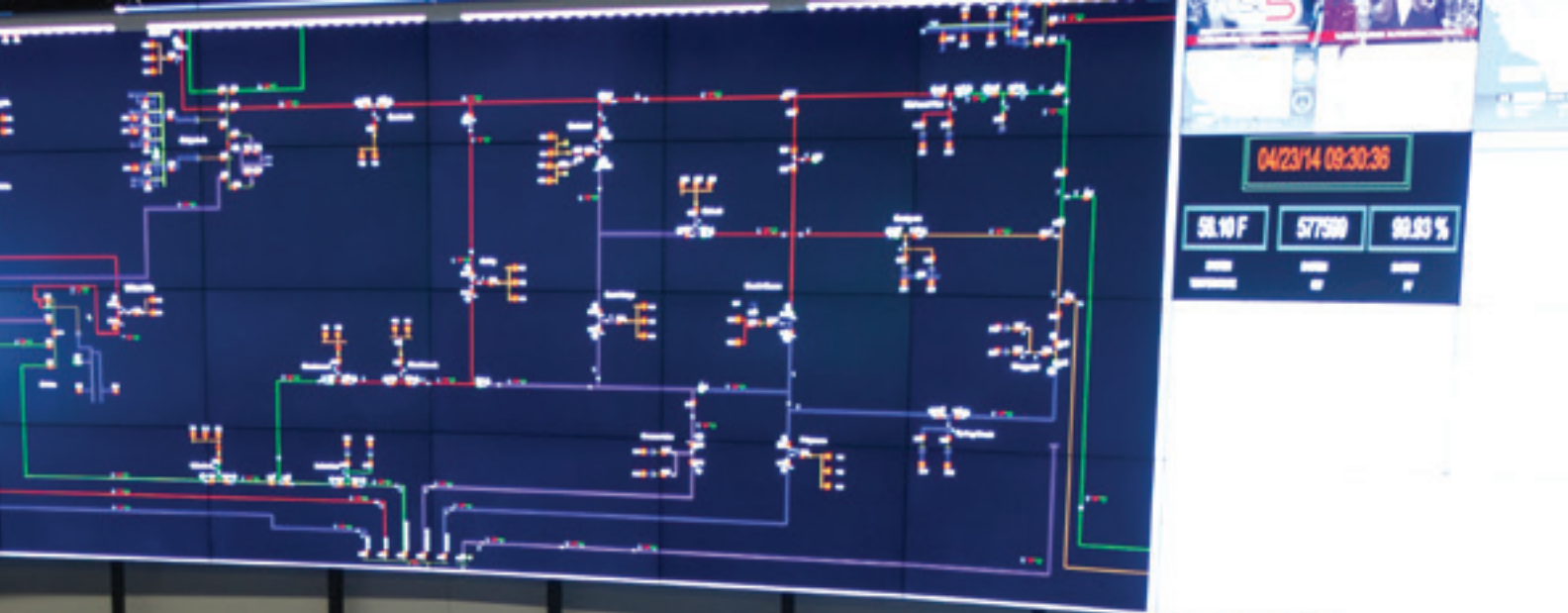
DW: The smart grid can detect faults almost instantaneously and re-route power around problems to minimize the number of people who experience an outage. That allows us to cut the number and duration of lasting outages by as much as 40- to 55 percent over any given year. As a result, people who would have been without power for hours or even days, instead see a momentary flicker of their lights as the smart grid automatically re-routes power to them in less than a second. Through remote operation of Chattanooga's Smart Grid from our control center, we can restore many more people while our line crews go to the damage to complete the necessary physical repairs.

When a devastating tornado and high winds swept through our community last year, the smart grid prevented about 44,000 households from experiencing an outage that would have lasted days. That allowed us to focus our restoration efforts on all of the other customers who remained without power so we could get them back on more quickly too.

Preventing outages saves our customers about \$26.6 million each year in terms of avoiding lost productivity, spoilage, and more according to Dr. Lobo's recent study.

We've also seen reduced environmental impact and operational savings because we no longer have to send trucks out to read meters. Instead, we get data from every meter in the system every 15 minutes. This also allows us to provide customers with real-time usage data and alert them to unusual spikes in their consumption. We often find that when we provide this information to customers, they realize they have a malfunction in their heat pump or other issue that they can address right away. Without this process in place, customers might not realize there is a problem until they get their energy bill.

Chattanooga's Smart Grid also allows us to help manage peak demand, monitor equipment that displays unusual patterns that often indicate an opportunity to do proactive maintenance before something fails, and much more. →



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EET&D: Are there any lessons learned you can pass on to other utilities?

DW: Definitely. First, I would say that constructing a comprehensive fiber optic network that is accessible to every home and business, without regard to income, creates a lasting community asset that can be used both for smart infrastructure projects and enhancing internet access. When considering a community-based deployment to address a lack of access, don't forget about smart grid and other smart city applications because they create a tremendous value-add. Working with the City of Chattanooga, Hamilton County, the University of Tennessee at Chattanooga, and other community-based organizations, we've been able to draw more than \$111 million in smart city research to Chattanooga. From reducing traffic accidents and testing automated vehicle technologies to building micro-grids that can automatically scale themselves larger or smaller in response to environmental conditions. We've also created a test-bed for research using quantum encryption to protect smart infrastructure. These are just a few of the many examples of how EPB is working with local and national partners to solve real-world challenges for our community that will also provide a model for other communities.

Of course, deploying a fiber optic network and launching new services entails all of the complications and challenges one would expect from a large-scale project, but EPB has developed a proven business model along with a range of services to make it easier for other communities to deploy. More information is available at epb.com/broadbandsolutions.

ABOUT DAVID WADE:

In 2016, **David Wade** was named president and CEO of EPB of Chattanooga after serving in various roles at the company for 30 years. His contributions range from hands-on construction in his early career to engineering and executive leadership roles. While serving as EPB's executive vice president and chief operating officer, Wade led EPB's deployment of one of the country's most sophisticated smart electric distribution systems and a community-wide 100 percent fiber optic network. As a result, EPB was the first in the nation to launch a ubiquitously available 1,000 Mbps internet service, earning Chattanooga its designation as "Gig City." Wade is a board member (and recent chairman) of Tennessee Valley Public Power Association (TVPPA). He also serves on the U.S. Department of Energy's Electricity Advisory Board.

2020: ONE STAR.
WOULD NOT
RECOMMEND
BUT THE UTILITY INDUSTRY
PROVIDED A SILVER LINING
TO THIS VERY DARK CLOUD





PRASENJIT SHIL AND MIKE SMITH

2020. If we all knew in advance what the year would have looked like we all might have canceled the entire year from our calendar. As of this writing, Covid-19 continues to dominate the news cycle and garner global attention we all try to navigate the pandemic. The World Bank reports that the global economy is down by more than 5 percent. Life, as we knew it, seems to have taken a very long pause.

But not all is dire news. We have seen resiliency in people, systems and culture. We have seen humanity rise to meet the challenges time and time again. And while it is pretty weird, we have been able to watch sports and listen to live music in new ways that were unimaginable just a few months ago...piped in crowd noise for football and baseball games? Of course! Drive-in concerts? Well, why not? →



One of the points of light of resiliency has been the utility industry. Every bit of good news that is helping keep people alive and economies afloat all have the underpinning of an energy infrastructure that did not fail to accomplish its mission through operating conditions that seem like they were dreamed up by a creative movie producer in Hollywood. Here are some examples of positive stories related to our industry:

- One utility that we spoke with created two completely separate control centers in a matter of days at the outbreak of the pandemic, the goal being, to keep staff working in “pods,” where contact with others could be controlled.
- A utility’s credit and collection function had to be re-worked to account for large segments of their customer base losing their jobs. The trick here was, not only did the utility demonstrate flexibility for customers facing hardship but also in designing programs that enabled customers to recover while keeping the utility solvent.

- Utilities also had to rethink how to manage work crews working in the field during a pandemic. Interacting with other crews and customers could be perceived as being a form of “super spreader” events.

Nowhere have utilities had to innovate processes more than in the forecasting functions. With traditional fundamentals of the load forecasting suddenly becoming stale, due to the pandemic and restrictions mandated by the local authorities, utility leaders had to learn how they could still have some predictability to their load forecasts. Too many misses for too many time periods would cost the utility millions of dollars in an environment that is already financially constrained.

At Ameren, the load forecasting and analysis group also had to change the fundamentals of the load analysis process. Explaining the impact of COVID-19 on sales was as challenging as forecasting for the balance of the year or next year. Traditional statistical models were augmented by a mix of weekly unemployment rate, Google



Businesses and governments continue to show resiliency and creativity in holding their economies together while taking on the challenges of the pandemic.



mobility indices, and COVID-19 infection rate in the service territory were consulted to determine the impact of COVID on sales and margin. Additionally, the forecasting group developed projections for COVID-19 infection rate which, in conjunction with traditional variables, were used in forecasting sales for the upcoming months.

