

EET&D MAGAZINE

Quarterly Issue 4, 2020 – Volume 23



**EVERSOURCE ENERGY:
LESSONS LEARNED WHILE
SHELTERING-IN-PLACE**

**2020
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POWER POINTS

INNOVATION AND THE NEW VIRTUAL NORM

Elisabeth Monaghan, Editor in Chief

In my column for the Q2 issue, I wrote that I believed innovation and resourcefulness would play key roles in getting the electric energy industry through the pandemic. Here we are, six months later, and based on the information presented in this issue of *EET&D Magazine*, the electric energy sector has indeed demonstrated an abundance of resourcefulness and innovation in its response to the pandemic.

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THE GRID TRANSFORMATION FORUM

LESSONS LEARNED WHILE SHELTERING-IN-PLACE

Tilak Subrahmanian and Frank Gundal, Eversource

We spoke with Tilak Subrahmanian and Frank Gundal from Eversource to discuss how the pandemic has affected the company's energy programs and its customers, as well as how the company responded. They also share best practices they learned from this experience.

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GREEN OVATIONS

SOLVING UTILITIES' DATA CHALLENGES WITH DIGITAL TWINS

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To understand the value of digital twins for the utility sector, we hear from two industry leaders whose companies' partnership has helped shape grid modernization strategies for the utilities of the future.

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ADDING AND ADAPTING DEMAND RESPONSE PROGRAMS DESPITE COVID-19

Erika Diamond, EnergyHub

Utilities have not lost focus on mitigating the risks to the grid that existing shifts are bringing, such as increasing renewable penetration and the rapid uptake of electric vehicles. For those utilities starting on their journey to draw value from DERs, here are five tips based on our experience of implementing, growing, and evolving DER programs across more than 50 utilities.

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MAXIMIZING MICROGRID RESILIENCE THROUGH INTEGRATED AUTOMATION STRATEGIES

Rick Kephart, Emerson

Implementing a single-platform automation strategy for microgrid management mitigates the inefficiencies of disparate systems and provides numerous operational, maintenance and financial benefits. This is not a new concept: Utilities and independent power producers have a long history of implementing similar strategies with field-proven technologies on the bulk power system to cost-effectively manage vital geographically dispersed generating assets.

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THE MOVING TARGETS OF RELIABILITY AND RESILIENCE

Brian Levite, S&C Electric Company

The market increasingly expects energy systems to deliver more services and increase reliability, even as stresses to the system are increasing and our generation base is shifting. When a global pandemic is added to this equation, there is a pace of change utility systems and regulatory models simply aren't designed to handle.

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A THREE-PART GUIDE TO REMOTE UTILITY MANAGEMENT THROUGH THE PANDEMIC AND BEYOND

Mike McGann, Sensus

The demand for remote management is clear, but the path to get there is not. Financial and operational pressures abound for utilities during this uncertain time, creating increased pressure to ensure investments are sound and that technology upgrades scale to meet evolving needs. This article provides a guide to exploring and implementing remote management at your organization.

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GUEST EDITORIAL

WHY THE ENERGY SECTOR NEEDS REMOTE OPERATIONS CAPACITY TODAY, AND HOW TO SUCCEED IN THE TRANSITION

Bill Moore, Xona

A hybrid workforce comprised of on-site, remote and distributed teams isn't just the future of the power industry. It's the present, and too many companies are falling behind. According to *The Washington Post*, as much as 90 percent of companies lacked adequate remote operations infrastructure to maintain continuity during this transition. The energy sector will have to navigate the pitfalls successfully without ignoring the operational necessity transformation.

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GUEST EDITORIAL

ESTABLISHING A SUCCESSFUL TRANSITION TO REMOTE PROJECT MANAGEMENT

Clarice Kinsella, Burns & McDonnell

The road to successful project management office (PMO) adoption and utilization begins with effective implementation. While there are many different models and types of PMOs, the shared intention of each is to improve project performance by standardizing processes and facilitating the sharing of tools and techniques that drive efficiency. When mapping out the right PMO that will support long-term project management excellence, utilities should focus on people, processes and technologies.

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GUEST EDITORIAL

ENERGY EFFICIENCY GETS A VIRTUAL BOOST

Seth Little, CLEAResult

Social distancing necessitated that utilities pause energy efficiency programs for customers, which traditionally required in-person assessments of customer homes. In the economic fallout that followed, utilities braced for hits to their revenue. As in other industries, virtual and digital technology has risen as a tool for utilities to maintain customer service in the new socially-distanced reality, and with this increased adoption, many previously unrealized benefits have become known.

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GUEST EDITORIAL

REDEFINING RESILIENCE IN POST COVID-19 AND WHY ADAPTING YOUR DATA STRATEGY MATTERS

Francois Laborie, Cognite North America

Utilities should think about resilience for their business models. This includes the means to respond to market opportunities like renewable energy and microgrids or securing market share against new entrants to the market. Disruption can and will come quickly, in the form of new storage technologies and breakthroughs in generation. Is your utility resilient enough to mobilize a new strategy at the speed of the market?

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THE BIGGER PICTURE

ENERGY TRADING AND THE INSUFFICIENCY OF WEATHER FORECASTS

Evan McNamara, ClimaCell

Energy trading consists of market trades involving development and consumption of energy and commodities, generated in many ways, or even stored in battery storage. In these systems, commodity and energy prices often fluctuate based on domestic or international weather patterns, energy usage, resource extraction and refinement, production activity and more.

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SECURITY SESSIONS

ELECTRIC UTILITIES NEED SECURE APPLICATIONS, NOT JUST SECURE COMMUNICATION NETWORKS

Roman Arutyunov, Xage

Electric utility distribution networks are composed of devices and software applications that cooperate with each other and humans in real-time. With DERs and grid edge devices added, electric distribution utilities may have hundreds of thousands of intelligent electronic devices (IEDs). Just one compromised component may create the potential for contagion. Security from core-to-edge, despite inherent challenges, is an absolute necessity.

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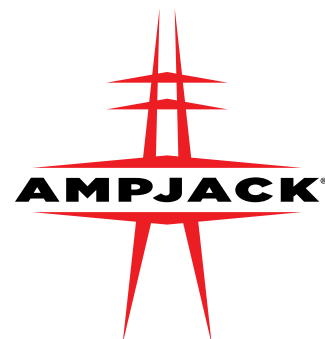
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PRIME MINISTER ANNOUNCES CANADA'S STRENGTHENED CLIMATE PLAN TO PROTECT THE ENVIRONMENT, CREATE JOBS, AND SUPPORT COMMUNITIES

December 2020

As we continue to address the challenges of today and the impacts of the global COVID-19 pandemic, the Government of Canada remains focused on meeting the tests of the future. Climate change is the biggest long-term threat of our generation, but it is also the greatest economic opportunity. By accelerating action to fight climate change and rebuilding a more sustainable and resilient economy, we can create new jobs and opportunities for Canadians, while also ensuring cleaner air and water for our kids and grandkids.

The Prime Minister, Justin Trudeau, announced Canada's strengthened climate plan on December 11, *A Healthy Environment and a Healthy Economy*, which will help achieve our economic and environmental goals. The proposed plan, supported by an initial \$15 billion in investments, will make life more affordable for Canadians, make communities more livable, and, at every turn, focus on creating jobs, growing the middle class, and supporting workers in a stronger and cleaner economy.

The plan's measures will:

- Make the places we live and gather more affordable by cutting energy waste: We will cut pollution, make life more affordable, and create thousands of good new jobs by making it easier for Canadians to improve the energy efficiency of the places where they live and gather, including through investments in retrofits.
- Make clean, affordable transportation and power available in every community: We will build cleaner communities and help Canadians get around in more affordable ways, by expanding the supply of clean electricity through investments and other measures to increase renewables and next-generation clean energy and technology.

- Continue to ensure pollution isn't free and households get more money back: We will give more money back to households in a way that leaves the majority of them better off, and reduce pollution, by continuing to put a rising price on pollution through to 2030.
- Build Canada's clean industrial advantage: We will create economic growth, cut pollution, and ensure Canadians continue to have good-paying and long lasting jobs by helping Canadian businesses reduce emissions and make low-carbon products that the world wants to buy now and into the future.
- Embrace the power of nature to support healthier families and more resilient communities: We will cut pollution, clean the air we breathe, create jobs, and make our communities more resilient to extreme weather by planting two billion trees, supporting sustainable farming, and better managing, conserving, and restoring our nature.

Canada's strengthened climate plan builds on continuing work with provinces and territories through the Pan-Canadian Framework on Clean Growth and Climate Change (PCF), which was released in 2016. When coupled with the PCF, the strengthened plan will do more to cut pollution in a practical and affordable way than any other climate plan in Canada's history. It means we can exceed our 2030 Paris Agreement emissions reduction target and establish the building blocks to get to net-zero by 2050. The proposed plan will also enable Canada to be an active and constructive player in the global fight against climate change.

Climate change knows no borders. By continuing to work together on this urgent crisis, we will be able to avoid the worst effects of climate change and build a healthier and cleaner future, while also creating new jobs and economic growth for all Canadians.

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QUOTES

“As we continue to address the impacts of COVID-19 and ensure our strong economic recovery, we must also continue to fight climate change for the good of Canadians, our economy, and our planet. Canadians don't have to choose between clean air and good jobs. This strengthened climate plan will help us build a healthier, fairer, and more resilient future that we can be proud to pass on to our children and grandchildren.”

– The Rt. Hon. Justin Trudeau, Prime Minister of Canada

“This is a plan that will help achieve both Canadians' environmental goals and our economic hopes: clean air, clean water and long-term secure jobs. It means we will exceed Canada's 2030 climate target while positioning Canadians to thrive in an increasingly low-carbon economy. It contains 64 strengthened and new federal policies, programs and investments to cut pollution and build a stronger, cleaner, more resilient and inclusive economy.”

– The Hon. Jonathan Wilkinson, Minister of Environment and Climate Change

QUICK FACTS

- The estimated size of the global clean technology market is expected to range between \$2.5 trillion and \$6.4 trillion (USD) by 2022-23. This strengthened climate plan seizes that opportunity and positions Canadian workers and businesses to be among the leaders in the increasingly low-carbon global economy.
- In the recent *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 more support for large-scale clean power transmission projects.
- The government also proposed in the *Fall Economic Statement* to invest in nature-based climate solutions, including to restore degraded ecosystems, protect wildlife, and establish a new Natural Climate Solutions for Agriculture Fund.
- While some of the proposed measures in this plan will take effect almost immediately, others will require work and collaboration with provinces and territories and through nation-to-nation, Inuit-Crown, and government-to-government relationships, as well as with many economic sectors, to ensure a strong, workable plan that we can deliver together.

“This isn't just a plan for climate action. It's a plan for Canada's economic competitiveness. By taking action now, we're confronting the urgency of climate change and setting Canadian workers up for an economy in which they can thrive.”

– The Hon. Seamus O'Regan, Minister of Natural Resources

“Climate action is about good jobs, Canadian innovation, clean air and water, more inclusive communities and, most of all, a better future for our kids. If we take the same approach to the climate crisis as we are to the COVID-19 pandemic - urgency, science-based decisions, working together across borders and focusing on the planet we want for everyone - we will win the race against climate too.”

The Hon. Catherine McKenna, Minister of Infrastructure and Communities

“This plan for a cleaner and stronger economy sets the creation of well-paying, resilient jobs as a top priority. Our government's investments mean companies in Canada will decarbonize faster and our clean-tech sector will scale-up faster, and in turn they will offer the world more of the low-carbon products that consumers and investors increasingly demand. Improving the global competitiveness of our industries means better job opportunities for Canadians today and for generations to come. This plan makes sure our children and grandchildren have a healthy environment and a healthy economy.”

– The Hon. Navdeep Bains, Minister of Innovation, Science and Industry

“Climate change is the greatest threat of our time, but it is also our greatest opportunity. Today, we are giving ourselves the means to achieve our ambitions, allowing us to face the future with confidence. We are not going to leave our children and grandchildren an ecological debt, as the costs of inaction would be far greater. Just as we are listening to the science to fight the COVID-19 pandemic, so too are we listening to the science to fight climate change. We are building on our strengths and are including each and every one of us in the transition.”

The Hon. Steven Guilbeault, Minister of Canadian Heritage

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DEPARTMENT OF ENERGY ANNOUNCES \$128 MILLION FOR SUSTAINABLE TRANSPORTATION RESEARCH

December 2020

Today (Dec 10), the U.S. Department of Energy (DOE) announced an investment of up to \$128 million in funding for research and development of sustainable transportation resources and technologies, subject to the availability of appropriated funds. Split between three separate funding opportunity announcements (FOAs), the investment supports DOE's goal of ensuring that American families have greater choice in how their transportation energy needs are met. The announcement was made by Deputy Secretary of Energy Mark W. Menezes when visiting a new hydrogen fueling station in Washington, D.C.

"As the transportation sector and our mobility needs continue to evolve, it is important that we support technological solutions from a variety of energy sources," said Deputy Secretary Menezes. "These three funding opportunities are excellent examples of the diversity of resources we have available. The Trump Administration is committed to harnessing the strengths of these technologies to ensure families, goods, and services are moved safely, efficiently, and cleanly."



Funded through DOE's Office of Energy Efficiency and Renewable Energy (EERE), the FOAs will be issued on behalf of EERE's three transportation offices: the Bioenergy, Hydrogen and Fuel Cell, and Vehicle Technologies Offices. Each contains multiple topics as summarized below:

Bioenergy Technologies Office (BETO) FOA (up to \$35 million): This FOA supports bioenergy feedstock technologies, with a focus on characterization of municipal solid waste, as well as algae research and development. This investment supports the Trump Administration's priority of advancing the domestic bioeconomy, as well as BETO's goals of improving the performance and lowering the cost and risk of technologies that can be used to produce biofuels, biopower, and bioproducts.

Hydrogen and Fuel Cells Technologies Office (HFTO) FOA (up to \$33 million): This FOA supports innovative hydrogen and fuel cell research and development, infrastructure supply chain development and validation, and cost analysis activities. Activities that result from the FOA will support EERE's H2@Scale vision and leverage capabilities at DOE National Laboratories through close collaboration with the Million Mile Fuel Cell Truck and H2NEW consortia.

Vehicle Technologies Office (VTO) FOA (up to \$60 million): This FOA supports priorities in batteries and electrification, advanced engine and fuel technologies, materials, mobility systems, and transportation and energy analysis. Some topics also support DOE's Energy Storage Grand Challenge, which draws on research capabilities of the DOE National Laboratories as well as universities and industry to accelerate the development of energy-storage technologies.

The two-phased application process for each FOA will include a concept paper, followed by a full application. Deadlines are as follows:

BETO FOA: Concept papers are due on February 1, 2021, by 5:00 p.m. ET, and full applications are due on April 5, 2021, by 5:00 p.m. ET.

HFTO FOA: Concept papers are due on January 15, 2021, by 5:00 p.m. ET, and full applications are due on March 8, 2021, by 5:00 p.m. ET.

VTO FOA: Concept papers are due on February 5, 2021, by 5:00 p.m. ET, and full applications are due on April 7, 2021, by 5:00 p.m. ET.

For more information, please refer to the BETO, HFTO, and VTO FOAs on EERE Program Information Center and Grants.gov.



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HITACHI ABB POWER GRIDS CREATES RESEARCH AND DEVELOPMENT CENTER IN MONTREAL FOCUSED ON CYBERSECURITY, MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE

New Digital Power Grid Center leverages Quebec's academic and technology leadership in fields critical to the future of energy

December 2020

Hitachi ABB Power Grids today (Dec 9) announced the establishment of a new research and development (R&D) presence in Montreal, focused on addressing key challenges in the energy industry related to artificial intelligence (AI), machine learning and cybersecurity. The new Digital Power Grid Center (the Center) will build on the company's pioneering work in the development of technology solutions for the global energy industry.

Part of Hitachi ABB Power Grids' Research arm, the new Center will develop key competencies in major technology disciplines related to cybersecurity, machine learning and data analytics, and contribute to product and solution developments in these fields. The Digital Power Grid Center will be the company's seventh research location, joining with existing R&D centers in China, Poland, Sweden, Switzerland, Germany and the United States.

As utilities and other companies move to digitalize their energy infrastructure, their assets will be increasingly interconnected and linked to the Cloud, which offers significant opportunities to optimize power generation, distribution, transmission and storage capabilities.

For instance, the Center will look to capitalize on opportunities presented by the increasing volumes of data being made available through a growing number of smarter, connected devices distributed throughout the grid. This data can provide valuable intelligence to power utilities and other organizations to help them more effectively address sustainability, reliability and resilience goals. The Center will also focus on mitigating potential threats arising from the increasing connectedness of grid assets.

In recent years, Montreal has emerged as a key hub of activity in the digitalization ecosystem, hosting a variety of world-class universities, research consortia and major companies, all contributing to the development of new technologies and collaborating on the creation of standards that will help to drive the next generation of sustainable energy solutions. The Province of Quebec is also strongly involved in the development of technical expertise in the region, and contributes both funding and guidance to help steer and foster a strong, collaborative R&D environment in the province.



Hitachi ABB Power Grids Canadian HQ, location of the Digital Power Grid Center

"The selection of Montreal for the company's new center of excellence highlights the important contributions Quebec-based organizations make to the global energy industry," said Bill Strohecker, Canada Country Managing Director, Hitachi ABB Power Grids. "The province hosts a number of top research institutions and leading companies that are making important strides in fields like AI and cyberdefense. We plan to tap into that pool of expertise. Hitachi ABB Power Grids Canada is proud to host this new center in our Montreal location, and to contribute to the Canadian economy and help attract future talent to the area."

"Montréal's ecosystems in artificial intelligence and cybersecurity, two closely related sectors, play a key role in the economic vitality of Greater Montréal. By establishing its research and development center in the region, Hitachi ABB Power Grids will have access to the best talent in these fields," said Stéphane Paquet, President and CEO of Montréal International. "In only 4 years, Montréal International has supported some 40 AI projects in the region, with investments totaling close to \$1 billion."

With more than 800 employees and 3 manufacturing locations, Hitachi ABB Power Grids has a strong presence in Canada. Located at the company's state-of-the-art country headquarters in Montreal, the Center will spearhead Hitachi ABB Power Grids' engagement with other researchers in the area that are focused on applying the power of pioneering and digital technologies to make grids stronger, smarter, and more sustainable. It will also foster collaborations with key customers in the region, which make important contributions to the evolution of energy infrastructure.

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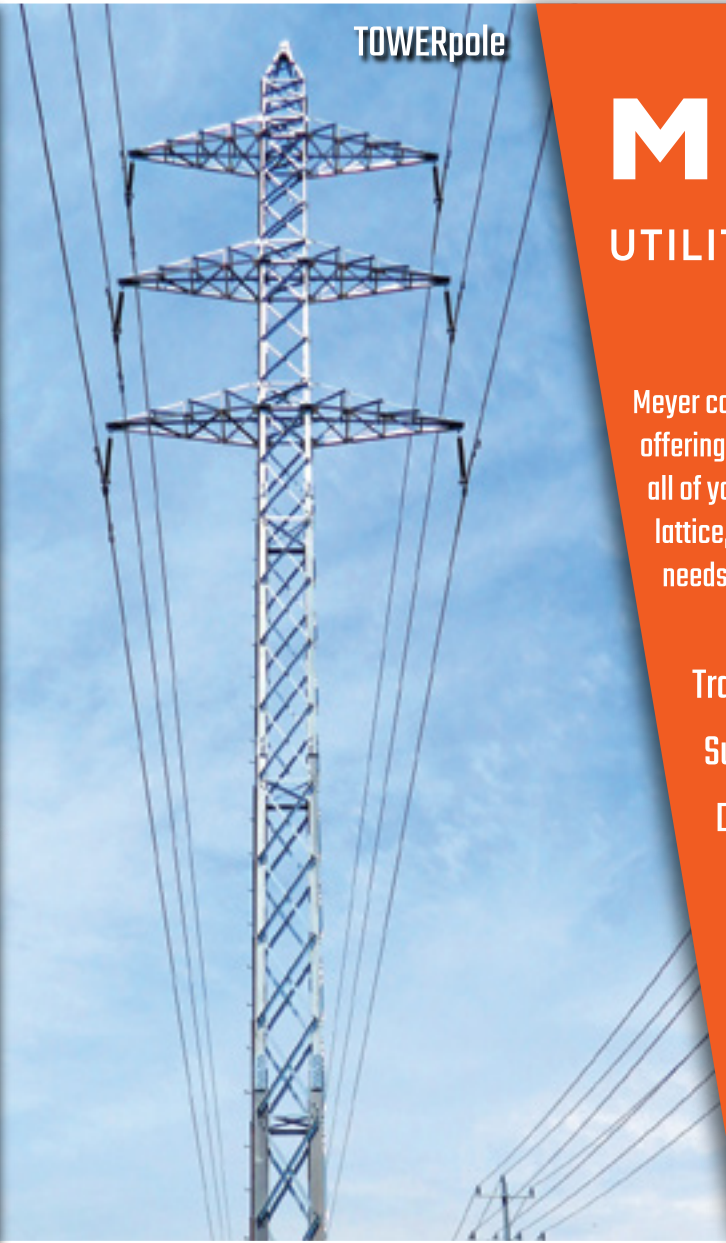
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INNOVATION AND THE NEW, VIRTUAL NORM



ELISABETH MONAGHAN
Editor in Chief

In March, I wrote about the uncertainty utility providers and consumers around the world were facing because of COVID-19. At the time, the United States was just beginning to adopt policies to address the pandemic.

Without a consensus among state and federal leaders on the severity of the virus, medical professionals, schools and businesses had to figure out quickly how best to connect with their employees, customers, industry partners and countless others while practicing social distancing. On top of this, they had to adjust their daily operations to provide the tools necessary so their staff members who interacted in-person with customers or co-workers could do their job safely and efficiently.

In that column, I wrote that I believed innovation and resourcefulness would play key roles in getting the electric energy industry through the pandemic. I also surmised that communication and best practice-sharing would make it easier for utilities and their customers to rebound from the pandemic and its impact on the energy grid.

Here we are, six months later, and based on the information presented in this issue of *EET&D Magazine*, the electric energy sector has indeed demonstrated an abundance of resourcefulness and innovation in its response to the pandemic. Following is a sampling of adaptability and innovative approaches utilities and industry partners have taken over the past several months to address electric energy during the pandemic and beyond.

Quick response through adaptation

When the stay-at-home order was first mandated, New England-based energy provider Eversource took immediate action to protect its staff and customer base of nearly four million. In this issue's *Grid Transformation Forum*, Tilak Subrahmanian and Frank Gundal from Eversource describe how they adjusted their operations promptly when the shelter-in-place order was issued. Once the order was lifted, Eversource had to make additional adjustments to their safety guidelines and protocols to ensure they met their customers' energy needs while safeguarding fieldworkers and those involved with onsite operations remained safe.

Remote management

Bill Moore, who is the founder and CEO of Annapolis-based Xona, writes about the impact the pandemic had on the way we conduct business. As Moore explains, "People's daily lives were transformed virtually overnight as businesses closed their doors and remote work became the default arrangement for hundreds of millions of employees."

Currently, more employees are returning to work, but chances are a hybrid workforce, consisting of those who work remotely, and those who work on-site or in the field, will become commonplace—not just in the energy sector—but across all industries.

Moore makes a case for remote operations, while also identifying considerations companies should keep in mind so that those changes they make are effective and sustainable. One of the key takeaways from Moore's article is that organizations that did not yet have processes in place for remote operations were at a significant disadvantage when the pandemic took hold. Quoting an assessment of COVID's impact on the energy sector, Moore reminds us that the pandemic should serve as a catalyst to future work processes by "rethinking how and where work is done and accelerating adoption of automation and digital capabilities."

In "A Three-Part Guide to Remote Utility Management Through the Pandemic and Beyond," Mike McGann, vice president of Sensus, Americas, writes about the perseverance and ingenuity that many utilities showed during the shelter-in-place order. Building on Bill Moore's point about the shift towards a hybrid workforce of remote and on-site employees, McGann explains how, with more employees working remotely, combined with greater adoption of video conferencing platforms to connect with colleagues in real-time, businesses must remain invested in technology that allows them to operate remotely.

McGann's guidelines for utilities is not a daunting list of financial investments utilities must make to improve their ability to ramp up remote operations. Instead, his is a common-sense approach that, if followed, will allow for a smoother transition to remote operations. That way, the next time there is an event that requires social distancing or telecommuting, utilities will be prepared.

Demand response

Just as Mike McGann offers guidelines for deploying processes for long-term remote operations, Erika Diamond with EnergyHub talks about steps utilities should consider taking to meet their demand response goals. With more consumers working from home while the shelter-in-place orders were in effect, utilities saw changes in peak loads, which meant they had to juggle higher peak loads more frequently.

Diamond points to Distributed Energy Resources (DERs) as a way to manage residential demand response. Calling upon her company's experience with DERs, Diamond lists five steps to help utilities "just starting on their journey to draw value from DERs." Diamond expects that if utilities follow these steps, they will see improved engagement and deeper relationships with their customers.

Learning from experience

The pandemic has taken a tremendous toll on our collective psyche and our global economy. It is likely the pandemic will continue to impact our daily lives, and the reality is, we may not return to life exactly as it was before the COVID-19 outbreak.

Uncertain as to what was in store, utilities got to work, identifying both short- and long-term solutions to keep their employees and customers safe, while also mitigating disruption of the grid. The articles in this Q4 issue represent some of the most compelling strategies and lessons-learned while sheltering-in-place. These same solutions can be leveraged to guide the industry through whatever unknown disaster may strike in the future.

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

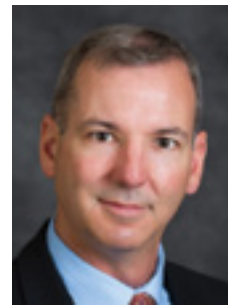
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EVERSOURCE ENERGY: LESSONS LEARNED WHILE SHELTERING-IN-PLACE



The COVID-19 pandemic has been challenging for many industries, including electric energy and efficiency. For the Q4 Grid Transformation Forum section, we spoke with Tilak Subrahmanian and Frank Gundal from Eversource to discuss how the pandemic has affected the company's nationally recognized energy efficiency programs and its customers and how the company responded. They also share best practices they learned from this experience.



EET&D: How has COVID-19 impacted your energy efficiency business and your customers? Did you notice any trends during this time?

Subrahmanian: We have approximately four million customers in Connecticut, Massachusetts and New Hampshire. This pandemic affected all of our customers in some way, but especially our residential customers, many of whom are now using more energy at home.

The month after stay-at-home orders were issued, roughly half of our residential customers saw an increase in their energy use, as they transformed their homes into a workplace, classroom, gym, playground and everything else they needed. That trend continued throughout the summer, along with historic high temperatures, forcing many customers to run air conditioners and fans to keep cool.

Small businesses and municipalities have also been hit hard by COVID-19. We initially saw a dip in energy efficiency projects, as everyone figured out how to adjust to the new normal, but since that adjustment period, we've had many customers come to us looking for help to reduce their energy use and costs to help make ends meet.

We had to adjust, as well. We started working from home mid-March. By the beginning of April, we transitioned our in-person home and small business energy assessment

programs to a virtual offering that protected the health and safety of our customers and contractors. We engaged a health and safety consulting firm, Environmental Health & Engineering, Inc. (EH&E). They developed health and safety guidelines specific to energy efficiency work to allow contractors to go back into customer homes and businesses safely. We started implementing those guidelines in May, and by June, we were able to allow most in-person work to resume. We also increased our incentives for energy-saving measures almost across the board to make it easier for customers to implement these measures without much or any upfront cost. These are unprecedented times, so we'll continue to adjust safety guidelines as the pandemic and the science around it evolves.

EET&D: You mentioned that Eversource transitioned its in-person energy efficiency services to a virtual offering. Can you further explain how you transitioned virtual services during the early stages of the pandemic and in such a short timeframe?

Gundal: At the beginning of the pandemic, New England had thousands of COVID-19 cases. Schools closed, non-essential businesses closed, and non-essential workers were told to stay home. Safety is our number one priority, and we, along with our other utility partners in each state, suspended in-home and in-business energy efficiency services. →





While this was no doubt the right decision, it was hard on the energy efficiency workforce. We work with an extensive network of contractors, many of whom are small businesses themselves, and in many cases, they depend on energy efficiency projects for income. And, of course, we knew residential customers were going to need our help more than ever with ways to save, so we needed to find a way to keep energy efficiency work going while we figured out if, and how, we could resume in-person work.

Subrahmanian: Time was of the essence. It's a point of pride for us that our team, especially in energy efficiency, is nimble and innovative. And it's certainly worth mentioning that we had the support of regulators and stakeholders. We couldn't have done it without their support. But really what it came down to was that our customers had an immediate need. From our experience with the 2008 recession, we knew energy efficiency would play an important role in the economic recovery to come. Our team went above and beyond to focus its best efforts on figuring out how to do assessments virtually and make those available to our customers as soon as possible.

We've completed more than 2,200 virtual energy assessments to date and will likely keep offering them even once COVID is a thing of the past. And while you can't do everything virtually, they did help our workforce maintain some level of work during the shutdown and fill their project pipelines so that they could get back to in-person work quickly once it was safe to do so.

EET&D: Talk about the health and safety guidelines you implemented to resume in-person work. Why was establishing industry-specific health and safety guidelines for your contractors so important? My understanding is that this wasn't only an Eversource initiative; it was implemented across the region.

Gundal: Correct, we understood that many of our contractors work across utility service territories and even across states. For us to really protect our customers and the workforce, any effort to implement safety standards or guidelines needed to be coordinated. Fortunately, we regularly work with the different energy efficiency program administrators under the statewide energy efficiency

brands in each of our states – Energize Connecticut, Mass Save and NHSaves. It was really just a matter of bringing everyone together to roll these out under the statewide brands. National Grid also decided to implement them in their Rhode Island territory, so it became a four-state effort covering most of New England.

But to your comment on why having guidelines specific to energy efficiency was important to us, there were, and still are, so many unknowns when it comes to COVID-19. We were the first to admit that this is not our area of expertise, which is why we brought EH&E in to develop these guidelines for our contractors. And again, because of the unknowns around COVID-19, even though there was guidance out there, we wanted to make sure we were doing everything we could to minimize risk for our customers and contractors and really needed to have confidence that any sort of health and safety guidelines would, in fact, protect people as they go about energy efficiency projects.

As to the guidelines themselves, we started with work that could be done with little to no customer contact. Starting with weatherization that could be done from the exterior of the home or unoccupied spaces, like unfinished basements or attics, and then following that with C&I work that could be done either from the building exterior or inside empty buildings. Finally, we developed guidelines for PPE, sanitation, etc., that allowed pretty much all work to resume.

EET&D: Did you have to make significant adjustments to the guidelines since issuing the first set in May?

Gundal: The short answer is yes, although I wouldn't say the adjustments were significant. The ultimate goal for these guidelines is to keep our customers and the contractor community safe and healthy while enabling these professionals to get back to work bringing these cost-saving solutions to customers and providing for their families. Our contractors have been instrumental in helping to refine the protocols to ensure that they're applicable to the work being done in the field.

While EH&E was and still is, the authority on what needs to be done from a health and safety perspective, they rely on the feedback of contractors and program administrators to help them understand how the guidelines work in practice. For example, there have been shortages of N95 masks, and many of our contractors were having trouble sourcing them. EH&E was able to provide some guidance on other acceptable face coverings that offer the same or greater protection.

We also learned that we needed to be more specific as to why a contractor was entering a home or business. The initial guidance was to wear full PPE from head-to-toe any time the contractor entered a home or business. But we realized that was a little overkill if the contractor was simply visiting a business for a meeting with the customer.

We clarified that they still needed to wear the highest level of PPE if they were in a home or doing actual installation work, handling supplies, etc., but if they were just visiting the business for a meeting or visual inspection they would be fine with a lower level of PPE. As we've seen with most everything related to the pandemic, that coordination and flexibility are key to implementing best practices as the experts' understanding of the virus continues to evolve.

EET&D: Were there any practices in place prior to the pandemic that have proven helpful during this time?

Subrahmanian: I've already talked about our team's ability to innovate and deliver solutions quickly, and I think that really is a product of our culture. We try as much as possible to recruit talent from outside of the utility industry. We also look at what is driving success in other industries and do our best to implement those strategies to improve how we deliver energy savings to our customers. We don't accept the excuse of "It's always been done this way," to justify how we go about delivering for our customers. Of course, not everything translates in a utility context, and we also have a wealth of institutional experience to draw from. But that focus on innovation is what has made us the #1 energy efficiency provider in the nation and has also served us well these past few months. This is new territory for everyone, for sure, but going into it with that expectation of innovation is what allowed us to act quickly and continue to adjust.

EET&D: According to the political advocacy group E2, clean energy unemployment claims are a little over a half a million and seemed to have stalled. How do you see energy efficiency helping New England's economic recovery? More broadly, what are your thoughts on the clean energy industry over the next few years?