Changes made in the traditional models helped Ameren improve its reporting of sales for financial closing. For example, inclusion of Google mobility indices and COVID-19 variables in statistical models improved overall estimates by as much as approximately 5 percent for certain months in 2020. Such a difference in overall estimates could have incorrectly translated into misleading class-level reported sales in the financial books. This is because class-level regression models built using the traditional method only include load trends, seasonality and weather information as driver variables, but sales during the COVID-19 era are also driven by factors such as mandates by local authorities, and office closure, etc. Inclusion of these newer information sources in the models helps in better financial reporting.

With 2020 behind us, there is reason for optimism. Vaccine deliveries were in place by the end of the year with upwards of 100 million vaccines planned by the end of March 2021 in the U.S. alone. Businesses and governments continue to show resiliency and creativity in holding their economies together while taking on the challenges of the pandemic. And utilities have kept the lights on while continuing to deliver reliable, safe, affordable, and sustainable electricity through conditions that were unimaginable just a few months ago. Here's to 2021!

ABOUT THE AUTHORS:

Mike Smith is an industry principal at SAS Institute. He is a 30-year veteran of the utility industry, having started as an analyst covering SCADA systems in 1990, and then leading numerous industry initiatives including founding the “smart grid” market’s first dedicated publication in 1995 and co-founding the Utility Analytics Institute in 2012. He is a graduate of San Jose State University (BA, economics) and is a veteran of the U.S. Army (Captain, Infantry). He can be reached at he can be reached at mikef.smith@sas.com.

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ADVANCEMENTS IN DISTRIBUTION GRID MONITORING ENABLE IMPROVED VOLTAGE CONTROL FOR UTILITIES

UTILITIES FACE INCREASED VOLTAGE VOLATILITY FROM DISTRIBUTED RENEWABLES-BASED POWER GENERATION

CONRAD OAKEY

The power distribution grid is undergoing unprecedented levels of change. The traditional one-way model of voltage regulation presumed voltages dropping predictably along feeders, from substation to customers. However, the proliferation of larger-scale Distributed Energy Resources (DER) along feeders is rendering traditional models and regulation techniques incapable of maintaining delivered voltages within ANSI C84.1 guidelines.

This proliferation is spurring new approaches in grid measurement, monitoring and control that provide real-time measurements, enabling Distribution Management applications to better manage voltages and maintain high power quality.

Voltage fluctuation from DER

The traditional power delivery model pushes electricity from a centralized power generation plant through distribution feeders to the point of consumption. Power is consumed along the line with utilities using tap changers, voltage regulators

and capacitor banks to regulate voltage to ensure delivery remains within an ANSI guideline range of ± 5 percent, all the way to the end of the line. Historically, the key concern was ensuring voltages did not fall below or above these standards.

Enter DER, electricity-producing resources or controllable loads that are connected to a local distribution system. DER can include solar panels, wind turbines, battery storage, generators and electric vehicles.

These points of power generation inject power along the distribution feeder, which may increase or decrease voltage levels outside ANSI guidelines. In other words, increasing integration of renewables means variable load and generation fluctuations which work against the constant voltage profile model.

In addition, solar and wind DER are, by nature, intermittent. Managing unpredictable intermittency without measurement, monitoring and control is even more difficult and may result in oscillatory voltages in the system. Voltage rises at injection points may also create reverse systemic power flow. →



As a result, utilities require more advanced power monitoring and control systems that can precisely and quickly measure voltage to enable their Distribution Management Systems (DMS) to respond and regulate the voltage on their feeder lines. But this means DER integration needs real-time data to implement their control strategies.

The issue goes beyond simply burnt toast in a home. What we are concerned about with unpredictable voltage delivery is the disruption of service to household, commercial and industrial customers all along the feeder, including damage to motors and equipment and interruption of service.

More precise monitoring and control

The challenge of effectively controlling unpredictable, variable and potentially bi-directional voltage flow starts with measurement. The only way to control this kind of variability is to have measurements along distribution feeder lines that are accurate and that can communicate data to control systems fast enough to modulate the voltage and keep it under control. Essentially – in real-time.

Voltage delivery monitoring and control can be the domain of DMS. These systems have evolved over the years with advanced DMS models now in play that use Volt/Var optimization (VVO) where capacitor banks, voltage regulators and solid-state systems are switched on and off to maintain acceptable levels of power factor and voltage. More recently, Distributed Energy Resource Management Systems (DERMS) have emerged in response to the increasing amount of renewables-based distributed energy resources. These are complex control systems for monitoring and controlling sources of energy.

DERMS require accurate, real-time measurement of voltages, loads, reactive power, fault data and even weather data. A key consideration has been how to design and install these monitoring systems in a way that is cost-effective for utilities. This has called into question the traditional approach of grid monitoring with conventional magnetic current transformer (CT) and potential transformer (PT). The installed cost of CTs and PTs is expensive and time-consuming, plus the feeder must be powered down for their installation.





An alternative lower-cost approach is to employ low voltage (0-10V ac) sensor technology for all voltage and current measurements. These sensors are safe, accurate for all required measurements and can be installed without taking an outage.

Three raw voltages and currents can be wired to a Distribution Grid Monitor (DGM), a pole-top measurement system and dozens of useful measurements made including voltages to better than .5 percent, loads, power factor, real and reactive power. An ANSI 51 overcurrent element enables reporting of fault pickup and peak fault currents. All these measurements are reported to DMS and DERMS through DNP3 over radio.

Initial DGM deployment at a New England utility drove further DGM enhancements. This includes new measurements for 'Normalized Voltage' to accommodate sensor readings instead of PTs and CTs, additional surge suppression and "safety shields" to prevent tampering of cable connectors. This major project was driven by a utility commission mandate to accurately measure and report end-of-line voltages.

Given that the trends indicate DER integration will increase significantly each year, so too will the need to maintain voltages, power factor and frequency within desired limits. New grid measurement and monitoring technologies are essential to keep these factors under control.



ABOUT THE AUTHOR:

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

TRAINING OPERATORS FOR THE FUTURE – WHAT’S THE BIG DEAL?

WES LOSH AND JILL RUSSELL

Understanding the primary role of distribution operators has been consistent for a long time: That role is to "dynamically make decisions that support keeping the lights on and safely protecting the crew and the public." The how of what distribution operators do, however, is a different story.

Constant enhancement of technology, tools and techniques has simultaneously helped operators do their jobs and made their jobs more complicated.

Why should we reshape operator training?

Keeping control room operators aligned with industry innovations is critical. Continual changes in electric networks, control room technologies and associated work processes make the need for updated and ongoing training content and methods inevitable. It is not sufficient to onboard new controllers and assume they are ready for the present and the future. A control room operator team with the right knowledge and skills is a good and necessary foundation. Still, ongoing training is required to keep your controllers up-to-date and to hire and retain the best resources.

Where have we been?

Electric companies have been keeping the lights on in one way or another since the late 1800s. Over time, the distribution operator's role has become more complicated as electrical generation, transmission and distribution have become increasingly widespread and complex.

In the last several decades, the distribution operator's focus has been primarily on reacting to the electrical distribution system and answering the following questions:

- How do you prioritize and manage the distribution system for planned and unplanned work?
- What is the cause of an outage?
- When does a situation require switching?
- Where does the field personnel need to go, and what do they need to do?

Experienced distribution operators can answer those questions and have significant skills for providing fairly stable electrical power to customers – whether using paper-based maps of the past, the more recent electronic boards or today's complex computer systems. Operator training typically involves sitting next to an experienced operator and learning the role over time, frequently for several years. Operator tasks have broadened to include, but are not limited to:

- Operating supervisory control and data acquisition (SCADA) systems and devices.
- Responding to and managing SCADA alarms.
- Switching substation and field devices to isolate problems and re-route electricity.
- Restoring outages.
- Responding to emergencies. →





As electrical distribution systems become more sophisticated, electric utility companies purchase advanced distribution management systems (ADMS) to handle the increased complexity. Areas of growing complexity include distributed generation (such as renewable energy sources: solar and wind) and novel industry technologies (such as smart meters and smart devices that continually relay information). These changes require operators to have investigative responsibilities, in addition to their operational duties. For example, knowledge of Fault Location Isolation and Service Restoration (FLISR) and Volt Var Optimization (VVo) and the ability to perform simulation studies in a duplicate training system are just a few of the new analytical expectations placed on operators.

Though these advanced technologies have been a part of transmission system management for a while, distribution operators rarely dealt with allocating energy resources or renewables coming onto the system. These ever-changing conditions result in shifting and increasing operator responsibilities, including enhanced duties, complex technical tasks, updated business processes and the need to continually learn new knowledge and skill competencies.