Subrahmanian: States in our service territory all have ambitious clean energy goals to reduce carbon emissions and transition to renewable sources of energy, which includes aggressive decarbonization efforts in the transportation, industrial and building sectors. Energy efficiency is a big part of these efforts across each state, as it not only drives down carbon emissions but it also provides a tremendous economic benefit through jobs and customer cost-savings. Not only is clean energy an environmental imperative; it drives economic development.

The pandemic certainly slowed down energy efficiency work, but there is an opportunity now for it to be a significant part of our region's economic recovery. In New England, a lot of our existing residential and commercial building stock is older and can benefit from upgrades and retrocommissioning efforts. Specifically, near-term investments in energy-efficient HVAC equipment, air purifiers and advanced system controls not only put contractors back to work and deliver customer cost-savings and operational benefits, but they also create healthier living and working spaces with improved air quality. →



We continue to engage elected officials, regulators, community leaders, and other key stakeholders about the critical role clean energy, particularly energy efficiency, can play in our economic recovery in the coming months. Looking ahead, I see the energy efficiency and clean energy industries continuing to expand. There seems to be an understanding that while the pandemic is the most pressing issue currently, we can't lose sight of climate goals. Leaders are looking for ways to stimulate economic growth and lower carbon emissions, and energy efficiency does just that.

ABOUT THE AUTHORS

Vice President, Energy Efficiency for Eversource, **Tilak Subrahmanian** leads a team focused on scaling energy efficiency, peak demand management, storage and electric vehicles to develop the clean energy ecosystem in the Northeast. Subrahmanian oversees one of the largest energy efficiency portfolios in the industry, and his team works closely with business partners and communities to help shape strong, environmentally sound energy policy.

Subrahmanian earned an MBA from the University of Michigan, an M.S in engineering from the University of Washington and a BTech, engineering from the Indian Institute of Technology, Madras.

Director of Energy Efficiency Implementation for Eversource, **Frank Gundal** has played an instrumental role in the development of go-to-market strategies that have earned national recognition. He has also championed new ways of delivering energy efficiency more cost-effectively and helped drive forward-thinking energy efficiency and clean energy policies. Most recently, he helped lead a regional response to the COVID-19 pandemic, helping to protect customer and contractor health while minimizing economic impacts. Gundal earned a B.S. in engineering from University of Massachusetts – Amherst.

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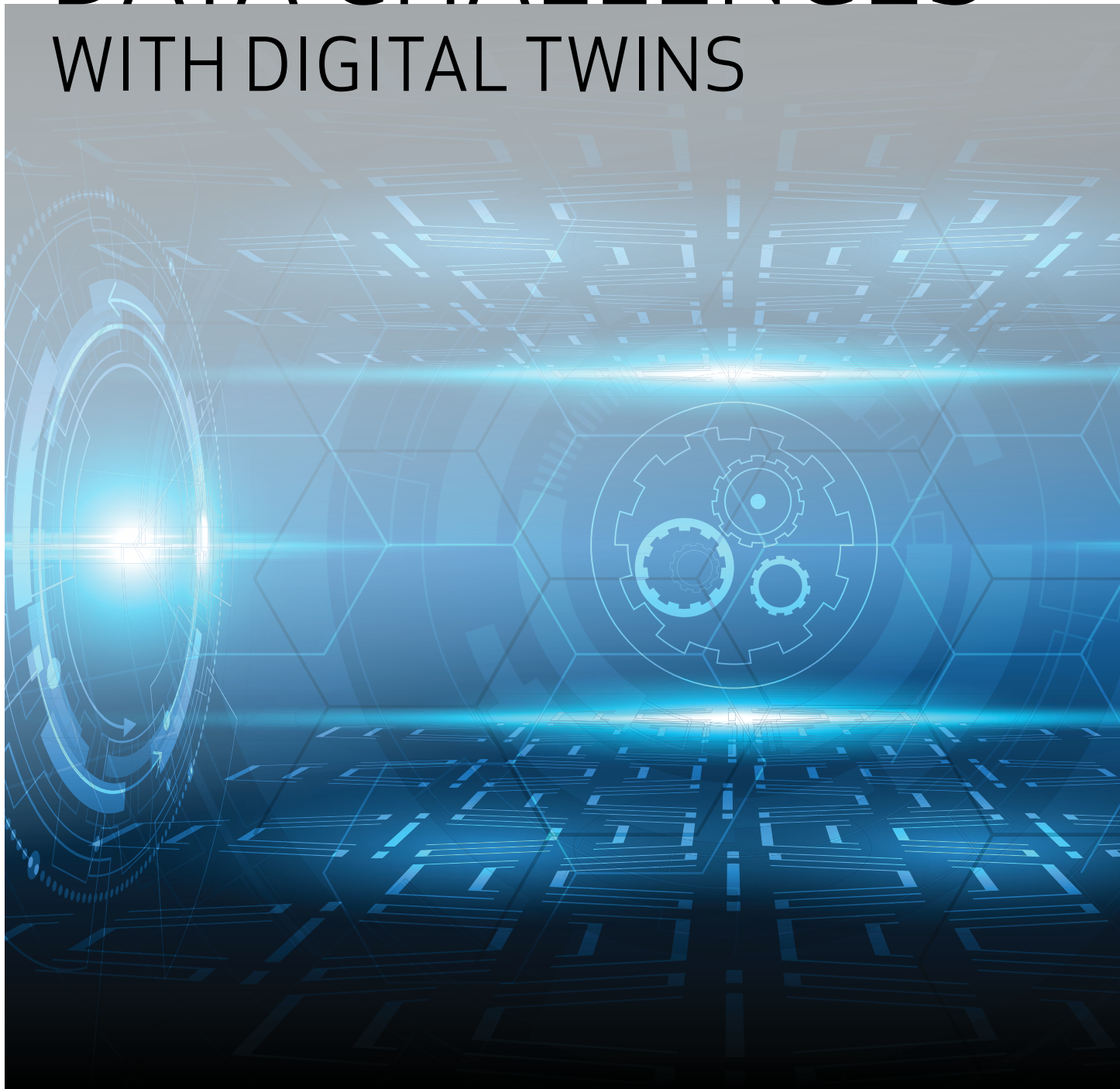
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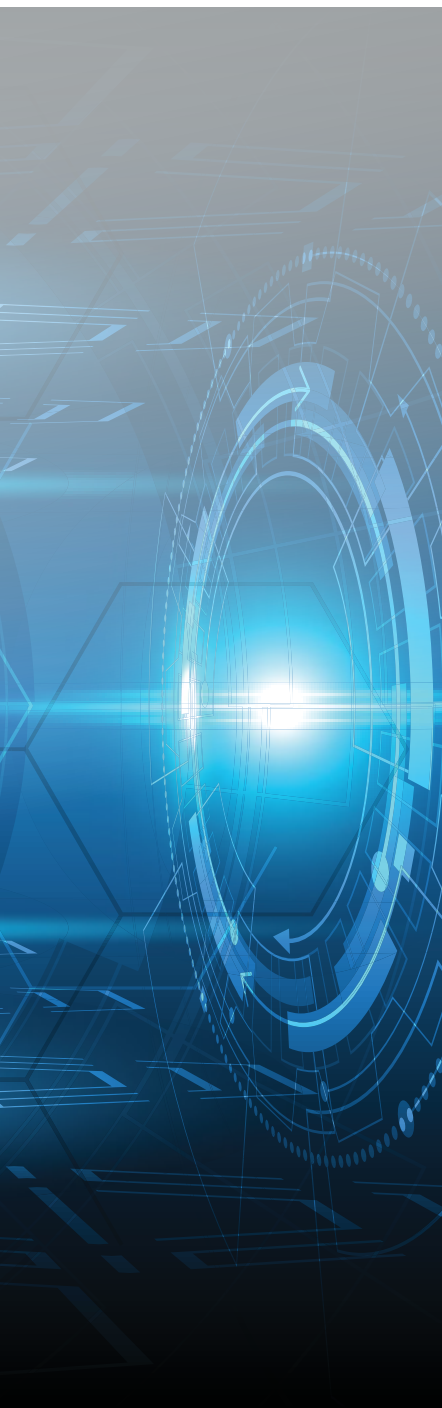
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SOLVING UTILITIES' DATA CHALLENGES WITH DIGITAL TWINS





VONNIE SMITH AND JIM TAYLOR

To understand the value of digital twins for the utility sector, we hear from two industry leaders whose companies' partnership has helped shape grid modernization strategies for the utilities of the future.

Q: What value is digital twins providing to utilities?

Vonnie Smith: Utilities have a ton of data, and they are facing tremendous challenges dealing with decentralization, electric vehicles, and changing customer demands and expectations. These challenges are putting pressure on utilities to access the right data at the right time. Historically, the data has been siloed in many locations, and it is through digital twins that utilities can consolidate the data, federate it and validate that it is aligned and is of the appropriate accuracy and fidelity. What digital twins give to utility owner-operators is the ability to easily access multiple sources of data across various formats and quickly gain insights to make more informed decisions.

Jim Taylor: Digital twins were originally developed out of industrial process or manufacturing environments, where it made sense to digitally model exactly how your process or your production facilities were going to operate. Using a digital twin, you can make changes in a virtual world and see how those changes will affect the process and its outcomes. Now, digital twins are being adopted by the utility industry. There can be multiple digital twins in a utility environment depending on the function or operation you're trying to emulate. You might have a planning digital twin, an operational digital twin, an asset digital twin, or a geographical digital twin. Some of them can cross each other and support each other. Others may be stand-alone digital twins. But the concept is the same. A digital twin helps us mirror what would happen in real-time in the field and reality, versus what we can do to model and emulate it in a digital environment. →

Q: What is the value of partnering with other industry leaders?

Taylor: When industry leaders work together, they can leverage each company's expertise.

For example, an industry leader with expertise in graphics and mapping capabilities as well as other related functions, teams up with a company that focuses more on the analytics engineering side of things, from a planning operational perspective. By joining these two fields, the companies can deliver better solutions to utilities for what's driving their future needs will combine multiple information modeling services to improve the lifecycle management and operational performance, safety, compliance, and governance of infrastructure assets while increasing the return on investment for owner-operators.

Q: What is an example of how Digital Twin Services help to advance utilities?

Smith: Utilities have to deal with hundreds, even thousands of requests to connect distributed energy into their electricity grids. To do that, they need to have access to information in multiple connected systems. They need to have access to information from the GIS system, and they need to have all of that balanced against the design information. For example, one Digital Twin service brings all that information together — through cloud services, providing digital workflows that are so visual they allow the user to become immersed in the visual environment. They provide a solution for decision-support. With built-in analytics and insights, tasks previously performed by engineers can now be done by customer service personnel. With engineering analysis at their fingertips, they only need to call upon the engineer in challenging situations. This means the utility is able to solve DER problems with a digital twin solution that is much more deployable and less expensive for the utility.

Q: What does going digital mean to you?

Smith: Going digital means utility organizations gain visibility into the data they need to solve the problems they have been dealing with for many years. For example, for substations, being able to produce greenfield and brown-field designs up to 40 percent faster. Or speeding project collaboration and coordination by bringing together electrical and physical design in the digital twin. Digitalization helps to avoid rework, reduce errors, and enhance collaboration. In operations, going digital means optimizing processes with day-to-day visibility of asset health to keep the lights on and minimize operational costs.

It means being able to provide whole lifecycle solutions to utility organizations. No longer do they have to guess, infer, or approximate information about assets or network

configurations. By providing an “evergreen” digital twin, the world can change within the utility organization. Digital twins are important because they are a step forward for technology, for usability, and for providing organizations and their customers with the solutions they need to manage projects and assets in a digital world.

Taylor: Going digital is how we turn traditional devices and capabilities into effective data collection and processing at an enterprise level. It's about adding sensors and devices in the field or from a geospatial information system perspective, where we have the capability to digitize it and use new visual capabilities to see the data and reflect on what the data might mean.

Q: How has digital advancement evolved in utilities?

Taylor: Digital advancement is a new term, but it has been in development for a long time — years, in fact. When IT organizations became involved in operational technologies, they helped implement different software applications to store and analyze data from devices installed within the utilities. Digitalization continues to evolve, and it isn't possible to pinpoint a time where it started. However, we can say that it has been evolving faster over the past 10 or 15 years for most utilities. Digitalization is becoming more prominent because we have enough equipment, systems, and other components in the field to make business-level decisions from the information. We have enough data-gathering devices, and that data has really become an important asset to utilities. The companies that can take advantage of their data are those that are going to succeed.

Q: What is influencing utilities today in their ability to change and advance digitally?

Taylor: It's all about the utility's ability to gain insights into their data in a timely manner to make the best decisions. Having all these new digital capabilities to generate data and sensing devices in the field provides the utility with the opportunity to produce a lot of data. We will continue to advance digitally if that data can be fully leveraged and measured to add value to the utility.

Q: What excites you about how things are getting done now versus what was traditionally done previously?

Taylor: Now is a really exciting time in the industry. There are so many electronic devices that we can use to collect meaningful data. Digitalization is really about collecting and processing data to solve a lot of problems that we couldn't in the past. Now, we're able to simulate and see what's happening to the systems in real-time. In the past, we were using what I would call a “gut feeling” to do what we thought was right. Now, we actually can simulate very complex systems or problems and have an engineering view of what really is happening and why.



Q: Where does someone begin using digital twins?

Smith: Whether they started using CAD software many years ago and are designing and delivering projects, or they are working in utility operations using asset information management software to improve the performance of their assets, ultimately, we want to move our utility customers from where they are to where they would like to be — digitally advancing, using digital twins. We believe we can do that by working with our users to get them, incrementally, to the next step.

ABOUT THE AUTHORS:

Vonnie Smith is vice president of Energy and Communications Infrastructure at Bentley, where she is responsible for products, solutions and consulting to the energy utilities and communications markets. Smith joined Bentley in 2005 and has worked in leadership capacities related to digital transformation, asset performance, infrastructure design and operations, project delivery and geographic information systems (GIS). Smith has a Bachelor of Science in electrical engineering from the University of Texas at Austin, with a specialization in electric power systems.

Jim Taylor is currently the VP, business development and strategy for Siemens Smart Infrastructure, Digital Grid. His professional experience includes 10 years of power substation and distribution operations and maintenance with Barrick Goldstrike Mine in Elko Nevada and two years substation commissioning and electrical maintenance with Power Engineers. The experience has provided a unique understanding and need for management of reliability, environmental sustainability and fiscal responsibility within the utility environment. Taylor has a B.S. in electrical engineering from the University of Wyoming. He also holds a Professional Engineer license and is a licensed journeyman electrician.

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ADDING AND ADAPTING DEMAND RESPONSE PROGRAMS DESPITE COVID-19

ERIKA DIAMOND

COVID-19 has had a significant impact on energy demand as a result of business closures and quarantine behavior. But overall reduction in demand due to COVID-19 has not triggered the abandonment of utilities' demand response goals.

Rapidly evolving energy consumption patterns as a result of COVID-19 have created an unusual challenge that demand response programs can help address. With continuity plans in place, utilities continue to rely on these programs to provide valuable grid services during this crisis. As we look ahead, the role of demand response may become even more important as utilities look for solutions to create flexibility on the grid that do not require sending workers into the field. Rather than physical solutions, utilities will increasingly need to rely on demand response to strengthen grid resilience, reduce risk, and smooth congestion challenges.

Distributed energy resources (DERs) provide a way for utilities to make the necessary adjustments to accommodate COVID-19's impacts on customer behavior and thus grid needs.

Utilities have seen an evolving role for DERs within the context of COVID-19.

The importance of residential demand response will rise relative to commercial and industrial

Residential demand response may become more important than it has been in previous years. The great advantages of residential DER programs are that they bring visibility and control to the utility, even in traditional dark spots behind the meter. In pre-COVID-19 times, these programs helped utilities to make a successful transition to a world where an electric vehicle sits in the garage, a battery in the basement and a smart thermostat on the wall. Post-COVID-19 residential loads can have more of an impact on system-wide peaks than usual.

While commercial and industrial (C&I) loads have decreased, residential load has increased due to the high number of people staying at home throughout the day. Early studies indicate homes have increased their daytime energy usage by up to 25 percent. A recent survey suggests that nearly three-quarters of the American public are still not engaging in a "normal" level of out-of-home activity and do not plan to increase their engagement in the short term¹.

This all means that residential demand response may need to continue to play an outsized role relative to C&I programs. →

¹ <https://www.mckinsey.com/business-functions/marketing-and-sales/our-insights/survey-us-consumer-sentiment-during-the-coronavirus-crisis>



Quarantine has not compromised demand response performance

Utilities have typically been able to meet their goals according to data collated to monitor the performance of demand response events. Utilities could see a higher rate of customers opting out of demand response events during the COVID-19 crisis. However, a higher overall residential load means a utility may achieve their desired total kW load shed for an event, even if the average percentage load reduction per device is lower than usual.