What makes a successful operator?

Current-day operators need to incorporate their day-to-day control room activities with the new advanced tools and methods, combining electrical network knowledge with an enhanced understanding of ADMS. Consider the advanced applications that go beyond knowing how electrical devices and networks work, such as:

- Emergency voltage reduction
- Distribution system demand response
- Peak shaving
- Self-healing team devices and/or FLISR
- Power flow (load flow) results and management
- Load and voltage profile
- Volt VAr optimization

Structured on-the-job training (OJT), where a trainee sits and learns beside a seasoned operator, will continue to be an essential part of control room operations. It is best suited for general workflow and utility-specific control room processes. However, this training method is no longer enough to effectively and efficiently train an operator across the full set of required knowledge, skills and responsibilities.



Utilities need to staff operators who can handle day-to-day situations and those who can proactively manage complex conditions.



Where is operator training heading?

Utility companies realize that OJT only exposes trainees to things that happen on the desk. It does not provide enough depth and breadth of information and experiences for new operators to learn the full job or experienced operators to meet continuing education requirements.

Advanced systems include a network simulator environment, such as an Operator Training Simulator (OTS). Developing and providing training in a simulation environment supports the current training requirements and accommodates future distribution operator situations. Simulators help operators gain knowledge and perfect the skills required to manage the electric distribution system during real-time operations in normal and emergency conditions.

Training simulators provide experiences with various real-life scenarios, advanced switching orders and system emergencies. Knowledge from a seasoned operator can be made clear and transferred to trainees through well-developed simulator training activities that include scenarios based on operators' past experiences.

Not every operator has all of the knowledge and skills to handle all situations. Utilities need to staff operators who can handle day-to-day situations and those who can proactively manage complex conditions. A well-thought-out training program advances operator trainees from electrical basics through planned and emergency distribution operations and beyond – to the point of advanced technical knowledge, data analytics and associated decision-making skills. A control room that can sustain an ever-learning workforce through inevitable knowledge gaps (new hires and changing technologies) and knowledge loss (natural attrition) is nimble and better prepared to handle whatever comes along.

How can we continually improve performance?

Training new hires and quick progression to an acceptable competency level is a common concern. However, ongoing training of seasoned operators also can be challenging. Consider the following:

- Are your operators interested in new technologies and processes?
- Are they interested in training in general?
- Will they retain the knowledge learned in the training room and apply it back in the control room?
- Is your training system set up to handle technology changes?
- Do you have the means to provide on-the-job performance support (such as job aids and seasoned coaches)?
- Does your OJT program result in consistent, accurate and efficient training? →





“

Making mistakes in the simulator environment is worry-free. In fact, making mistakes can be very educational by highlighting what-if conditions and results.

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Current and future operators need to spend a significant amount of time in the training environment experiencing the pressure of responding to unexpected events. A common problem is a lack of training for unforeseen circumstances that catch an operator off-guard. It is challenging to train for those rare but crucial situations during OJT. Training simulators can recreate and replay many variations of these events through training scenarios.

It is important to remember that adults often learn best through trial and error, along with hands-on training. Making mistakes in the simulator environment is worry-free. In fact, making mistakes can be very educational by highlighting what-if conditions and results. Without a simulator, operators miss out on many valuable lessons learned that could negatively affect real-time operations, resulting in unexpected outages, damaged equipment or unsafe work practices – with possibly severe and dangerous consequences. The ability to review, adjust and repeat operational scenarios provides engaging and useful training and results in confident and experienced operators.

Using a training simulator often reduces new operator training time from years to months – with improved results. The reduced time to competency results in knowledgeable trainees available to fill shifts quicker. Post-training, structured OJT programs with high-quality and relevant support tools (e.g., job aids and references) provide consistent, well-coached situations. A broad-based training program also provides refresher training to sharpen and maintain critical skills for seasoned operators – lessening the loss of knowledge and skills for infrequent but critical operating conditions.

How has the pandemic affected operator training?

Hiring and training more than a few new operators or providing enhancement training for several experienced operators all at the same time is rare. Most utilities have staggered new hire training schedules based on staff attrition, control room staff growth, career growth opportunities and training progression. The typically small numbers of concurrent trainees are helpful when COVID-based restrictions, such as limited people in one room, spacing requirements and sanitation of shared training and work stations, are in place.

Training conceptual information is supported through a variety of training technologies, including presentations (which can be in person or virtual with online meetings and webinars) and self-study modes (such as computer/web-based training, reading and videos). These training methods can support learning concepts such as basic facts, ideas and rules without close contact between instructors and trainees.

More complex training goals, such as analysis, evaluation and creating new solutions, are better supported with more structured guidance and the ability to practice. Fortunately, many advanced training methodologies can be administered within the constraints of COVID-related restrictions. For example, structured OJT is typically a 1:1 mentor to student ratio supported by performance support systems and tools (e.g., job aids, checklists, online help, etc.). Training simulation systems are ideal for analysis and applying what-if scenarios while minimizing person-to-person contact. Many of these systems even allow an instructor to observe trainee interactions from a separate console. Immersion training, 3-D modeling, advanced virtual reality (VR) and enhanced reality (ER) systems take these simulations to the next level with realistic visuals and system responses to a trainee's actions. They also provide fantastic coaching opportunities for instructors.

Not every utility has the training support, timeline and budget for 100 percent simulation and immersion training. However, a broad range of training methods, from the simple to the advanced, and a willingness to think outside of the box for training solutions, can result in very effective training even with constraints such as COVID safety practices.

ABOUT THE AUTHORS:

Wes Losh is a grid operations industry expert with The Mosaic Company. His career includes 20+ years of extensive experience in distribution operation control centers at several major utilities. His experience and ability to problem solve and adapt to new systems led to expertise in developing and executing training and improving operations.



Jill Russell is a senior consultant with The Mosaic Company. Her career includes 30+ years of consulting within regulated industries and utilities. She has vast experience in training analysis and strategy and the design, development and delivery of advanced technical curricula and the corresponding change management.

TRANSMISSION INVESTMENTS CAN PAVE THE WAY TO CARBON-NEUTRAL ENERGY FUTURE IN THE U.S.

ANTHONY ALLARD

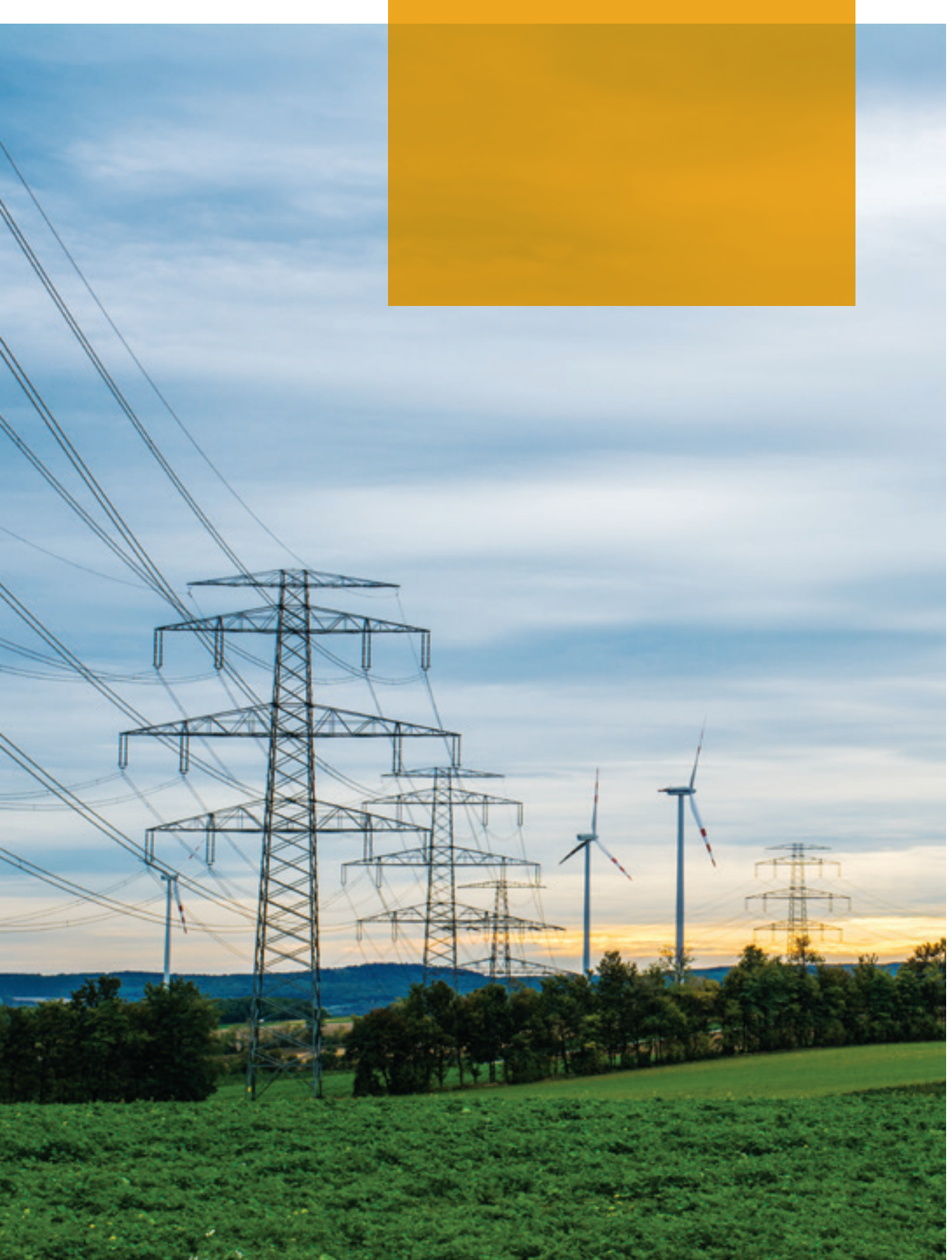
Many states in the U.S. have developed aggressive greenhouse gas (GHG) reduction goals as part of their efforts to combat climate change. Such goals typically involve commitments to reduce carbon emissions dramatically by 2050. Many power utilities have followed suit, implementing their own carbon emission reduction goals to conform with state mandates.