In general, utilities should avoid overestimating the negative impact of customers opting out. Demand response participation is not all or nothing. The average customer who opts out during a demand response event still contributes about 50 percent of the load shed of a customer that fully participates.

Finally, utilities have room to focus their demand response strategy on meeting their top priority goals. A typical demand response season includes a degree of experimentation, typically 5-20 events per season. To ensure customer comfort and reduce opt-outs, utilities can choose to focus on where load is needed most in order to ensure the system gets as much of a load reduction as possible during a select few events.

The crisis will pass. Utilities must not lose focus of the long-term

The planning horizon for most utilities is closer to ten years than one. Utilities launch DER programs to build resources that will have a positive impact on the grid for years to come. While overall load may have reduced this summer, utilities are continuing to grow their demand response programs in line with their long-term goals. Utilities have not lost focus on mitigating the risks to the grid that existing shifts are bringing, such as increasing renewable penetration and the rapid uptake of electric vehicles.

For those utilities just starting on their journey to draw value from DERs, here are five tips based on our experience of implementing, growing, and evolving DER programs across more than 50 utilities.

1. Let the customer choose

A bring-your-own-device (BYOD) approach empowers the customer and removes barriers such as having to purchase a specific device to participate. Customers have the flexibility to join a DER program through the device provider of their choice.

BYOD programs allow customers to participate in utility programs with their own equipment. This enables utilities to build a demand response resource without a truck roll.

In normal times, the BYOD model holds several advantages for utilities including cost-effectiveness, improved customer comfort, and enhanced customer choice. During the COVID-19 crisis, the BYOD model offers a way to scale demand response programs while keeping utility employees and customers safe since there is no need to enter homes to grow the resource.

The BYOD model also affords utility customers the ability to manage their participation in demand response events, directly through their connected thermostat of choice. This should reduce call center volumes, especially during a summer in which many switch customers at home may want more participation flexibility during demand response events.

2. Go to the customer, don't expect them to come to you

Utility programs may produce lower levels of engagement when they require the customer to participate through the utility's app versus the native thermostat app. The fact is, you have to meet customers where they are.

If a customer has gone out and spent hundreds of dollars on a thermostat or another type of DER, then they probably feel some loyalty towards that brand and likely use the device's native app. Asking them to then download another completely separate app adds a layer of friction. Instead, work with device manufacturers and recruit participants through their channels. Working with thermostat brands to implement in-app program marketing and enrolment, we see program enrolment rates rise from under 10 percent to upwards of 30 percent.

3. Minimize friction in the enrolment process

Make the enrollment process as simple as possible to ensure interested customers do not miss out on participating.

For example, try to require as little information as possible in the sign-up process. Asking for a customer's utility account number is an example of a barrier to enrollment. In side-by-side comparisons, we've seen enrollment rates in the single digits when the account number is required, versus 40 percent or greater without the requirement.

Similarly, don't let language be a barrier. Try to avoid industry jargon and stress customer choice and comfort when describing DER programs to customers.

4. Get the incentives right

Putting cash in customers' pockets while meeting grid needs is a win-win that is especially important now. We've even seen some of the utilities we work with go above and beyond by further paying down the cost of a connected thermostat in their marketplaces so customers can purchase an energy-saving device. It's a meaningful gesture to support customers during these tough times.

You have to explain customer incentives in terms that are easy for consumers to understand. Flat incentives are preferred over performance-based incentives because customers likely won't understand an incentive, based on kilowatt hours or other performance metrics. An upfront incentive ensures customers will see an immediate benefit to participating. Second, make sure the incentive is attractive enough. Every utility will have a different cost-effectiveness number, but generally speaking, as close to \$100 total incentive will optimize enrolments.

Utilities can also experiment with creative incentives. For example, we've worked with utilities to partner with Google and offer a Google Home Mini as part of a program incentive for a limited period. We've even seen a utility successfully run a sweepstake to reduce incentive costs.

5. Keep customers comfortable

Programs must be designed to maximize both load-shed and comfort. If you cut corners on customer satisfaction, then you will simply get less customer participation in the program (and therefore, less value).

With thermostat programs, we encourage clients to do a longer pre-cool. It keeps customers more comfortable and maximizes load shed for each device.

Similarly, make sure there is always an opt-out for participating in demand response (DR) events. Even if a customer never uses the option, having the choice puts their mind at ease. Those who do opt-out of an event typically still deliver on average 50 percent of the load shed of customers who participate fully.

Next steps

As utilities explore different avenues for demand response, they should look to a solution that can meet grid needs while prioritizing the customer experience. Utilities should look for a solution that enables customer choice, manages multiple classes of DERs at scale, and integrates with complementary utility systems to unlock value across the enterprise. Designing DER programs that meet the criteria mentioned above can help utilities meet their goals even during challenging times such as the current pandemic.

If utilities plan ahead and deploy a scalable DERMS platform for their demand response programs, they can benefit more readily from the opportunities provided by the ongoing evolution of the grid. This will pave the way for them to achieve their strategic goals, extract operational grid value, and ultimately deepen relationships with their customers.



ABOUT THE AUTHOR:

Erika Diamond is the VP of Utility and Market Services at EnergyHub, where she oversees program delivery, customer engagement and market development. With more than 15 years of experience in the energy space, Diamond is EnergyHub's resident expert on wholesale energy markets, customer marketing/engagement and regulatory affairs. She is a frequent speaker on the energy conference circuit and is the vice-chair of the Advanced Energy Management Alliance (AEMA) and co-chair of the Women in Demand Management group of the Peak Load Management Alliance (PLMA).

Diamond holds a Bachelor of Arts in environmental studies from Vassar College, an MESc from the Yale School of Forestry and Environmental Studies, and an MBA from the Harvard Business School.

MAXIMIZING MICROGRID RESILIENCY THROUGH INTEGRATED AUTOMATION STRATEGIES

RICK KEPHART

Now, more than ever, communities ranging from metropolitan areas to educational or medical campuses need emergency preparedness plans that include contingencies for widespread power disruptions or long-term outages caused by unforeseen incidents such as severe storms or wide-spread fires. Microgrids offer one solution to providing reliable, uninterrupted power during emergency events.

Balancing the mix of traditional fossil generators with renewable or alternative assets—each with its own dedicated control and monitoring system—within a microgrid presents unique challenges. Use of multiple, standalone systems limits the broad information-sharing necessary for optimal operational efficiency. This includes sharing the massive amounts of data created from connectivity with the Industrial Internet of Things (IIoT) and converting that data into actionable information. Additionally, each system requires its own set of HMIs, graphics and control standards as well as spare parts, training and service. These factors can hinder operator performance, increase maintenance costs and delay service time.

How do microgrid owners embrace innovation while leveraging existing investments? How do they adapt to new technology without increasing operating and maintenance costs? How can they help their personnel evolve with rapid technology changes?

Implementing a single-platform automation strategy for microgrid management mitigates the inefficiencies of disparate systems and provides numerous operational, maintenance and financial benefits. This is not a new concept: Utilities and independent power producers have a long history of implementing similar strategies with field-proven technologies on the bulk power system to cost-effectively manage vital geographically dispersed generating assets.

By selecting the right scalable, secure platform and services, through a safe supply chain, microgrid owners can digitally transform their operations by leveraging IIoT across their infrastructure. Providing access to better data and digital intelligence can dramatically improve the speed and accuracy of decision-making and actions based on having the right information in the hands of the right expert ... no matter where they sit.

An integrated distributed control and SCADA platform efficiently manages a microgrid's distributed energy assets to cost-effectively produce low-carbon electricity while maintaining grid stability and operational resiliency. A unified system maximizes microgrid resiliency through on-demand, grid-connected and islanded control. It reliably automates control of all microgrid components and macrogrid interconnections to satisfy power demand and maintain stable operating conditions in the event of a macrogrid electrical disturbance. Should a weather or other emergency event disrupt grid operation, customers using this technology can safely disconnect and operate autonomously. When connected, the microgrid can draw supplemental power from the grid if needed or sell excess power back to the grid.

A comprehensive microgrid manager consists of standard integrated functions such as data acquisition, alarm management and historical archiving, as well as embedded energy management and electrical control applications. Energy management strategies optimize power production, power purchasing, energy storage and demand response; protect the microgrid from high macrogrid demand charges and manage energy flow and voltage regulation at the point of common coupling. Electrical applications include breaker control and interfacing with intelligent electronic devices (IEDs), load-shedding (demand management), voltage control and grid synchronization. →





Scalable, robust controllers cost-effectively extend the centralized system to widely distributed assets or applications that require direct control near microgrid generators or equipment. The controllers use built-in, flexible networking capability via local or wide-area networks, such as cell or wireless communication technologies, to help manage vital distributed assets. The controllers and associated control strategies can be easily engineered and added to the overall architecture, as needed, to accommodate microgrid additions or process changes. Microgrid owners can leverage existing investments through native data link protocols that connect the platform to a host of Ethernet-enabled devices that are typically provided as part of packaged equipment purchases such as battery management systems and photovoltaic power inverters.

Common HMI, engineering tools, hardware and software used within that platform enhance operator decision-making by presenting a single comprehensive view of all microgrid processes; simplifies control changes and troubleshooting while enabling in-house maintenance; and reduces maintenance costs associated with spare parts, service and training.

Additionally, cybersecurity programs designed specifically for industrial control system environments can be easily applied to protect common industrial control system equipment and network components. Comprehensive security solutions and services bridge the gap between operational technology (OT) and information technology (IT) to mitigate risk and maintain reliable operation by proactively addressing threats, enhancing protection and streamlining security program management.

Unplanned downtime—the loss of production availability—is one of the biggest causes of reduced profitability, not to mention safety and compliance risk. These unplanned outages result in excessive maintenance, repair and equipment replacement. The ability to incorporate new, transformative technology into a single microgrid management system

positions staff as the front-line-of-defense to changing conditions or emerging issues using a proactive rather than reactive approach.

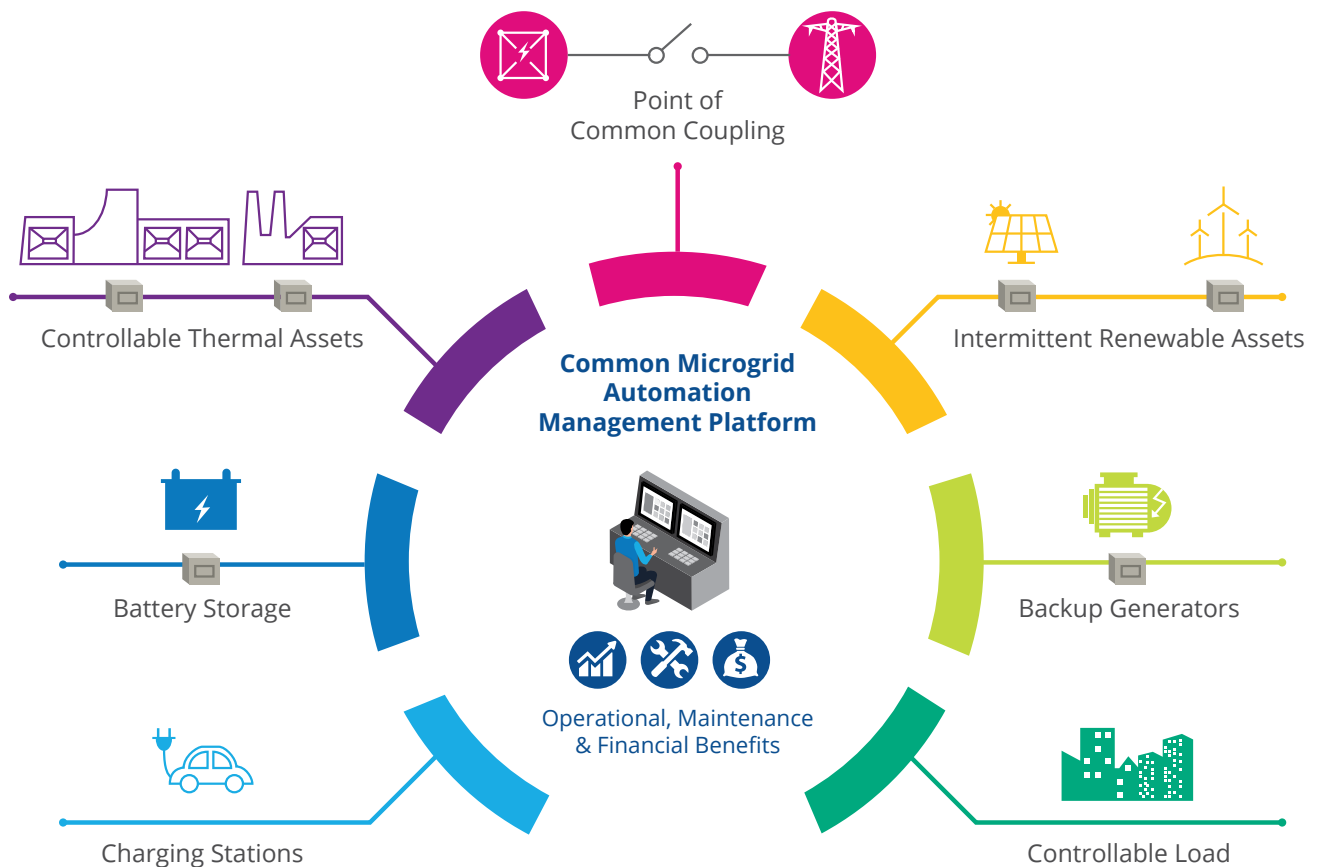
Four of the most significant automation technology developments in this era of digitalization that empower a microgrid's workforce are analytics, digital twin, mobile and remote work and cloud-based services; all of which can be embedded in a unified automation and software platform. A centralized microgrid manager enables engineering applications in the cloud, viewing of process conditions on a mobile device and optimizing operator performance using analytics and digital twin simulation.

Digital twin simulation enables microgrid owners to test new or updated control and operating strategies in a reliable, risk-free environment that mirrors real-life operating conditions. Cloud-hosted digital twin and engineering services supplement limited onsite resources and reduce maintenance burdens. This is possible by allowing the automation provider to establish and manage an easily accessible cloud-based simulator or engineering environment.

Advanced analytics transition customers from a reactive operations and maintenance approach to a predictive or prognostic strategy, which helps extend equipment life and reduces overall costs while increasing plant safety, reliability and availability. Analytical solutions bring together the automation platform, an intelligence framework and prognostic applications to deliver advanced diagnostics that identify impending process upsets or equipment anomalies and trigger mitigating action to avoid downtime or catastrophic damage. Prognostic advanced applications provide complex modeling, artificial intelligence, based on advanced pattern recognition (APR) and machine learning functions while interacting with an intelligence framework and data from the automation platform. Collectively, they alert and guide operators to take immediate, specific action or direct the control system to do the same to avert future, potentially catastrophic equipment or process failures.

Integrated enterprise data solutions provide microgrid staff secure, remote access to enterprise-wide key performance indicators, enabling them to make well-informed decisions that can improve operations and reduce costs. Mobile deployment enables on-demand process monitoring from virtually anywhere to assist onsite operators with decision-making.

As technology advances and interest in energy independence and renewable generation grows, microgrids are becoming more prevalent. And as they gain traction, they will begin to reshape the power generation sector. An integrated automation platform can play an important role in helping organizations operate their microgrids more efficiently and reliably.



Implementing a single-platform automation strategy for microgrid management mitigates the inefficiencies of disparate systems and provides numerous operational, maintenance and financial benefits.



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THE MOVING TARGETS OF RELIABILITY AND RESILIENCE

BRIAN LEVITE

When the lights go out and people hear the telltale whine of computer fans slowing to a stop, the energy system that supports most aspects of daily life becomes truly visible because of its sudden absence. It's at this point utilities and their customers alike wonder: Will the power be out for a minute? An hour? A week?

In any of those scenarios, a power outage will affect the economy, learning and even public health. So, how do utilities go about prioritizing keeping the lights on or getting them back on quickly when they go out? How much should they spend on *reliability* and *resilience*? How do utilities balance these priorities against each other?

The market increasingly expects energy systems to deliver more services and increase reliability, even as stresses to the system are increasing and our generation base is shifting. When a global pandemic is added to this equation, there is a pace of change utility systems and regulatory models simply aren't designed to handle.

Reliability is typically defined as an energy system's everyday ability to avoid outages and resilience as an energy system's ability to withstand storms and come back online after a major outage. The aging energy grid is not being replaced and updated at the rate needed to stay ahead of worsening reliability numbers. In fact, the American Society of Civil Engineers gives the U.S. energy infrastructure a D+ rating, stating: "Without greater

attention to aging equipment, capacity bottlenecks and increased demand, as well as increasing storm and climate impacts, Americans will likely experience longer and more frequent power interruptions."¹

As people have begun to work and attend school from home, due to the COVID-19 pandemic, energy-demand patterns have changed. While commercial energy demand is down, demand for daytime heating, ventilation and air conditioning (HVAC) and plug loads of residential customers is up, shifting the load burden to different parts of the electricity distribution system. This may affect the loading of circuits and make peak demand a bigger challenge in residential areas.