To achieve these goals, there needs to be a shift away from fossil fuels, toward more carbon-free energy generation, such as solar, wind and hydro. This needs to be coupled with the electrification of major sectors of the economy, most notably transportation – cars, trucks and other vehicles account for a significant portion of fossil-fuel consumption and associated carbon emissions.

As a result, demand for electricity is expected to increase dramatically over this same period. The National Renewable Energy Laboratory (NREL) has forecasted that the transition to EVs alone will lead to a 20 to 38 percent increase in electricity consumption by 2050.

The net impact of these changes is an increased load on the power grids, coupled with a simultaneous switch of 60 percent of our energy generation away from fossil fuels. As an industry, the power sector has made significant progress in the development of carbon-free energy resources. According to the U.S. Energy Information Administration, carbon-free generation such as nuclear, hydro, wind and solar currently deliver approximately 40 percent of generation in the United States. Equally as important, renewables, such as wind and solar, have become increasingly cost-competitive, comparing favorably with coal, natural gas and other fossil-fuel-based generation.

The point being, we have the technological know-how to replace the fossil-fuel generation sources that need to be retired over the next 30 years. However, today's transmission system cannot get the renewable energy from where it is generated to where it is needed reliably and economically. →



Location matters

There is a mismatch between the ideal locations for renewable energy generation (typically rural, sparsely populated areas), and the locations that have traditionally been served by the transmission grid (specifically coal, gas and nuclear plants in more populated areas).

The U.S. Energy Information Administration predicts that a vast majority of carbon-free energy generation will come from wind and solar. When it comes to wind power, nearly all of it is expected to come from large, utility-scale operations; however, most of the best wind sites are either offshore or in areas that have historically had few energy generation facilities, and typically lack transmission infrastructure.

This is particularly true when it comes to the development of offshore wind. Many states in the northeast already have plans to purchase the output of offshore wind projects. A study by a premier analytical resource for energy information has documented 27.5 GW of offshore wind projects planned along the Atlantic coast for completion by 2035. These projects alone will require a significant investment in the region's transmission systems, including new overhead or underground transmission lines, substations, undersea cables and monitoring equipment.

While we can expect to see continued development of smaller-scale, "rooftop" solar, most estimates still predict that two-thirds of future solar generation will be at utility-scale. It is easier to find suitable sites for large-scale solar installations than for wind projects, but the most favorable locations for solar development are still in remote, mostly rural areas that are not well served by transmission infrastructure.

This geographical misalignment is already quite evident. A study by the American Council on Renewable Resources (ACORE) found the 15 states between the Rocky Mountains and the Mississippi River account for 88 percent of the U.S.' wind potential and 56 percent of the country's utility-scale solar potential. However, in 2020, these states were home to only 30 percent of electricity demand. Moving energy generated in these areas is challenging for two primary reasons - local transmission network constraints, and the lack of a nationwide grid in the U.S. with capacity to move large amounts of power between regions.

Regional grids

The North American grid is in fact four separate, regional grids: The Western Interconnection, the Eastern Interconnection, TransÉnergie in Quebec and the Electric Reliability Council of Texas (ERCOT). These large grids lack the ability to efficiently transfer large amounts of energy between or across grids from areas with favorable conditions for renewable energy to major load centers.

A further complication is that wind and solar energy are produced at variable rates and times. These resources can be curtailed if there is surplus generation, but wind and solar are not considered dispatchable, since they are not available on demand. This limitation creates timing issues when balancing load and generation resources; the grid is not optimized to move power between regions or from one part of a region to another to help address timing issues.

The impacts of timing and location also lead to saturation effects, in which more wind or solar power is generated than is needed at a given time and goes to waste. Energy storage facilities and load shifting programs help with timing issues, but both are currently limited in terms of capacity and availability.

Also, increased use of wind and solar power reduces grid inertia, which is where energy stored in large rotating generators typically found in hydro, fossil fuel or nuclear power plants, but not present in wind and solar arrays. Reductions in grid inertia lead to faster decay in frequency when there is a loss of generation or a major transmission line.

Fortunately, there are still untapped opportunities to use hydro facilities to boost storage capacity. By expanding bi-directional transmission capacity between areas with major hydroelectric facilities and areas with large volumes of renewable generation capacity, excess wind and solar power can be exported to loads that would otherwise be served from hydroelectric facilities. Hydroelectric facilities can in turn reduce output and store energy behind dams, which can later be used to supply loads in the other direction when wind and solar conditions are less favorable.

Existing dams in Quebec, Newfoundland-Labrador, Manitoba and British Columbia provide some of the most efficient and largest installed storage resources in North America, capable of serving as a kind of massive, virtual battery for much of the region. This dynamic is already being played out in Europe, in the case of NordLink, for instance, where existing hydroelectric resources in Scandinavia are being linked to regions to the south that have ambitious wind and solar development plans such as Germany, the Netherlands and the United Kingdom.

Transmission planning

There currently is no overarching energy transmission plan for the United States, let alone North America. Today, each county, state, province and energy region have different infrastructure, capabilities, and prospects for carbon-free generation. Documenting and analyzing this information on a macro level would enable planners to develop a transmission system designed to address future requirements. For instance, comparing where existing

transmission resources exist against the locations where large-scale renewables can and will be produced can drive more effective development decisions. Failing to develop such a plan could instead result in a patchwork that recreates many of the transmission problems that we face today, such as intraregional bottlenecks.

There are efforts underway to address this planning gap, such as ACORE's Macro Grid Initiative, which aims to "connect centers of high renewable resources with centers of high electric demand, enhance grid resiliency and dramatically reduce carbon emissions." While ACORE suggests that a nationwide high-voltage direct current (HVDC) network is integral to improving the energy transmission system in the United States, there are other approaches that could be beneficial in the short term. For instance, an HVDC system that bridges the three 'seams' between energy regions in the U.S. could eliminate many of the choke points in the system.

Technology options

HVDC technology has emerged as a natural fit to address the need to move energy between regions. With an HVDC system, the power flow can be controlled rapidly and accurately with respect to both the power level and direction. This will also improve the performance and efficiency of the connected local AC networks and address the lack of synchronization between regional grids. As a bonus, such HVDC links can also help reduce the risk of uncontrolled propagation of faults in the case of a major disruption.

Another way of addressing many of the transmission capacity issues is to upgrade regional AC transmission systems with Flexible Alternating Current Transmission Systems (FACTS). FACTS are power-electronic based devices that can be integrated into existing AC systems. They increase the power transfer capability, stability, and control of the AC system with series and shunt compensation. FACTS devices such as Static Compensators (STATCOMs) and Series Capacitors are designed to help the grid maximize throughput while remaining stable through varying power flow conditions.

Making connections

Significant efforts have already been made to link renewable-rich areas with major load centers. Some wind-rich states have successfully initiated and developed projects linking solar and wind resources to their regional transmission networks. For instance, the Public Utility Commission of Texas (PUCT) created Competitive Renewable Energy Zones (CREZ) in 2008 to link the wind energy-rich West Texas with the high energy demand of East Texas. The project was completed in 2013 and has

enabled the development of 27.7 GW of carbon-free wind generation capacity.

In the Midwest, Midcontinent Independent System Operator's (MISO) developed the multi-value projects (MVP) program. The program includes 17 projects spanning 9 Midwestern states. The completed projects have already connected 28 GW of wind power to the grid.

Offshore wind

One largely untapped resource in the U.S. where we expect to see increased development is offshore wind. Offshore wind resources on the East Coast represent a tremendous opportunity, but also present unique locational challenges and require dedicated transmission investments.

One of the main challenges with offshore wind is connecting wind generation to the onshore grid and ensuring adequate transmission capacity onshore. There are two options when connecting offshore wind resources to an onshore grid: 'Gen-Ties' and offshore transmission grids. A Gen-Tie is a transmission link that directly connects the wind farm to the onshore grid. Offshore transmission grids, in contrast, offer a transmission network that can connect multiple wind farms to the mainland, allowing wind generation developers to focus on collector systems and links from their wind farm to the offshore transmission grid.

Offshore wind interconnection systems can utilize both AC and HVDC transmission lines from offshore wind sites to onshore terminals and substations, which in turn transfer the energy to the regional grid. For each offshore wind project, onshore grid capacity needs to be studied to determine if additional transmission investment is needed to avoid congestion when the offshore wind is interconnected.

Benefits and challenges

The development of large-scale, carbon-free energy generation comes with a cost. A study by the Brattle Group estimates that to meet state-level carbon-free generation goals, the U.S. will need to invest \$12 to \$16 billion annually in transmission until 2030. While this is a substantial public infrastructure investment, it would represent a great addition to any economic recovery package and could help offset negative impacts from the COVID-19 pandemic and the associated economic downturn. Not only does it offer direct economic stimulus; it can also lead to the creation of new jobs and generate long-term monetary savings.

When it comes to direct economic stimulus and job creation, transmission projects typically take upwards of 10 years to complete and supply high-quality, consistent employment. The massive scale of projects that need to be undertaken will lead to job creation in nearly every part of the country. →

Despite the benefits new transmission projects can offer in terms of facilitating the shift toward renewable energy, not all challenges related to electrical transmission can be solved with technology. In many cases, political dynamics and regulatory requirements play at least as important a role in determining the success or failure of a given project.

This dynamic is particularly evident in the United States. Because renewable generation occurs far from load centers in many instances, transmission systems frequently cross state (and occasionally national) borders, passing through multiple jurisdictions in the process. As a result, the power to regulate these projects often lies with state governments, and local communities can have significant influence on decision-making at this level.

Opposition from local communities concerned about potential environmental and/or health effects associated with transmission, coupled with aesthetic objections, have created roadblocks that have slowed or prevented the completion of some large projects, raising the prospect of substantial financial risk for developers. Often this opposition is compounded by the lack of obvious benefit to local communities from projects that are simply passing through their area, without delivering obvious, immediate benefits.

The development of a unified, national planning process could help eliminate some of this uncertainty. A national plan could help guide siting decisions and give some much-needed clarity and confidence to developers, both of transmission infrastructure and renewable generation projects, as to the required steps and likely outcomes of development projects.

The path to a carbon-neutral future

To reduce the nation's carbon footprint and meet GHG emission goals, we need to implement large-scale carbon-free generation resources and electrify major sectors of our economy, most notably transportation. Currently, the largest hurdle for this development is modernizing the transmission grid to accommodate renewable energy generation and electrification of the economy. Investing in transmission system technology that expands the capacity to transfer energy from areas with favorable conditions for renewable energy development to major load centers and that bridges regional seams is crucial to meeting these goals. Despite these challenges and large financial investments, de-carbonizing society will create long-term economic, social, and health benefits for the country. When combined, strategic transmission investment coupled with renewable energy development can be a powerful contributor to economic growth, job creation, prosperity and ultimately the achievement of a carbon-neutral future.



ABOUT THE AUTHOR:

Anthony Allard is executive vice president, managing director, United States and head of Hitachi ABB Power Grids' business in North America. Allard was most recently chief operating officer of BECIS, a leading energy as a service solution provider in Singapore. Having spent most of his career in the power sector at GE and Alstom in the U.S., he held several executive-level positions, including general manager and board member for GE Prolec Transformers in the U.S. He was also general m for the GE-XD High Voltage Products partnership and spent 10 years working for Alstom Grid in both North America and the Americas in strategy and operations management role.



CAN YOU REALLY HAVE IT ALL IN ONE ELECTRICAL TESTER?





JEFF JOWETT

A vital trend in electrical testing technology that has been gathering momentum is the consolidation of features and functions. This is worth looking into when searching for new or replacement testers, as you may be able to “kill two (or more) birds with one stone,” as the expression goes. You may not necessarily have to replace, say, an insulation tester with another insulation tester, but may be able to take advantage of a multifunction tester that does much more.

For the first half of the 20th century, development of electrical test equipment was relatively slow. The instruments were just fine for what they did, but they generally focused on between one to three functions. The individual testers manufactured by high-quality brands were sometimes literally signed off by the final technician on a plate or permanent label because they were expected to last ad infinitum. And believe it or not, some are still in use to this day. But reference resistors, decade switches and analog displays fairly limited what could be done with a single instrument. For many jobs, you needed many boxes.

Innovation: The mother of invention

Innovation began to pick up after mid-century and took a quantum leap with the introduction of microprocessor technology circa the 1970s, continuing its momentum right into the 21st century. Multiple functions and applications can now be coordinated in a single handheld tester. Remember, however, it is never a bargain to replace two good-quality testers with one mediocre one. A promotion may trumpet the many things that a multi-function tester can do, and this can be impressive, but you need to be aware of what you are purchasing. The good news is that in electrical testing, there are independent standards and SOPs that can separate the “real deal” from the “wannabes.” →

Knowing what to look for in a tester

When searching for a multi-tester, it is important to be on the lookout for certain features. One of the most important features a tester should have is protection against arc flash/arc blast, which can be lethal to the operator. Verbal claims like “safe” mean nothing. Fortunately, there is an international standard that rates this protection with a numbering system. It is essential that whatever tester you choose is rated as such. The standard you should be on the lookout for is IEC 61010-1. Be familiar with it and always use an instrument that is correctly rated for the testing environment.

Remember, as instruments become smaller, manufacturers are presented with a design challenge to keep them safe from deadly internal arcing. The IEC rating tells the operator where the instrument can be used safely. If there is no rating provided, don't buy the tester.

Measurement is still the core function of any electrical test, so when choosing an instrument to purchase, this should be top of mind. Many operators still like the interplay between tester and test item that they get with mechanical analog results, but liquid crystal displays are a quantum leap in accuracy and resolution. These displays provide a wealth of additional data, including voltage, current and resistance in a single test, as well as make vital checks on test conditions, like noise interference. And the old-timer's favorite, pointer travel, may be made available electronically. But it may be of interest to determine that what you're seeing is a true logarithmic arc and not just a curved bar graph. In the latter case, the travel could be misinterpreted and result in a wrong conclusion.

Be wary of the 'jack of all trades and master of none'

With electrical testing, and especially maintenance and troubleshooting, one of the wisest observations is that “time is money.” Test equipment is primarily viewed in terms of the measurement, and rightly so, but consider ease of use and speed as well. These have been notably improved in recent decades. Size reduction can put a whole toolbox of instruments into one. But when looking at multiple functions, be careful and remember that quality is still the prime importance. Be careful of instruments that do a lot of things, but none of them well. That is no longer necessary. Both multiple functions and high-quality measurement are available in single instruments. Also, be careful of instruments that have a few popular functions well developed at the expense of more basic or limited ones that can stall your testing over critical issues.

It is possible to have it all in one tester

Safety, function, accuracy and speed of testing can all be brought together in a single piece of test equipment. Consider the tasks at hand and in many cases, they may be included together in a single test instrument. A common task is proofing an electrical facility against NFPA 70, commonly referred to as the National Electrical Code. This is a widely respected document that assures that an electrical facility is safe. It doesn't focus on maximum efficiency or performance; however, it does assure that the facility has been tested and proven safe against hazards like electrocution and fire. The electrical plant can be given a final check before being brought online. The circuitry is tested for integrity and proper grounding. A single piece of multi-function test equipment can do this.