As some return to work, a societal shift to increased work-from-home policies may make some of this trend permanent. It is clear, though, increased remote work and virtual learning mean power users are more reliant on reliable and resilient electricity service.

So, what investment in reliability would regulators consider appropriate? A 2020 survey of commercial and industrial businesses determined 40 percent of respondents experienced financial impacts of \$50,000 or more during a typical energy outage (with 21 percent of respondents claiming to have outages at least monthly).² →

¹ <https://www.infrastructurereportcard.org/cat-item/energy/>

² <https://www.sandc.com/globalassets/sac-electric/documents/sharepoint/documents---all-documents/technical-paper-100-t125.pdf?dt=637352767010635122>





Solutions to improve reliability exist, such as advanced reclosers, modern grid protection and controls and more aggressive vegetation monitoring and management. The right investment and solutions have to do with what the goals are. If regulators and utilities want to minimize long outages but are okay with more frequent power blinks, intelligent reclosers and switchgear may be the answer. If these parties want the total number of outages reduced, but are okay with a longer response time for each outage, they might shift away from grid investments and focus on vegetation management to minimize temporary faults. If they want reduced blinks, they might focus on using smart technology on laterals at the grid edge.

It is important to note policymakers do not necessarily need to focus on one outcome over another. A balanced approach is possible, but in a capital-scarce environment, understanding outcome preferences will be important.

Energy resilience is a different animal with different strategies to combat it. When a major event takes down the power system, energy resilience is the ability to bring the grid back online quickly (in whole or part).

No part of the country is immune to major disruption events. There are wildfires in the West, ice storms in the North, tornadoes in the Midwest and hurricanes in the East and South. While there is a debate in economic circles around how bad natural disaster damage is for the economy, access to electricity in the days after a natural disaster is critical to saving lives.

Finally, cyberattacks are another threat. In 2016, a malware-based cyberattack shut down one-fifth of Ukraine's electrical grid in what investigators have called a "dry run" for future attacks. Energy systems will be a key target in the international conflicts of the future, making resilience to cyberattacks a matter of national security.

**Energy resilience is a different animal
with different strategies to combat it.**

No matter the cause, the longer the outage, the more aspects of the economy and society will be impacted. This is the "time value of resilience." As society considers where to prioritize energy-resilience investments, we must consider what is most critical. The longer the grid is down, the more aspects of the community are at risk. Increased reliance on electricity and the Internet for commerce and learning will make the impact of every outage more severe. When this is coupled with the changing usage patterns caused by such things as transportation electrification and social distancing, utilities are faced with reevaluating how their energy resilience efforts are directed.

So, how do utilities shape their preparation for major events and ensure grid resilience? If they aim to keep critical facilities such as hospitals and first responders up and running, microgrids and well-communicated disaster preparations are probably the ideal tools for local resilience. If they want to bring the entire system back online as quickly as possible, grid hardening, undergrounding of lines and major investments in self-healing switchgear approaches are likely the smart investments.

Once regulators have prioritized our goals around reliability and resilience, they need ways to realize those goals. The present system of ratemaking throughout most of the U.S. is unlikely to enable rapid transition. First, the metrics used to track reliability (SAIDI and SAIFI) do not typically include power blinks and ignore outages caused by major events. This means the industry is only tracking a subset of outages and are not providing utilities any incentive to dig deeper into the most problematic areas.

SAIDI and SAIFI are also system-average numbers, an approach that can result in making reliable parts of the network even more reliable when that's easier than addressing the worst-performing feeders. There are almost no metrics in U.S. state regulation to address energy resilience. Regulators need a suite of new performance metrics that address all aspects of outage events while also demonstrating the energy resilience of a system.³ These metrics will allow utilities and regulators to more effectively track how they are doing at addressing service challenges and help understand which solutions are working best.

Metrics are not enough, though. Utilities require financial incentives for reliability and resilience innovation. All utilities want to do their best on this front, but building outcomes on these (and other outcomes important to customers) into their financial remuneration will truly unlock the innovation and investment needed to change the grid.

Performance-based regulation (PBR), which involves tying utility profits not simply to capital investment but desired outcomes, has proven to be an effective approach. The global pioneer of PBR has been the UK's RII0 approach. In the first round of this new regulatory scheme, customer satisfaction and reliability increased. Utility profits went up, and customer costs for the distribution grid went down.⁴

Modern energy systems, such as self-healing grids, automatic reclosing technology and non-wires solutions, help utilities mitigate the increasing risks to both reliability and resilience. However, increasing storm activity, an aging grid, and cybersecurity threats will mean more pressure on these solutions.

On a typical day, society demands energy reliability. When things are at their worst, people and businesses desperately need energy resilience. The industry can invest in a reliable electricity system that will minimize outages, and it can invest in a resilient system that will come back online after major outages. Doing this effectively will mean deciding what outcomes are desired most, allocating funding to make the necessary investments and instituting regulatory changes that will allow utilities to see improved financial outcomes from improved customer experiences.

³ You can read the paper on improving reliability here: <https://www.sandc.com/en/gridtalk/2020/july/21/moving-beyond-average-reliability-metrics/>

⁴ <https://www.utilitydive.com/news/uk-riio-sets-out-to-demonstrate-how-a-performance-based-regulatory-model-ca/555761/>



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A THREE-PART GUIDE TO REMOTE UTILITY MANAGEMENT THROUGH THE PANDEMIC AND BEYOND

MIKE MCGANN

If necessity is the mother of invention, then 2020 could prove the most fertile time for technological and operational innovation in decades. The COVID-19 pandemic has upended the world, forcing organizations to rapidly innovate amidst economic uncertainty to ensure safety and continuity of service to their customers.

Technology has been a key enabler of this innovation. While digital transformation is not a new concept, it has taken on new meaning as organizations adapt to the new realities set forth by the pandemic. For example, a survey of 200 retailers administered early in the pandemic found that 25 percent of brick-and-mortar stores launched e-commerce platforms to offset the loss of foot traffic¹, and overall e-commerce sales are expected to jump nearly 20 percent for the year².

Electric utilities reacted similarly, quickly transforming operations to support flexible work arrangements and social distancing. Mindsets shifted from *if* a utility could operate remotely to *how* this would happen. Utilities responded

heroically. Millions of Americans shifted to remote work seamlessly, never wondering what was happening behind the scenes when they plugged in their laptops.

The shift to remote work came with the amplification of customer, operational and employee expectations around digitization of critical utility infrastructure. Nowhere is this more evident than in the demand for remote management of key functions, such as outage management and response, customer usage monitoring and load management, among others.

The demand for remote management is clear, but the path to get there is not. Financial and operational pressures abound for utilities during this uncertain time, creating increased pressure to ensure investments are sound and that technology upgrades scale to meet evolving needs. Following is a guide to exploring and implementing remote management at your organization. →

¹ "The Retail Pivot: How Retailers Have Adapted Through Digital Transformation," June 5, 2020. <https://www.softwareadvice.com/resources/covid-19-digital-transformation-retail/>

² eMarketer, "US Ecommerce 2020," June 8, 2020 <https://www.emarketer.com/content/us-ecommerce-2020>





Part 1: Understand your customer base and operational realities

Millennials surpassed baby boomers as the largest living adult generation in the U.S., according to population estimates from the U.S. Census Bureau³. This means an electric utility's largest customer base is often comprised of individuals who have enjoyed technology from a very young age and their entire working life. Salesforce's *State of the Connected Customer* 2019 report found that 75 percent of customers expect companies to use new technologies to create better experiences, while nearly as many (73 percent) said that one extraordinary experience raises their expectations of other companies⁴. Considering all the ways customers have become accustomed to using digital tools in their personal lives, this also drives expectations around how these customers receive service and information from their utility.

Think about it this way. If these customers want to get healthier, they monitor data from fitness trackers that can tell them how they slept, their heart rate and much more. It is with this same hunger for information that these customers view their electricity usage. They want the ability to peer into their usage and analyze it over time. They want to

compare usage data when they switch to more sustainable appliances and light fixtures. Of equal importance, they want to predict and understand their monthly bill. This expectation has been exacerbated by the pandemic as some customers face job loss and unpredictable income.

“
Residential outage and restoration management also takes on new meaning when customers are working at home, especially given this year's active hurricane season and the winter months ahead.

Running parallel to these evolving customer expectations is changing operational demands. Utilities seeking to better forecast demand have deployed digital solutions to glean more insight into customer usage patterns. Some have transitioned from power-line communication systems and automated meter reading (AMR) to advanced metering infrastructure (AMI) to streamline the data collection process and allow for more accurate meter readings delivered with greater frequency.

³ U.S. Census Bureau; July 1, 2019 <https://www.census.gov/data/datasets/time-series/demo/popest/2010s-national-detail.html>

⁴ ZDNet, “New customer expectations are rewriting the digital transformation playbook,” June 12, 2019 <https://www.zdnet.com/article/rewriting-the-digital-transformation-playbook/>

The pandemic has made these solutions essential due to increasing revenue uncertainty. A recent industry survey conducted of 51 utilities across the electric, gas and water sectors, found that 78 percent of respondents highlighted revenue collection as one of the top challenges they expect to see due to the crisis.

The global shift to remote work has also placed new demands on the grid and disrupted utilities' demand forecasts. More people working at home means more consistent residential energy usage, making accurate peak usage more difficult to predict and load management imperative. Residential outage and restoration management also takes on new meaning when customers are working at home, especially given this year's active hurricane season and the winter months ahead.



Mutual aid workers move quickly to restore power following Hurricane Florence in 2018.

Utilities can look at these demands as challenges, but the other side of this coin is the opportunity to deliver value to both customers and employees while improving asset utilization, operational efficiency and costs. So, how can a utility translate these needs into smart investments in remote management?

Part 2: Prioritize what challenges you need to address

In an uncertain economic environment, utilities should take every opportunity to shore up revenue while investing in services that create meaningful customer connections. There are many ways to do this, and any savvy utility manager knows that there is a wide spectrum and no perfect solution when it comes to remote management. To find the right solution, at the right time, start by identifying what key problems your organization needs to solve. While it can be tempting to implement a solution that addresses one particular pain point, don't overlook the challenges you may face over the next several years and even decades.



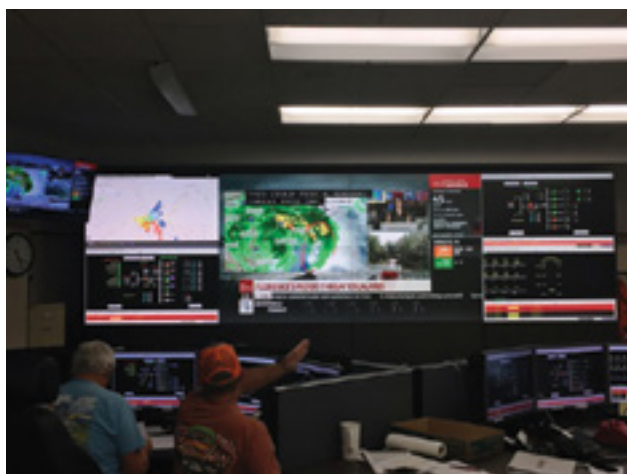
Remote management provides the foundation for demand response capabilities, enabling analysis of data collected over time to accurately forecast demand.

Think of it like this. You visit the grocery store when you're hungry for lunch. Does that mean you only buy your lunch and leave? Usually not. You think ahead to dinner that night, even breakfast for the week. You're thoughtful about what needs you will have in the future, and you stock your cart accordingly. Using this analogy, there are several key elements of remote management that utilities may consider adding to their shopping list as they consider the right solution.

Outage and restoration management: Remote monitoring capabilities automate the outage notification process so crews can be dispatched even before the customer calls. This helps save time and costs associated with the process of identifying outages and decreases the length of disruption to the customer. It also minimizes safety risks to employees investigating the extent of the outage. →



Crews use remote management capabilities to pinpoint exact outage locations, saving time and costs while minimizing safety risks.



Remote management proves essential to disaster preparedness efforts for Fayetteville PWC in North Carolina.

Remote connect/disconnect: Utilities once viewed remote disconnect as a nice-to-have ability in certain service territories. This mindset is shifting rapidly as access to customer homes is either completely impossible or significantly more challenging. In parallel, some utilities faced smaller work crews because of sickness or family issues caused by the pandemic. Both realities heightened the need for meters that can be connected or disconnected remotely.

Customer portals: Customer expectations to check usage and conserve energy can be accomplished with a customer portal. In many cases, it empowers the customer to become their own billing specialist and review their usage and subsequent costs. Many utilities also use portals to educate customers on energy conservation and usage.

Control over grid assets: As residential usage patterns have changed peak usage becomes more difficult to forecast. Remote management serves as the foundation of demand response programs, conservation voltage reduction (CVR) and other capabilities that can help utilities lower their overall costs while maintaining better control over their assets.

Most forms of remote management will help solve workforce utilization and operations throughout the pandemic and beyond. By remotely managing key functions, utilities can enable more remote work, prioritize worker safety and, in some cases, reprioritize workers to more strategic initiatives.

For utilities that have not yet invested or are driven by market conditions to explore options, you may be wondering where to start.

Part 3: Map out your technology journey

A utility's technology implementation starts with identifying the key challenge or a set of issues you want to tackle. This is the first step on a technology journey that has no true endpoint. Rather, the best technology solutions will grow and evolve along with the organization. If the prospect of an endless technology journey sounds more intimidating than exciting, you're not alone. Following are some considerations to make it more manageable.

- **Prioritize investments:** Start with the key issues – a wish list of specific customer challenges or operational problems that need to be solved. Let this be your North Star as you consider an investment in remote management technology.



One of the most important factors to evaluate is the communication network used to deliver data digitally as this is the foundation for all remote management.



- **Take inventory and use what exists:** Review current infrastructure investments and determine whether the asset can be extended to deliver additional benefits. For example, if a utility is currently leveraging AMR to obtain meter data, a natural migration is to AMI and connecting endpoints via a two-way communication network to automate and speed the collection of this data. Utilities that have already deployed AMI can examine how current capabilities may be extended, or which new capabilities can be added to solve problems. For example, can the utility deploy a new service in addition to their current AMI through a software update, or is new hardware required?
- **Explore new technology options:** If little foundational infrastructure exists that can be used for remote management, conduct a thorough review of technology options. One of the most important factors to evaluate is the communication network used to deliver data digitally as this is the foundation for all remote management. Private spectrum offers significant benefits against public mesh networks, including (but not limited to) security and low latency.

- **Drive long-term value:** One of the best ways to maximize value from new technology investments is to deploy systems that not only meet a current need but offer the flexibility to add new capabilities as customer and employee expectations evolve. Review the priority list for capabilities that seem unrealistic now and ask if they can be added later once budgets allow. For example, perhaps a customer portal is simply not feasible in the near-term. With the right AMI system and associated software in place, it might be a possibility down the road.

The road ahead

The acceleration of digital transformation amidst the COVID-19 pandemic has had a major impact across industries, with many left wondering what changes are only temporary and what will be here to stay when things go “back to normal.” Utilities should consider this question as well. Regardless of any future developments with the pandemic, the utility landscape has been altered and there is likely no going back.

The bright spot in this change and uncertainty is the critical role utilities have played and will continue to play in what comes next. As communities worldwide ran out to thank healthcare workers throughout the pandemic, they simultaneously sang the praises of utility workers who ensure that hospitals have power and millions of Americans can safely work from home without interruption. The perseverance and ingenuity that utilities exhibited in providing service through the pandemic underscore their ability to take on whatever is next with their communities and customers in mind.

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Mike McGann is vice president of Sensus Americas, Global Engineering and Assessment Services at Xylem. He leads teams solving tomorrow's biggest challenges for water, gas and electric utilities, today.

A Lean Six Sigma Master Black Belt and United States Marine Corps Veteran, McGann is skilled in applying continuous improvement methodology and process control to help individuals and teams do their best work and serve their customers and communities.





WHY THE ENERGY SECTOR NEEDS REMOTE OPERATIONS CAPACITY TODAY, AND HOW TO SUCCEED IN THE TRANSITION



Photo by Matthew Henry on Unsplash



BILL MOORE

For most people, 2020 has been an unforgettable year. Not only did a viral pandemic sweep the globe, bringing along financial hardship and social unrest in its wake, but people's daily lives were transformed virtually overnight as businesses closed their doors and remote work became the default arrangement for hundreds of millions of employees.