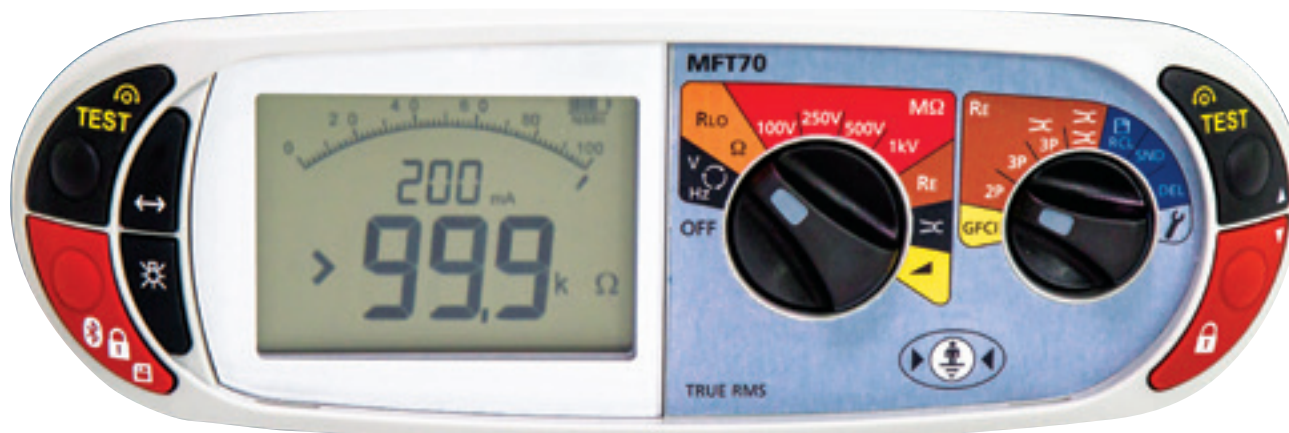


Figure 1 – Multi-function testers skillfully combine form and function to provide both speed and accuracy.

The core functions performed by a multi-function tester for NFPA 70 are insulation testing and ground testing. There are other functions as well, for the convenience and safety of the operator. The testers are small, lightweight, approximately 2 pounds and easily handled. Selector switches are a major convenience for the operator. Membrane switches belong in the lab. In the field, the operator may be wearing safety gloves and needs to be able to just turn a switch to a desired function and be ready to test. Complicated setup procedures need to be reduced or eliminated. If there is a pause or distraction, the operator merely looks at the instrument panel to see where he or she is in the testing process.

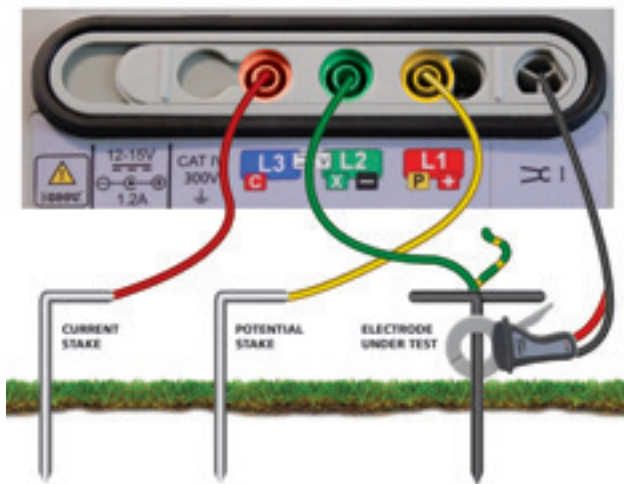


Figure 2 - Integrated color coding of instrument and leads makes setup easy and eliminates mistakes.

Insulation testing

The insulation test confirms the integrity of wiring and equipment by applying a test voltage across the insulation and measuring the leakage current that gets through and then converts this to a resistance. Considering that the human body generally interprets 5 mA as a shock, with 0.5 being the lower limit of perception, it is apparent that any leakage should be limited to the nano-amp or even pico-amp realm.

Consequently, an insulation test should produce a result well into the megohm or even gigohm range. On new wiring, don't be surprised if you test all day and get nothing but over-range readings. That's good. But if a carpenter drove a nail through the wiring and shorted it out, that will appear as a zero or something down in the kilohm (k Ω) range.

Judicious placement of the alligator clips that apply the test voltage across the insulation is key to either quick or exhaustive testing. This is often at the operator's

discretion. For instance, all three phases can be tested to ground at once. The more that is put on the tester, the lower the reading will be. Hence, if a nice, comfortably high reading is attained, then each phase would read higher if tested individually. It is not necessary to go to this length. On the other hand, if the operator wishes to be completely thorough, then every combination – phase to phase, phase to ground, etc. – can be tested individually. The tester will typically have a test voltage selection, such as 100, 250, 500 and 1 kV. A 500V test is universal for building wiring, with 1 kV for troubleshooting because incipient damage or flaws may be revealed at the higher voltage. For more sensitive circuits, like telecom/datacom, computer and other such equipment, the lower test voltages may be appropriate.

Ground testing

A click of the insulation selector should move the operation to the ground test selector. This will verify that there is an effective ground rod or other grounding electrode in place, and at sufficiently low resistance to safely divert any fault current into the earth and not through equipment or people. The test is performed with long leads and metal probes driven into the soil at some distance. The far probe establishes a distinct test current through the soil. Unlike the dc insulation test, this is done at an alternating square wave to have a distinctly recognizable signal apart from noise traveling in the soil. The second probe senses voltage drop from soil resistance, and the two measurements are combined to produce a resistance shown on the display. The Code is forgiving in this regard, specifying 25 Ω or less, or a second driven rod. This may do for residential grounding, but for commercial and industrial, a much lower value, 5 Ω or less, is recommended.

The ground test function typically will have selections for terminals engaged. A 2-pole function performs an important corollary to ground testing; that is, bonding. All the grounding conductors from equipment to bus should be tested for low resistance continuity. This can be readily accomplished by a selector position making a 2-pole tester, much like a DMM, but with the advantage of the long leads used for ground testing.

The 3-pole position is for the core ground test - tested electrode, current and voltage probes. Also, a tester may offer current and voltage clamps. Used in tandem, these can substitute for the long leads and setup time by performing a clamp-on ground test. But never do this until you've learned the limitations of the method...shorts and opens...otherwise it could be merely a waste of time. Used alone, the current clamp can be a valuable tool in proofing the electrical system and troubleshooting problems. →

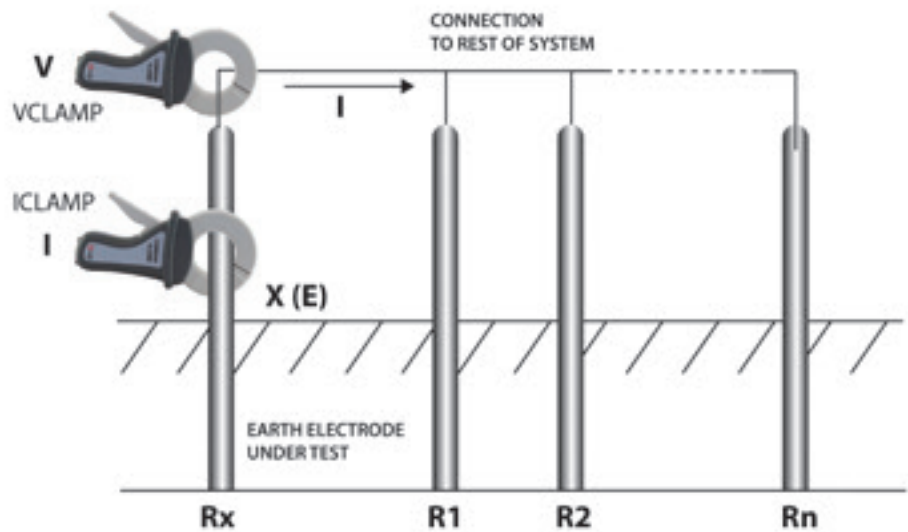


Figure 3 – Schematic for typical clamp-on ground resistance test

Continuity and voltage functions are important too

Continuity and voltage functions are almost automatic in such testers, as they are already included in the more complex measurements. But they give the operator two additional tools for measuring, checking and proofing the circuitry, plus in the case of the voltage meter, added safety. And it's a good idea to consider an instrument that has storage and downloading. It can be as simple as pressing a button to store a result and it can save you headaches later on when dealing with customers, clients, inspectors, insurance and even legal cases.

In the old days, dual- or multi-function instruments were sometimes little more than two or more boxes stitched together, with little integration of function. Twenty-first-century technology makes it possible to have the best of both worlds – an instrument that not only performs multiple functions but also does them all well. And that saves the operator time and reduces or eliminates errors.

ABOUT THE AUTHOR:

Jeff Jowett, senior applications engineer for Megger has more than 40 years of experience in application and instrumentation. A recognized industry expert, Jowett is a frequent presenter to industry organizations including NETA and NJATC, has written numerous articles for trade journals, presented seminars and conducted multiple industry training sessions. He is a member of IEEE and the committee for the revision of Standard 81, *Recommended Guide for Measuring Ground Resistance and Potential Gradients in the Earth*. He received a B.S. in biology from Ursinus College in Collegeville, PA.