Time Magazine described the coronavirus outbreak as "the world's largest work-from-home experiment". For the energy sector, this means we have entered a uniquely transformative moment. More specifically, it provides an operational imperative to play catchup on critical infrastructure that will empower long-term growth.

Power producers and energy companies can use this moment to springboard their technology into the future, making them more capable and competitive for years to come. A hybrid workforce comprised of on-site, remote, and distributed teams isn't just the future of the power industry. It's the present, and too many companies are falling behind.

Of course, this transition isn't without its challenges. According to *The Washington Post*, as much as 90 percent of companies lacked adequate remote operations infrastructure to maintain continuity during this transition. The energy sector will have to navigate the pitfalls successfully without ignoring the operational necessity transformation. →



The case for remote operations capacity

A potent collection of sociological trends and physical imperatives make remote operational capacity a critical component of any sustainable, continuity-oriented company.

Remote work as a long-term trend

Regardless of the industry, remote work is an indelible reality with far-reaching implications. According to a May 2020 Gallup poll, more than half of workers want to continue working from home, even after the pandemic eventually subsides. This number is even higher in the energy industry, where 70 percent of employees prefer a long-term remote work arrangement.



According to a May 2020 Gallup poll, more than half of workers want to continue working from home, even after the pandemic eventually subsides.



Traditionally, power plant operators and other industry professionals are restricted to working in a control room with access to Human Machine Interfaces (HMIs), and any off-site accommodations were applied using a band-aid approach that flouted cybersecurity and operational realities.

While jobless numbers are temporarily high, potentially expanding the talent pool available for energy producers, the sector has struggled to attract and retain top talent, something that will certainly persist as the overall economy eventually improves. However, according to a recent industry survey, a remote work option helps with talent acquisition and retention. Consequently, companies that develop and deploy remote operations capacity during this transformative time can provide the in-demand work arrangements that can allow them to engage with the most qualified professionals from around the world.

Operational continuity; regardless of circumstances

To be sure, remote operational capacity is about more than employee preference, and many power producers view scaling this technology as a mission-critical component of their long-term sustainability.

Most obviously, COVID-19 has illuminated the speed and scope with which unforeseen disasters can disrupt operational capacity. Similarly, natural disasters, including floods, tornados, hurricanes and earthquakes, are becoming increasingly prevalent. This year's hurricane season is expected to be "one of the most active seasons on record," according to scientists at the National Oceanic and Atmospheric Administration. The power supply is an essential service, and producers and distributors need better operational resilience to navigate these predictable but always surprising events.

“Not only does the average data breach cost companies nearly \$4 million, but a cybersecurity incident for utilities can have real-world implications for people’s lives.”

In this environment, companies that didn’t already have remote operations capacity were at an overnight disadvantage. In an assessment of COVID-19’s impact on the energy industry, Deloitte identified “Strains on the workforce, such as a shortage of engineers or restrictions on the movement of personnel” as a key challenge for utility providers during the pandemic. What’s more, the report encourages power producers to use the current crisis as a “catalyst to usher in the future of work by rethinking how and where work is done and accelerating adoption of automation and digital capabilities.”

Comprehensive remote operations capacity ensures that energy producers, suppliers and their network of service providers can ensure reliability regardless of the on-the-ground reality.

Efficiency & effectiveness improvements

Energy producers face increasing competition as a dynamic energy environment increases the impetus for cost-savings and efficiency.

Remote operations capacity can keep valuable employees from traveling to disparate locations to diagnose problems or to collaborate with team members, something that not only saves time and money but provides a more compelling work environment that can adapt to different situations.

At the same time, these technologies can reduce redundant processes and other measures that increase efficiencies and reduce costs. For example, workers can:

- Collaborate with remote and on-site staff and experts
- Centrally configure plant operations
- Diagnose and troubleshoot problems
- Digitally operate, startup, and shutdown plant operations.

As companies embrace a long-term remote-first environment, comprehensive remote operations capacity can provide accountability and productivity metrics to ensure that, no matter where your workforce resides, overall performance remains an asset, not a vulnerability.

Taken together, today’s power producers have millions of reasons to pursue remote operations capabilities, and now is the perfect time to scale these initiatives. Of course, these efforts aren’t without challenges.

Navigating the challenges of adoption

Remote operations capacity is not anathema to the energy industry, which has sought to develop and deploy this technology for years. However, these solutions tend to be temporary, relying on workarounds that don’t address the very real challenges of adoption. This moment requires a more holistic approach to remote access and operations that accounts for the challenges and meets them with appropriate solutions.

1. Cybersecurity

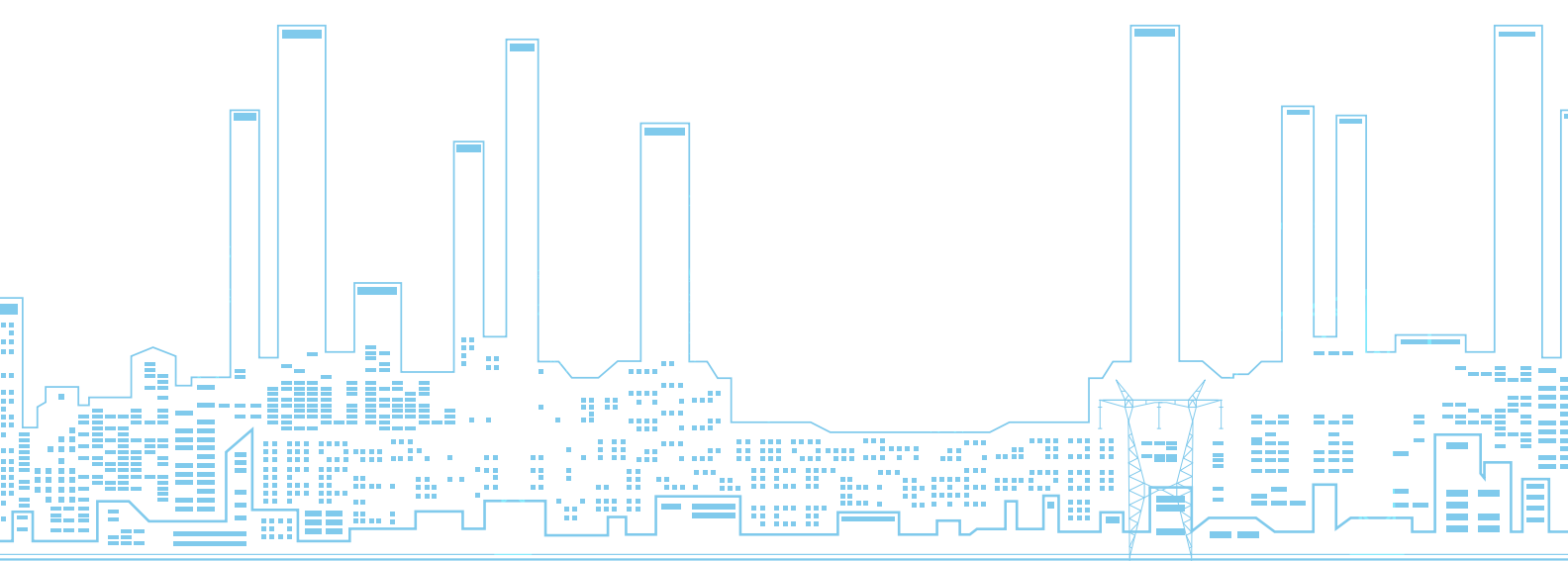
Today’s threat landscape is expansive as bad actors and accidental insiders create a cadre of cybersecurity risks that could have costly (or worse) consequences for power producers. Not only does the average data breach cost companies nearly \$4 million, but a cybersecurity incident for utilities can have real-world implications for people’s lives.

In an assessment of the cyber threats and vulnerabilities in the US energy sector, the Idaho National Laboratory found that “cyberattacks on the North American electric grid continue to grow in frequency and sophistication.” The wrong approach to remote access can heighten these risks, making it critical that remote operations capacity be met with robust cybersecurity protocols.

While today’s next-generation firewalls (NGFWs) offer significant protection for on-site workers, such as sandboxing, application-level inspection, and intrusion protection, this technology isn’t designed to accommodate a remote workforce. Instead, companies should turn to a zero-trust OT platform that brokers connections between remote workers and on-site operations. Also, power producers can mitigate cybersecurity risks by adopting a defensive posture that includes:

- Multi-factor authentication
- Protocol isolation
- Moderated Uni-directional Secure file transfer
- Full user access logging and recording
- Compliance-ready standardization.

Since today’s threat landscape is continually expanding in scope and sophistication, having the right defensive capabilities in place is the first step for power producers implementing remote operations capacity. →



2. Regulatory compliance

To protect consumers, lawmakers are increasingly implementing or updating security and privacy regulations that will impact utilities' transition to a hybrid workforce. In response, companies need built-in systems and workflows for maintaining and documenting regulatory compliance. Specifically, companies need to consider:

- **NERC CIP:** This security standard provides guidelines for protecting critical cyber assets related to public utilities. It includes nine standards that dictate everything from personnel and training protocols to disaster recovery planning.
- **NIST SP 800-53:** Information security is a high priority for regulators. It needs to be top-of-mind for leaders implementing remote operations capacity, which comes with inherent risks related to data privacy and protection.
- **IEC 62443/ISA 99:** Remote operations capacity incorporates automation as a key driver of new efficiencies. This regulatory standard ensures that automation and control systems security remain a top priority for power producers.

Regulatory compliance is more than just a nascent obligation for power producers. These guidelines help ensure that their infrastructure remains secure, regardless of circumstances.

3. Usability

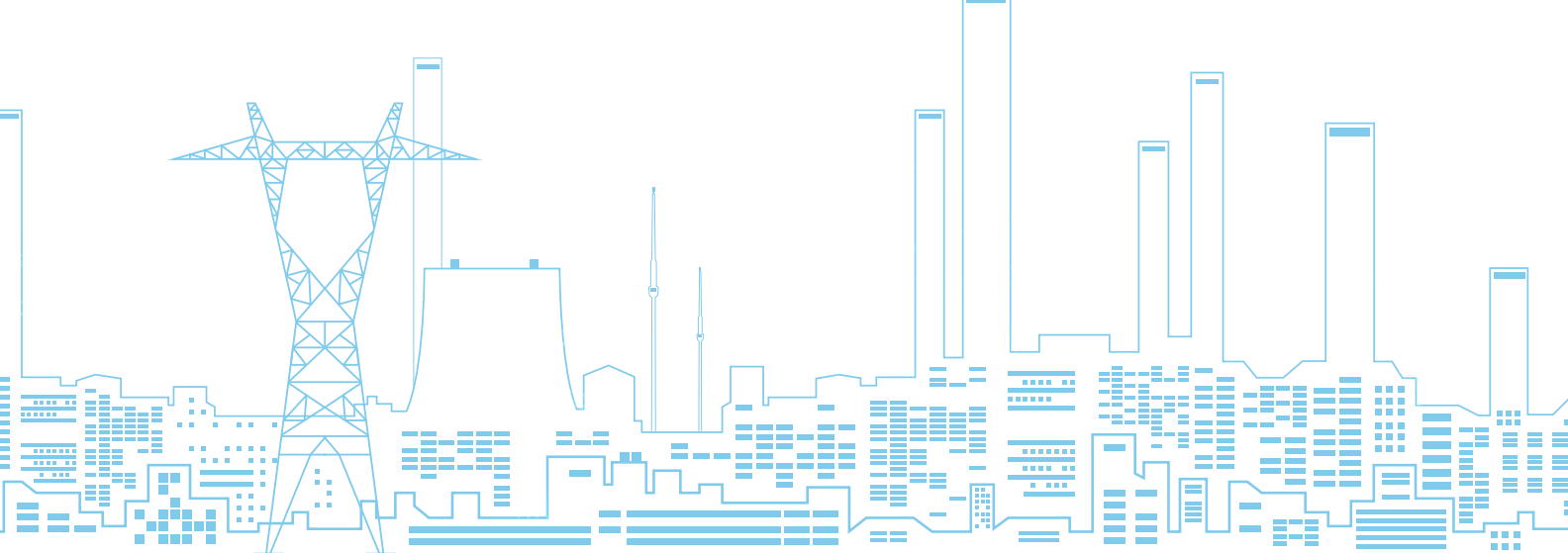
Workers are clamoring for remote work opportunities, but that doesn't mean that they are ready for new technologies to supplant existing workflows. When transitioning to a hybrid workforce, new operational capacity needs to be simple to use and deploy.

Focus on intuitive interfaces that can capitalize on existing technology. For instance, remote operations that support standard devices and connections with an accurate and real HMI experience can help translate on-site protocols to the digital realm.

Simply put, a hybrid workforce won't be successful if the tools are overly complicated or include significant usability hurdles.

4. Affordability

Right now, power producers need affordable solutions, not elaborate next steps. Designing and deploying remote operations capacity from the ground up is expensive and time-consuming. Fortunately, a variety of off-the-shelf options are emerging, meaning companies don't have to build this capability from scratch, which reduces transition, implementation, and development costs.



By getting the most out of their technology investments, companies can more efficiently budget for their workers' other remote working needs, like workspace upgrades, hardware updates, and other amenities that are common for on-site employees but that often get overlooked when transitioning to off-site workspaces.

Adjusting to a hybrid workforce can bring new efficiency and cost-savings standards, but it also requires new tools and workflows that always come with a cost. An affordable transition means relying on existing tools and infrastructure. Leaders need to do their homework before throwing their weight behind any solution.

Conclusion

The COVID-19 pandemic has illuminated the already-prevalent need for remote operations capacity in the energy sector. This isn't a bad thing. Moving forward, energy producers and distributors will depend on this technology for more than just responding to a pandemic. In this way, right now is a unique moment where the sector can turn its attention to an immediate need with long-term implications.

In a report on this shifting landscape, McKinsey & Co. describes the effect of this transition: "Many companies are not only seeking solutions to improve their performance in the short term—and increase their competitive edge in shrinking markets—but also to ensure long-term sustainability in the next normal through healthy transformation."

People will experience pandemic as a before/after event that alters the way we live, think, and work. Leaders that meet the moment will be prepared to move their company forward, while those that ignore the challenges are at risk of being left behind. Remote operations capacity is only one part of this equation, but it's something that the energy sector needs to continue evolving in the months and years ahead.

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ESTABLISHING A SUCCESSFUL TRANSITION TO REMOTE PROJECT MANAGEMENT





CLARICE KINSELLA

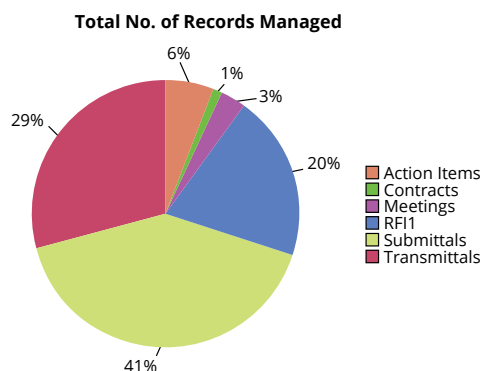
Achieving increased project alignment and finding actionable intel by implementing a project management office.

As historically resolute industries continue to navigate how to stay productive during these uncertain times, and the workforce charts new territories in further blurring the lines between work and home, remote project management will continue to be vital for organizations and the communities they serve. Utilities nationwide have a responsibility to keep advancing critical projects — even when key personnel are unable to be in the office or field — to support the safe and reliable infrastructure that will help our country move forward.

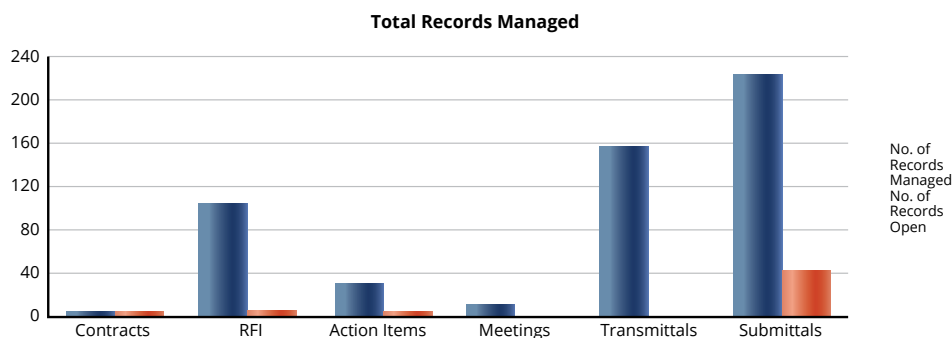
Project management office (PMO) provides the insight needed to create a more efficient project life cycle by not only identifying challenges but providing proven solutions. By applying the forward-thinking principles of a PMO, technology and processes can be aligned and improved to optimize project delivery and help maintain business continuity. →

Usage Metrics

Date: 08/27/2020



Business Process	No. of Records Managed	No. of Records Open	Avg. Turnaround Time (Days)
Contracts	8	7	-
RFI	106	7	5,18
Action Items	32	7	13,66
Meetings	14	2	1,63
Transmittals	156	0	-
Submittals	223	44	11,30
Total	539	67	-



Sustained success through intuitive implementation

The road to successful PMO adoption and utilization begins with effective implementation. While there are many different models and types of PMOs, the shared intention of each is to improve project performance by standardizing processes and facilitating the sharing of tools and techniques that drive efficiency.

When mapping out the right PMO that will support long-term project management excellence, utilities should focus on people, processes and technologies.

People

Creating effective change in any organization begins with support from the top. A successful utility PMO is supported at the highest level to both champion and direct the establishment of new internal functions.

With executive buy-in and expectations established, a PMO then defines and builds the project team by recruiting people with the necessary experience levels. Whether consisting of project managers, subject matter experts or business personnel, this group has clarity of purpose and understands how a PMO can bring value to a utility.

Firms with experience in utility PMO setup can fast-track progress and train internal staff for highly effective, long-term project management roles.

Processes

Using a consistent lens to plan and execute projects saves utilities time and money by increasing efficiency and reducing risk. A consistent approach is only possible by defining overarching objectives and creating clearly defined processes that will support the success of these goals.

By nature, utility projects consist of an almost unlimited number of variables. The creation of and adherence to PMO processes supports consistent decision-making and helps define project elements, from data gathering and resource tracking to budget monitoring and project team training. The result: consistency, a hallmark of excellent project management.

Evaluating existing processes and assessing areas of past project performance can help identify what methods can be used, what aspects need to be modified and where new procedures are required.



Technologies

With the proper team established, goals set and processes defined, a utility PMO is prepared to evaluate the tools and technologies needed for execution. The toolset used by a PMO helps to drive process accountability and further increase efficiency.

Utilities should begin by explicitly defining what the criteria are for software and technology tools to support the processes developed by the PMO. Requirements for technology options will be driven by the vision for the PMO, stakeholder roles and needs, and will be used to enforce the defined processes.

Pathways to proactive project management

With the right technology applications in place, utilities can continue operating, managing projects, and communicating efficiently and effectively with their teams, clients and vendors.

While utilizing online collaboration tools such as Microsoft Teams or Zoom is a valuable first step, remote project monitoring requires the technical capabilities of more sophisticated software. Technology can be empowering, but without effective business governance and a strategic framework, it can become an encumbrance just as easily.

The following project management applications can help utilities stay abreast of project progress and continue moving projects forward:

- **Project and construction management:** In the current environment, a web-based platform for managing project and construction data is crucial. Project and construction management tools provide a variety of project-related functions and allow clients to access timely information in a central repository. These software supports cost management and offers features that enhance communication among project stakeholders, including requests for information modules, change control, submittal management and invoicing. (Examples in this category: Primavera Unifier, ProCore, Ares Prism, Hexagon EcoSys.)
- **Document management:** Successful remote project monitoring depends on efficient information sharing. This requires all project team members to be engaged on one platform that supports all file types without file size limits. Organizations are increasingly migrating document management to cloud collaboration platforms, and the pandemic has only hastened this trend. It provides project-wide visibility and control among the many different entities collaborating on a project. Internal and external team members alike can access project data regardless of whether they are in the construction trailer or their living room. (Examples in this category: Oracle Aconex, OpenText, HxGN SDx.) →



- Portfolio management:** Proper front-end project development increases the chances of project success during execution. A portfolio management tool facilitates this process by tracking projects and advancing them through stage gates as they meet requirements. Capital program scenario planning can be especially powerful when projects may need to be shuffled around to accommodate a dynamic environment. Using a portfolio management tool, teams can run scenarios to optimize a portfolio with changing conditions and criteria, advance the business process and projects through online stage-gate approval, add or remove items from the budget and authorize project execution digitally. (Examples in this category: Primavera Cloud, Hexagon EcoSys Portfolio)
- Dashboard reporting:** A business analytics tool that provides configurable, role-based dashboard reporting is also important. Microsoft Power BI provides dependable data with decreased report assembly time and minimal human errors. Regardless of which backbone project management platform you use, Power BI can be configured to aggregate data from various databases, tables and spreadsheets through integration or data staging.
- Schedule management:** Remote project scheduling keeps projects moving regardless of where you are. Oracle Primavera P6 Enterprise hosts live project schedules, cash flow-related data and performance measurement baselines. Activities are grouped by work breakdown structures or contracts so the groups responsible for the work can provide updates remotely and reliably. Critical path method scheduling also allows teams to identify bottlenecks in the

projects to pay attention to. What-if scenarios can be run to assess impact of disruptions on schedule. P6 can also provide schedule and project status reporting. It also has the ability to migrate your desktop schedules to a cloud-based P6 platform.

These latest technologies can help project teams stay connected with colleagues, clients and vendors. The implementation and integration of these applications with an enterprise system allow you to scale up or down to meet your unique project needs, facilitating a seamless transition to remote project monitoring.

Putting the pieces together

Organizations typically face a common set of challenges: prioritizing their projects, then executing them within budget and on schedule. This requires juggling budgets, resources, schedules, contracts and communications across teams — and often across multiple technology platforms. Undoubtedly, these struggles are exacerbated in the current environment.

The route from strategy to customized solution follows a simple, yet vital, path through four basic steps: organizational assessment, business process design, technology consulting and implementation and continuous improvement.

Step 1: Organizational assessment. Before improving your business practices, you must first intimately understand them. Organizational assessments comprise a holistic review of current project management strategies, an inventory of current software and tools, and an assessment of the organization's appetite for change.

Through a combination of interviews with leadership and other professionals, as well as an in-depth review of existing information, a picture emerges of the current state of the organization. After performing this comprehensive audit, only then can new initiatives be identified and implemented to bridge the gap between current and future efforts and achieve the necessary employee adoption of enterprise-wide changes.

Step 2: Business process design. Sound business processes streamline workflow, reduce unproductive work, align objectives and optimize resource utilization. The process design stage homes in on determining the right blend of management systems to organize and capitalize upon existing processes while also supplementing where needed.

Bringing in an end-to-end delivery perspective — from planning and engineering to construction, coupled with industry-specific experience — can facilitate tailored, streamlined solutions that integrate business processes across an organization. The result is a creative and efficient project management framework, which draws on stakeholder ingenuity at the right time to facilitate a paradigm shift from reactive administration of tasks to allowing project managers to focus on proactive management of risks and uncertainties.

Step 3: Technology implementation. Your business systems and software provide the tools and information you need for daily operations. Specialized systems may be necessary for different components of your business, accompanied by significant investment in the systems, staffing and training.

The true differentiator for enterprise project management is the integration of software within your governance process. The strategies developed in earlier stages will help dictate how processes and systems — whether on-site or in the cloud — can be coordinated to facilitate the smooth flow of data.

Step 4: Continuous improvement. Implementing PMO principles is a good start toward enhanced efficiency and improved project management. To thrive in an evolving market, organizations must commit to continuing to innovate and embrace change. Data analytics can help you identify areas that could be strengthened — data's value is greater when it is successfully interpreted to drive actions that enhance performance.

Key performance indicators (KPIs) collected and analyzed during the PMO process should continuously inform business decisions by incorporating real-world observations and calibrating approaches to optimize outcomes. With a tailored combination of data collection, visualization and assessment, the prioritization and gaining of efficiencies are made easier, more successful and more productive when filtered through iterative improvements.

Progressing toward an integrated future

Now more than ever, infrastructure and investment projects must be efficient, on time and add value for utilities and their communities alike. With leadership commitment to a PMO in place, utilities can move on to establishing the right team, defining overarching goals and developing effective processes. These critical elements help utilities succeed in creating an effective PMO, ultimately driving longer-term project management success.

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ENERGY EFFICIENCY GETS A VIRTUAL BOOST:

HOW UTILITIES ARE USING
VIRTUAL ASSESSMENTS
TO TAP INTO HIGHER
CUSTOMER ENGAGEMENT





SETH LITTLE

In response to the COVID-19 pandemic, safe social distancing necessitated that many utilities pause energy efficiency programs for customers, which traditionally required in-person assessments of customer homes. In the economic fallout that followed the pandemic, utilities braced for hits to their revenue, as impacted customers struggled to pay electricity bills. As in many other industries, virtual and digital technology has quickly risen as an important tool for utilities to maintain customer service in the new socially-distanced reality, and with this increased adoption, many previously unrealized benefits have become known. →

The case for customer control

According to 2013 data from the Lawrence Berkeley National Laboratory, the average annual energy bill for a typical single-family home is more than \$2000¹. Yet that number may well be higher now due to stay-at-home orders and preferences that have largely shifted energy usage from commercial buildings to residential homes. Now more than ever, improving energy efficiency in the home is pivotal to reducing energy usage and electricity bills. Recent trends in customer behaviors, where demand for more transparency and control of energy usage has reshaped utility business models over the last few years, have become even more exaggerated as customers look to tighten their belts amidst an ongoing economic recession.

In response to these extraordinary circumstances, virtual approaches have very rapidly risen as a critical solution for continuing to engage utility customers and their unique needs. Where energy technicians once needed to enter a customer's home to perform a thorough energy efficiency assessment, the control now quite literally sits in the hands of customers where they can conveniently operate guided assessments via a tablet or smartphone.

As utilities adapt to new ways of serving and engaging customers in a COVID-19 world, virtual assessments and programs may soon become the new normal for the many benefits, advantages and cost savings it provides over traditional in-person service models.

Energy efficiency gets a virtual boost

Traditionally, when utilities conducted an energy audit or assessment of a home's energy efficiency, a technician may visit a customer's home armed with tools including a digital tablet, infrared camera, tape measure and a work order document requiring a customer signature.

The technician would start by examining the outside of the home, including walls, windows and attics to locate any potential leaks for energy that might be seeping into or out of the home. They would explore the attic and insulation, examine electrical lines and holes for proper sealing and assess the condition of the water heater and furnace. They might have also performed a blower door test that uses an infrared camera to spot leaks through doors and windows and check the lights throughout the home to determine if upgrades to more energy-efficient models were needed, such as switching from standard incandescent light bulbs to light-emitting diodes (LEDs).

Throughout the traditional assessment process, customers are typically passive participants, receiving a summary

of findings from the technician at the conclusion of the assessment and a recommendation for ways to improve energy efficiency. This could include upgrades to windows to reduce air leaks, where the technician may take measurements of the window dimensions. It may also include a recommendation for installing window coverings to reduce heating from sunlight, resealing doors or windows, upgrading water heaters and lighting and more.

With a virtual assessment, customers are connected to a utility technician in real time through their smartphone or tablet, without needing to download an app. Using augmented reality (AR) via a smartphone or tablet camera, customers receive live instructions from a technician that allow them to accurately assess and perform the same energy efficiency assessment as an in-home audit from a safe distance. Depending on the design of the virtual program, built-in user-friendly tools could also help navigate customers through thermostat installations or reconfigurations, allow them to take accurate measurements of window dimensions, lighting or water heaters, and potentially even help them identify air leaks. As in many virtual and digital applications, privacy control measures and settings allow customers to pause the video call, use a mute function, control certain permissions and perform other safety and privacy functions.

Virtual assurance programs can perform field verification and installation quality assurance using similar approaches and with similar benefits. This technology limits the need for further appointments to be scheduled for home and business owners. In process, virtual inspections also reduce the need for costly go-backs for program contractors. Additionally, using time-stamped and geo-located photography from the virtual assurance record, programs can provide best practice levels of confidence in installations to program evaluators and participants.

Virtual assessments tap into higher levels of customer engagement

Unlike traditional energy efficiency audits, virtual assessments and assurance can ensure utilities can deliver important customer programs while maintaining safe social distancing requirements. A virtual approach also gives customers full control over the inspection of their home and to take a more active role in identifying issues and opportunities. AR technology makes it easy to follow directions and give customers the opportunity to ask questions throughout the process. AR technology also empowers customers to become more knowledgeable about their options, improving their energy efficiency and make smarter decisions.

¹ https://www.energystar.gov/products/where_does_my_money_go



Homeowners would also have the opportunity to see where simple do-it-yourself improvements can make a significant difference and provide instant savings, such as installing window treatments and coverings, switching out lightbulbs for more efficient models, or adjusting their thermostat settings.

Due to the remote capabilities of a virtual program, utilities can better ensure the safety of their technicians as well as increase the number of customer assessments and appointments that could be conducted daily. Where travel to various customer locations for in-person audits may have limited customer assessments to only three to four per day, virtual assessments allow for as many as seven to eight per day when travel time is removed.

The convenience of a virtual assessment not only gives customers more choice and control, but it also creates a more personal touchpoint with utilities that goes beyond a simple video call. Utility programs can more easily diagnose and troubleshoot issues remotely, map out installations and respond to customer issues faster, ultimately improving the way they engage with and service customers.

A new virtual norm

As utilities look for solutions to the new circumstances of social distancing and economic strain, virtual assessments and assurance could be one important way that utilities safely continue supporting customers by identifying energy efficiency opportunities for more affordable energy bills. Data and analytics will be critical to this effort, particularly as utilities examine swift solutions for low- to moderate-income neighborhoods that have been hit especially hard by the pandemic.

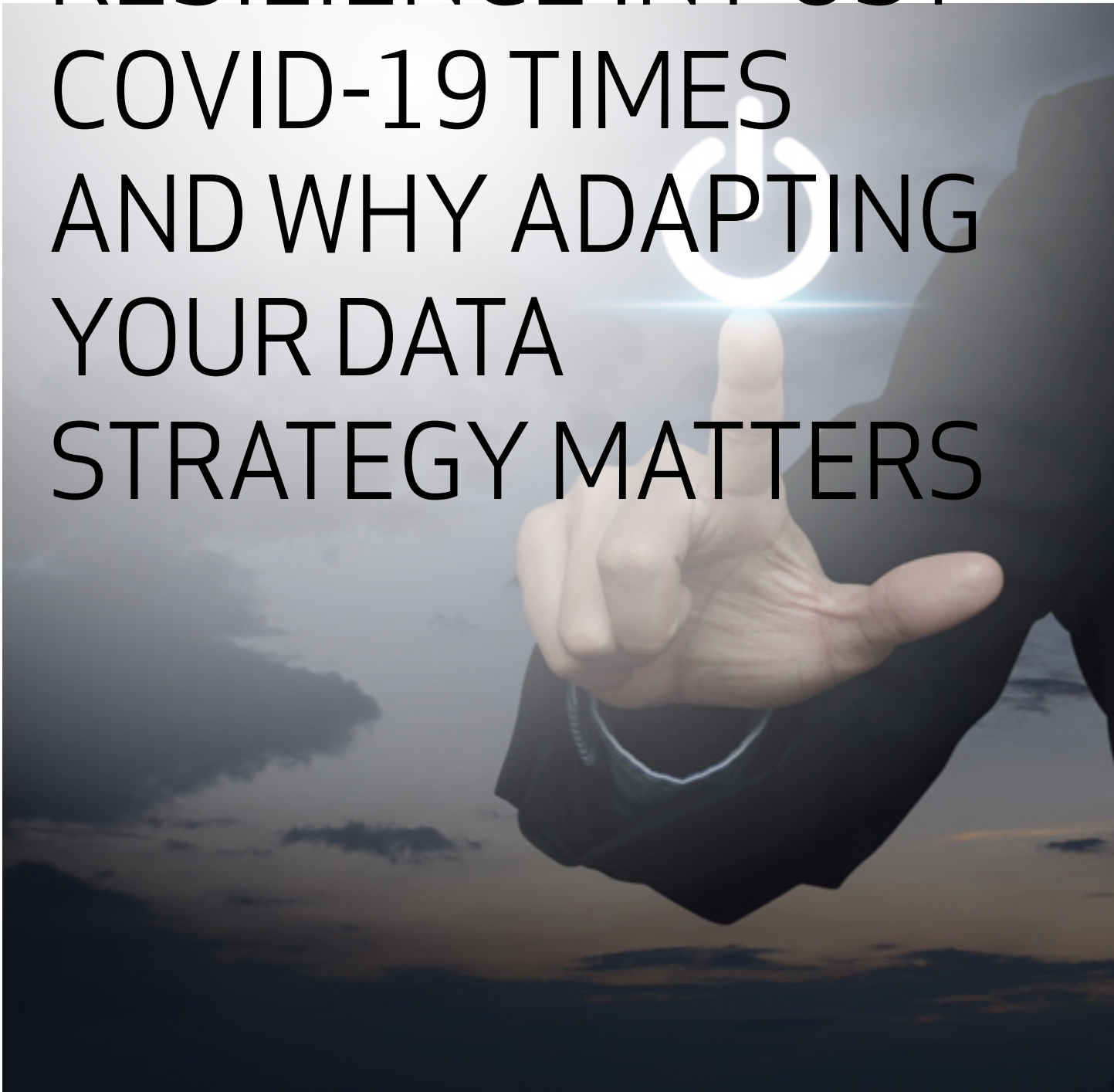
Furloughed utility employees could also resume traditional field activities remotely and virtually, as they tap into new digital technology capabilities that streamline response times and improve the average number of customers that can be assisted daily.