THE BIGGER PICTURE

WORLDWIDE UTILITIES 2021 PREDICTIONS



ROBERTA BIGLIANI

Around the world, 2020 was not an easy year for electricity, gas and water companies. For proof, one need only look at the declining energy consumption deriving from industrial and commercial slowdowns, financial credit deterioration, commodities' price volatility, increasing competition and lockdowns impacting operations and maintenance – not to mention an increase in extreme weather occurrences. Nevertheless, the industry has demonstrated resilience and has not stopped its ongoing transformation journey. For the next five years, utilities will have to accelerate the reinvention of their core businesses while deploying new business models to get new revenue streams. In the next normal, hybrid working models, the shift from face-to-face to digital and new business ecosystems will be the norm. Leading utilities will not just adapt to shifting customer needs and market conditions, but will proactively shape the needs and the market to valorize their strengths, innovation and reinvented business models.

In this context, my fellow IDC Energy Insights analysts and I have developed the top 10 predictions that make up what we consider to be the framework for IT and line-of-business (LOB) decision-makers and influencers' technology-related initiatives in the year ahead. Of the 10, the following four predictions should be at the forefront of all IT professionals working in the utility industry and considered a top tech priority in the next several years. →



“While the recovery pace will vary across regions, by 2024 80 percent of electric, gas and water companies will have implemented sustainable business models by accelerating DX and rearchitecting the core business”

Across the world, COVID-19 has helped accelerate the transition to more sustainable societies and economic models. From an electricity perspective, lower demand and favorable weather meant that renewables recorded their strongest contribution to the world's electricity generation mix, offering a glimpse into what could soon be achieved. In the U.S., for example, renewables far outpaced coal-fired generation during lockdown and produced more than 21 percent of all electricity in 1Q20. In India, the share of coal in the mix has consistently remained under 70 percent since the introduction of lockdown measures, with renewables generating a third of all electricity in mid-August. A similar pattern was observed in China, despite the gradual easing of lockdown measures starting in March. In the EU, renewables outstripped fossil fuel generation from February through the first week of July. This corresponded to the longest coal-free power stretch for the U.K. (over two months), and Germany produced 56 percent of its power output from renewables in 1H20.

While the road to recovery will vary across regions — as will the mix of forces shaping individual energy and utility markets — the trend of operating model transformation and strategic portfolio reshaping is likely to accelerate. Utilities will balance resiliency and reinvention, focusing on the speed and agility of their organizations while transforming their companies' culture and values to embrace sustainability on every level. On one hand, they will accelerate their move to full-fledged digital operations.

Data-driven risk management, digital customer journeys and prescriptive maintenance are a few of the key initiatives for an industry looking to attain operational excellence and a digital customer base. On the other hand, while rethinking their products and offerings, they will launch new purpose-driven brands around resource conservation and circularity, community energy, emobility and energy as a service for large consumers, among others.

By 2024, IDC Energy Insights estimates that new utility business models could grow to account for 4-to-15 percent of the commodity business' EBITDA, with sustainable ones taking up most of the value.

To be effective and accelerate the transformation, at IDC we suggest the following to CIOs and IT departments:

- Bring new data types into the wider data governance lap, balancing safety and privacy with the benefits of access for personalization and efficiency.
- Adopt agile techniques and develop an enterprise road map that is modular (i.e., breaks down effort into chunks delivering immediate business value), scalable (i.e., thinks through how the road map will evolve) and extendable (i.e., accommodates changes as they unfold).
- Fully deploy agile DevOps teams to manage the life cycle of new front-end applications and evolve IT assets.
- Engage the ecosystem (partners, new players and start-ups) to inform and educate IT teams. Work with the business to map requirements and capabilities and influence what business outcomes can be achieved given available technology.

“By 2023, because of the increasing role of residential consumers in distributed energy, 45 percent of grid operators will have deployed AI to enable resilient and flexible management of the grid”

Delivering power reliability, efficiently and safely to residential customers is becoming increasingly difficult for power grid operators. Penetration of renewable sources, growth in electric vehicles, increasing investment in energy storage capabilities and large-scale distributed energy investments are changing the complexity of the grid environment that needs to be managed. Many distributed resources are being connected to the grid; globally, solar photovoltaic (PV) capacity is forecast to grow 250 percent by 2024, and residential annual capacity additions are expected to triple by 2024 (IEA).

Distributed energy resources mitigate energy costs for residential consumers who can leverage the benefits of selling electricity back to the grid. They can also ensure the security of supply in areas where peak demand challenges centralized power availability and satisfy many customers' preference for sustainability. But for utilities maintaining resiliency, reliability, efficiency and safety particularly at peak demand, integrating many renewable resources into the grid is far more challenging. The intermittent nature of renewables poses a threat to the stability of the entire grid, often resulting in increased costs for the grid operator. This new grid environment requires automation, real-time planning and control systems to anticipate, manage and ensure that demand and supply are balanced. Traditional approaches and systems are not sufficient to manage the complexity of this environment; artificial intelligence enables the computation of far more complex scenarios and predictive capabilities to support the complexity of the challenge that grid management faces. IDC expects that the artificial intelligence market for utilities globally will grow from \$1.09 billion to \$2.6 billion by 2024 (CAGR of 19.3 percent).

IDC offers the following guidance to effectively manage increased data from AI-powered tools and solutions:

- Implement an enterprise data governance model and consider investing in master data management. This will be a critical requirement given the amount of data that is being generated and the requirement to scale capabilities.
- Consider having a road map in place that will help evaluate infrastructure requirements and develop the strategies around governance frameworks and operating models to drive real-time value.
- Build capabilities within the organization that brings in consistent knowledge and become educated on how AI can be leveraged to solve business problems and identify near-term use cases that are important for organizational goals →



“In deploying the hybrid working model, in 2021 40 percent of electricity, gas and water companies will prioritize wellbeing monitoring and enhanced personal safety thus improving employee experience by 30 percent”

The shock of COVID-19 and the immediate need to protect employees left its mark on utilities and their day-to-day operations. Working from home was not unheard of prior to the pandemic, but it was far from the norm. In Europe for instance, less than 15 percent of utility employees used to work from home before the pandemic — by August 2020, the percentage had tripled. Making a virtue out of necessity, utilities can now rightfully claim to have made a huge step toward deploying a hybrid working model, supporting a large share of their mission-critical operations remotely using digital tools.

Utilities have now realized that there is room for a permanent change in the way of working and running operations, balancing their onsite-remote workforce. Also reflecting an increased focus on employee experience, utility companies will put the wellbeing monitoring and personal safety of their employees at the center of this shift.

Concrete examples of how enhancing personal safety will take shape include providing flexible working hours during the day, rotational working from home and ensuring time and space separation between staff and field teams. Spanish utility Iberdrola, for example, has championed these measures, with a staggered return to the office for most of its employees. Going beyond anti-COVID-19 measures, utilities will further embed the monitoring of their employees' wellbeing in the standard set of HR processes. U.S. utility Puget Sound Energy (PSE) is actively promoting workplace mental health by setting up an employee assistance program (EAP). Besides training and raising awareness concerning mental illness, employees are offered counseling for themselves and their family members. Despite this being a pre-COVID-19 example, it shows the way for other utilities that still have to take on the challenge of improving employee experience in light of recent events.

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In Europe for instance, less than 15 percent of utility employees used to work from home before the pandemic — by August 2020, the percentage had tripled.
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In relation to this information, we recommend that utilities:

- Ensure the new generation of applications used to manage human capital, skills, and employer relations are designed around the user and enable an employee experience feedback loop.
- Put public cloud and advanced security as the cornerstones of the future utility enterprise infrastructure, enabling IT to provide maximum availability to its users and resilience for the enterprise.

“By 2025, 35 percent of energy utilities will drive at least 30 percent of their business via digital platforms based on cloud native technologies, fulfilling the evolving needs of customers and infrastructures”

Leading international utilities are leveraging digital infrastructure to develop common information, intelligence and process platforms to create efficiency and extensibility in their operations. Specifically, these global data and business platforms respond to one fundamental tenet — the centrality of the consumer and asset data in the system — and two key requirements of the transforming utility: the need to drive efficiency and customer experience in the core business through consistent and scalable processes and resources as well as a more flexible and accessible IT infrastructure, and the need to quickly deploy new services and business models (around sustainability, conservation, decarbonization and electrification), supporting the resulting expansion of the customer base outside the commodity business

With its Enel X brand, for example, Enel is creating open platforms to enable consumers, prosumers and cities (even assets) to actively participate in energy markets through technologies such as demand response, storage and vehicle-to-grid technology, among others. Another pillar of its platform-based model is the distribution network's digital twin, and so is the company's cloud-only strategy (which is providing savings and economies of scale) and is maximizing the impact of innovation. In a similar vein, U.K.-based utility Centrica has developed a vision of the industry transformation that builds on three platforms:

- New market platforms enabled by IoT and AI such as real-time flexibility, which sits at the core of the company's energy-as-a-service offering for C&I with Centrica Business Services
- Local, peer-to-peer energy markets unlocked by distributed transactional technologies such as blockchain, which Centrica has tested in Cornwall and competitors EDF Energy and OVO are demonstrating in Scotland
- Home energy management, orchestrating smart home devices, micro-renewables, energy storage and electric vehicles to make it easier for consumers to understand and control their energy use, and possibly participate in markets where such control can be monetized.

From a technology perspective, our guidance to utilities is to:

- Use DevOps and agile as the standard organizational architecture and way of working to be able to integrate innovation and deliver projects with a three-to-four-month cycle.
- Consider whether to adapt what is already available and deployed for the traditional business or adopt new solutions. Cloud-native solutions and as-a-service procurement can quickly provide capabilities and facilitate scale.
- Use cloud to energize legacy infrastructure. Adopt a cloud-first approach for new applications and technologies. Promote the adoption of a platform-led modular architecture and prepare pathways for microservices and application programming interfaces (APIs).

As we continue along the road to the next normal, utilities' executives will have to continue balancing resiliency and reinvention, keeping their hands in the present and eyes on the future. This also implies a different approach to business and tech ecosystems to deliver one integrated experience to customers. Those that can successfully do so will emerge as leaders.

ABOUT THE AUTHOR:

Roberta Bigliani is a group vice president at IDC. She leads the European industry research teams, which includes coverage of energy, financial services, healthcare and life science, government, manufacturing and retail. She is also the executive sponsor for Europe of IDC's Future of Work Practice and the IDC IT/OT Integration Strategies Practice. With three decades of experience in consulting, advisory and research, Bigliani previously worked for Accenture, where she led innovative consulting projects for major utilities and oil and gas companies.

MELISSA CARMINE-ZAJAC

DOBLE ENGINEERING



BY ELISABETH MONAGHAN

For our first Powerful Forces profile of 2021, we spoke with Melissa Carmine-Zajac. She is the director of laboratory services for Doble Engineering Company and has nearly 15 years of experience in chemical analysis, process engineering and management of analytical laboratories.

Although she wasn't sure which area of science she was going to pursue, Melissa Carmine-Zajac knew from the time she was in elementary school that she was going to be a scientist. She also says it was a series of happy accidents that led her to the work she does today for Doble.

The following are insights that Carmine-Zajac shared with us and have been edited for clarity.

A series of happy accidents

As a kid, I went through these obsessions over how things worked, but they were always science- or technology-related. I was the weird kid in class that was obsessed with dinosaurs. And then, as toys came out that were more technologically advanced, I'd be the one that would rip them apart and try to figure out how they worked. It's something that I've always done. My parents thought I was nuts, but [being inquisitive] landed me in what has turned out to be a pretty good career.

The way I ended up working in this industry wasn't on purpose; it just kind of happened. Before college, I was actually looking at studying pharmaceuticals and taking a microbiology approach to that field. Then, when I was in high school, I got Lyme Disease. At the time, there were not many good treatments available to treat the disease, so I thought, "why don't I study *this* as my focus?"

But the more I learned more about the pharmaceutical industry, the more turned off by it I became. As I interacted with people in that sector, I felt like I didn't fit in and realized working in pharmaceuticals was not the appropriate field of science for me. That's how I ended up working in energy. Given my personality and the general service the power sector provides, I now work in an industry that feels more like home.

The work we do

When someone unfamiliar with my work asks me to explain what I do, I distill it down to the simple explanation that “I help keep people’s lights on,” but a more eloquent answer is that I provide diagnostics for power equipment, based on oil chemistry. There’s oil inside electrical apparatus [such as a transformer], and that oil acts like blood does in a human. If you’re sick and you go to the doctor, they may take your blood and provide with you a diagnosis based on those blood tests. Or, if you get your blood drawn during a routine physical, you now have a baseline for future comparison. We can take a sample of the transformer oil and run a series of tests to either establish a baseline or uncover a fault. So, in this case, it’s a machine application versus a human application, but that’s it in a nutshell. We’re assessing the health of electrical apparatus based on oil chemistry, so it’s really not that far a stretch from what I originally wanted to go pursue.

This [period during the pandemic] has been one of the most challenging things as a manager I’ve had to face. I feel I’ve been on a fast-running train. Leading a team of 50 during a pandemic has been nothing short of bizarre and wild, but as a laboratory director, I really have two priorities: The first is to keep my staff safe. The lab environment is one that has very unique hazards, as you can imagine, and COVID has added new and unique safety requirements on top of the usual lab safety protocols.

Doble labs provide extremely important key diagnostics to the industry, so my second priority is keeping the doors open. I think we were about two weeks into the pandemic when we started receiving letters and emails from our customers asking if we were going to shut down and expressing to us how critical it was to remain open to support them. It was important that we let them know we heard them and that they knew we were there for them.

Also, the data that we produce actually means something – people are looking at this data and making decisions – and they often rely on Doble’s lab to provide the diagnostics and key context. They’ll call and ask me to explain crucial

next steps and provide additional diagnostic support. We’re always looking at different ways to further develop and improve our diagnostics so we can provide the most accurate and insightful answers to their questions.

Because oil-testing is a key diagnostic, especially dissolved gas analysis (DGA), which is the most important diagnostic test in our entire industry, it’s important we stay up and running throughout the pandemic the best we can. People cannot go without utilities, service companies or generators, so we completely redesigned our entire workflow and the way that we schedule our shifts. We also worked as a team with our customers to come up with a model of operating that worked best for everyone. I am happy to say that as a result of the work we did, we did not have to shut down once.

Using our experience

Doble’s lab has been testing since 1933, and a lot of our interaction with Doble Engineering customers has been the old-fashioned, person-to-person connection. Since we can’t meet people in person right now, we’ve had to come up with other ways to make this connection, because it’s probably going to be a while until we’re traveling or meeting in-person again.

Recently, we switched from hosting our laboratory diagnostic presentations that used to happen face-to-face to online. We’ve been conducting training via webinar, and we now offer prerecorded video training that is more easily accessible to the masses.

As far as how the pandemic has affected my team, our experience has been a little different than others in the industry. I come from a background, where I’ve dealt a lot with emergency response and worked as a hazmat first responder, so this is the type of situation I am trained to deal with. Also, all lab employees are trained to deal with emergency situations in general. Even though none of us had ever dealt with a pandemic, we have been able to apply our experience to this situation. →



None of us is happy with it, but we radically accept the reality, and my team is dedicated to serving the industry and to ensuring we provide the data our customers need to operate their equipment safely.

Appealing to future generations

If you go to a career fair, you might see industries that may be underdogs but they're also really cool. For so long, our industry was kind of a dinosaur, but because of new technology, renewables and cybersecurity, our sector has become "sexier." We now have more IT considerations, like the role of cybersecurity and implementing systems to keep data and assets safe. We also have online monitors that can feed you data in real time and aid in the decision-making process. Automation and artificial intelligence are emerging as technologies that will play a bigger role in the work we do. Renewable energy, especially solar, is another significant factor changing the way we generate power.

It used to keep me up at night, wondering who was going to take the place of the experienced management and workers who are retiring. Because of the green movement and emerging technology, I am no longer as concerned, as more young people are gravitating towards those things. This is an exciting time to be entering the power industry.

When people think about professionals who work in electric power, they picture fieldworkers wearing hardhats, but there is so much more to what we do and so many things happening behind the scenes. In addition to fieldworkers, we have a variety of professionals including chemists, operations directors, people who work on infrastructure and different types of engineers.

Beyond the pandemic

My team has dealt with safety measures forever. Because of COVID, we've incorporated additional protocols, but I'm trying to look beyond the pandemic because for so long, that's all our universe has been.

It helps that we are working on some cool projects, like the sensors we're developing for online dissolved gas monitors, which is technology that will become more important as we transition from analog to a digital grid. Online DGA monitoring allows utilities to monitor their assets in real time allowing them to spot potential issues earlier and possibly avoid catastrophic failures

Now that we've made it nearly a year since COVID first hit, it's obvious we will be dealing with the virus as part of our daily lives, but the pandemic cannot be – nor is it – the driving factor for everything we do.

ABOUT MELISSA CARMINE-ZAJAC:

Melissa Carmine-Zajac provides utility companies around the world with in-depth oil analysis and insight into transformer operating condition. She manages a team of up to 55 chemists, technicians and administrative personnel across four labs in the U.S. She's an experienced Hazmat responder, industrial safety professional and a member of several prestigious industry associations, including the ASTM D-27 Technical Committee on Electrical Insulating Liquids and Gases, and Doble's Insulating Materials Committee



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