These virtual program approaches are already being implemented in commercial, single-family and multi-family residences and will very quickly become the new virtual norm given both the intuitive and user-friendly nature of the virtual engagements. Data from early virtual pilot initiatives are also driving the industry into further virtual innovation as programs explore on-demand energy advising, EV site assessment, electrification readiness panel inspections, etc. As the industry works to break down traditional models of customer service in favor of faster, virtual models, regulatory plans and policies may soon follow suit to encourage wider adoption.

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REDEFINING RESILIENCE IN POST COVID-19 TIMES AND WHY ADAPTING YOUR DATA STRATEGY MATTERS

A hand in a dark suit sleeve points upwards towards a glowing white circular icon with a vertical line through it, resembling a power or refresh symbol. The background is a dramatic sky with dark clouds and a hint of sunset or sunrise colors.



FRANCOIS LABORIE

In 2020, resiliency has taken on expanded meaning as utility companies worldwide adopt new, evolving strategies for new, evolving norms. Defined as “the capacity to recover quickly from difficulties; toughness,” resilience is usually thought of in relation to the operator’s ability to bounce back from severe weather events and unexpected grid outages. →

Today, this operational pillar remains as important as it ever was. In August 2020, Tropical Storm Isaias battered the East Coast and caused more than two million power outages. That same month, Hurricane Laura, a Category 4 storm, pounded the Gulf Coast for hours, leaving hundreds of thousands of people without power in Louisiana and Texas. Meanwhile, on the West Coast, California faced new, unexpected blackouts due to an intense heatwave, an overloaded grid and offline generation. Not only are these examples indicative of the pressures to come; they highlight the fact that operational resilience is a moving target, making it difficult to sustainably achieve related KPIs.

But because the complex grid system is composed of complicated, interrelated physical and digital elements, similar thinking about resilience should be applied to the workforce, customers and even the utility business model.

The traditional onsite working model, for example, is being disrupted by the pandemic as the need for safer, more flexible options for remote work arises. This includes a strong push towards more digital solutions and access to remote operations. How quickly can utilities empower this new model while facilitating a return to the same or growing rate of productivity? To accomplish this, utilities must explore the latest technology to promote the safety of their employees and ensure continuity of service for customers, while at the same time remaining flexible enough to adapt to a rapidly changing environment.

Then there's the concept of customer resiliency: How can utilities in competitive markets provide improved, differentiated customer experiences that reduce churn and streamline customer management? While half of this is an operational problem – keeping the lights on – the other half depends on quickly identifying emerging customer risks and opportunities and being flexible enough to respond quickly with a unique offer or experience.

Lastly, utilities should think about resilience for their business models. This includes the means to quickly and accurately respond to market opportunities like renewable energy and microgrids or securing market share against new entrants to the market. Disruption can and will come quickly, in the form of new storage technologies and breakthroughs in generation. Is your utility resilient enough to mobilize a new strategy at the speed of the market?

The rapidly evolving age of data-driven resilience

It is no secret that improving resilience across the four dimensions mentioned above starts with data. Today, the US utility sector is investing heavily in data collection and analysis to better identify and interpret the signals that impact their operations. But because resilience is a

time-bound problem, the value of this analysis boils down to the efficiency of the entire value chain by which data transforms into insight and action.

This is where traditional data management strategies start to break down. Existing strategies work against the speed and agility needed to deliver resilience in time-sensitive scenarios such as outages that must be resolved, or when competitive windows of opportunity are closing. The trail of failed proof of concepts that never quite make it into production is evidence enough of the need for a smarter, more data management strategy designed around the *trajectory and potential of the business*. This is where utilities should focus their attention now-especially during unprecedented industry change.

Why is the industry at this crossroads? First, more data than ever is being collected from new sources and is being stored across the enterprise. Secondly, analytics tools are becoming more mature, accessible and valuable, leading to a new class of data consumers (citizen data scientists, analysts, engineers, etc.). While these both should be net positives over the long term, they expose entrenched utility data architectures that are not set up to support the potential of digital use cases at scale.

Complexity: the enemy of data agility & digital productivity

This is the reality that many utilities are now waking up to an overly complex, compartmentalized data architecture that does not well facilitate data access, agility or scale –all key requirements of healthy, prosperous and ROI-delivering digital transformation.

Until data usage is ubiquitous to more consumers and more applications, utilities will struggle to rapidly act on their initiatives around resilience. On one spectrum, utilities will face physical barriers to data ubiquity that center around fundamental connectivity and access to the relevant data silo(s) that must be tapped to solve the problem.

Take for instance the health monitoring of a transformer. Data from the transformer control system (one silo) is useful for analyzing performance trends over time. But this set of information is only part of the overall maintenance workflow: engineers must also correlate documented events such as repairs and faults which exist in a separate system. Additional information such as weather patterns and demand forecasts exist unconnected in other silos, further complicating the monitoring, diagnostic and decision-making process.

This access problem may be simple enough to overcome for a straightforward use case or a static proof of concept, but what are the implications for when the application moves



from development to production? Will the data flow from the silos to the application remain intact? What other security or quality issues will manifest?

In addition to these physical barriers, utilities will also face knowledge barriers having to do with the specialization of these data sets. Just as it is not feasible for every citizen data scientist or developer to become a subject matter expert in the data they're working with, it is also not efficient for the data's subject matter expert to help every data consumer understand the data set. This highlights the need for a better way to improve how embedded data knowledge is contextualized across types, sources, silos and domains. Fortunately, these problems are being addressed head-on, with the next wave of industrial data management software.

Overcoming digital complexity with DataOps as a best practice

While there's no slowing down the evolution of the modern digital infrastructure stack, implementing emerging DataOps practices is one of the few concrete steps to get ahead of the impending digital complexity. Just as DevOps redefined the process for application development, so too is DataOps redefining industrial data management practices for utilities. Gartner defines DataOps as "a collaborative data management practice focused on improving the communication, integration and automation of data flows between data managers and data consumers across an organization." As an automated, process-oriented methodology, DataOps can improve the quality and reduce the cycle time of data analytics. DataOps uses technology to automate the design, deployment and management of data delivery with appropriate levels of governance, and it uses metadata to improve the usability and value of data in a dynamic environment. Put simply, DataOps enables

efficiency and effectiveness for a previously complex and time-intensive process.

DataOps focuses on enabling the entire data value chain from the point of collection, through contextualization and analysis, and ending with the distribution of digital applications. To date, the digital and analytics software market has provided solutions to individual pieces of this data value chain (think data historians, AI & Machine Learning), but this is exactly where the complexity exists. Given the fragmented market, fundamentally sound DataOps practices must, at a minimum, solve for these following holistic data problems to return significant value.

- Large scale management, contextualization and transformation of structured & unstructured data
- Automating quality checks & enriching data for advanced analytics, hybrid models and ad-hoc reporting
- Comprehensive query & visualizations with open delivery and distribution of data + insights

By integrating DataOps into their digital solution stack, utilities can reduce the overhead (and lower the marginal costs) of data management and contextualization and execute more effectively towards use cases that are tied to resilience. For example, being able to automatically map the relationships that exist across a network of transmission substations makes it then possible to query on operator-centric knowledge. They query evolves from "show me time series data from substation x, y, z" to "show me the events log from substations in zone F with transformers that are older than 20 years." The initial subject matter expertise involved with knowing the right assets in question becomes codified in the data model so that others can leverage the mapping. →



This has short and long-term advantages: Immediately, digital teams can equip the means to better solve prioritized use cases by the enablement of their workers with access to high quality, contextualized data. A common priority, for instance, is getting better operational visibility into the health of the entire grid network. Then, once DataOps practices are established and in place, utilities are better positioned to solve the long list of emerging use cases and nimbly adapt their digital architecture for future data types, sets and volumes. This includes solving the long-term challenges associated with successfully integrating DERs, microgrids and other technologies.

Avoiding the consequences of inaction

By addressing fundamental challenges with data infrastructure and culture now, utilities not only better serve their immediate business interests, but also avoid the challenges that will compound as a result of growing digital complexity and speed of change. First, additional data silos will be created, making it harder to access and mobilize the data required for a given business problem. Over time, these new silos will lead to a lack of trust in the overarching data quality required for advanced modeling and predictive machine learning-based analytics. Then, without proper automation of data contextualization and pipelining, fewer models will get deployed and at higher costs. This ultimately will result in longer adoption timelines, lower ROI and lost competitive advantage.

Leveraging the current industry inflection point to improve utility resilience

Out of disruption comes opportunity and creativity. As utilities re-examine their operations in response to changing customer patterns, volatile weather events and other macro pressures, now is the ideal time for executives to reevaluate and bolster their digital strategies for the next era of accelerated change. Given the growing needs for operational, workforce, customer and business model resilience, only by taking advantage of their data will utilities can evolve and adapt at the speed of the market.

Now to make this actionable, below are several strategy recommendations and best practices that may bring clarity in this time of uncertainty.

1. Aggressively pursue the commoditization of data and delivery of insights

Data will not cease to be a valuable asset to the organization and is positioned to continue expanding with regards to volume, types, sources and complexity. Because of this, the dominant utilities of the future will be the ones who are able to effectively collect, mobilize and apply their data efficiently and at the lowest marginal costs. But to do this well, leadership must take serious, honest stock of their current digital maturity in order to properly identify gaps and opportunities.

2. Think beyond the traditional data KPIs.

As business models shift, utilities are already shifting their KPIs to more performance-based. The same KPI thinking should be applied to data initiatives. Rather than focusing on the quantity of data collected, for instance, metrics around data quality, time to deployment, reduction of workflow steps, data onboarding time, etc., will matter much more moving forward and will also highlight the largest areas of current inefficiency.

3. Help drive the industry's most significant up-skilling to-date

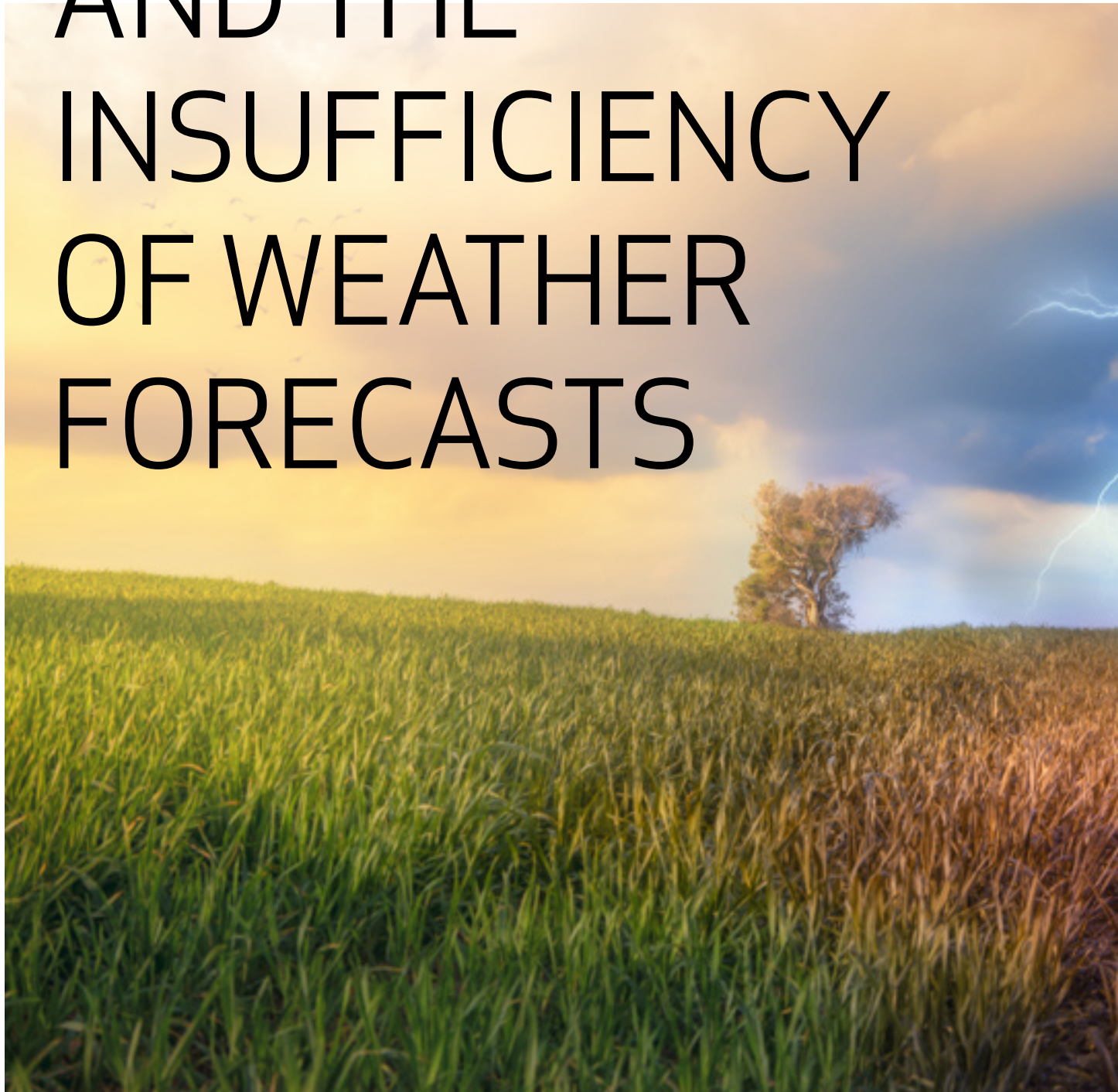
This is where the true value of industrial digitalization lives – in transforming data culture through ubiquitous access and more on-demand application to real-world problems. This requires investing not only in DataOps architectures and analytics tools but also investing in the change management and education of the experts closest to the business problems. When data barriers are no longer a problem, these experts can focus their efforts on what matters most.

Utilities have a significant opportunity to emerge from the COVID-19 crisis in a stronger position than they entered by doubling down on their digital strategies. By solving fundamental issues with data access, mobility, contextualization and operationalization, utilities can accelerate the way that data is used to respond to time-sensitive resilience use cases that exist across the organization.

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Francois Laborie is president of Cognite North America, overseeing Cognite's expansion and operations in the U.S. and Canada. Laborie has had an extensive career in the technology industry, serving in both research and executive roles. Before shifting to lead Cognite North America, Laborie managed Cognite's overall marketing activities, including product marketing and the Cognite partner network, as Chief Marketing Officer. He has master's degrees in computer science and engineering from the National Institute of Applied Sciences and a Ph.D. from the Toulouse Computer Science Research Institute.

ENERGY TRADING AND THE INSUFFICIENCY OF WEATHER FORECASTS





EVAN MCNAMARA

Energy traders keep a close eye on California during the summer. As the wildfires rage on, energy traders play a huge factor in the energy markets and how they affect energy producers, service providers, and consumers alike. Tuning in to the news to check the weather forecast may be a way to predict how your day is going to pan out, but for energy traders, this simple routine is crucial for strategic planning and allows them to make calculated investment decisions. Weather and weather prediction play a volatile role in energy trading.

Energy trading consists of market trades involving development and consumption of energy and commodities like coal, oil, natural gas and energy itself, generated in many ways, or even stored in battery storage. In these systems, commodity and energy prices often fluctuate based on domestic or international weather patterns, energy usage, resource extraction and refinement, production activity and more. →

Energy traders are required to research and collect data regularly, to make accurate predictions based on market trends for buyers and sellers of energy commodities in order to properly advise them on investments. The profession demands consistent communication, optimization and problem-solving and strong negotiation and interpersonal skills are imperative. In addition to calculating investments, they use weather prediction tools to best calculate the demand for energy during a given period in order to bid correctly for a positive return on investment.

There are many different ways energy traders buy and make sales. Depending on how traders are making these decisions, they are grouped into different categories, producers, buyers and speculators. Producers of energy commodities estimate how much energy they need to produce by securing guaranteed sales, creating a fixed price for the buyer. Buyers of energy come from industrial, commercial, residential and even those with an electric power industry background. For speculators, trades take place with futures contracts, which means the trader has agreed to buy or sell products or commodities at a predetermined price in the future. Another trade option is cash market transactions which are immediate transactions between a buyer and a seller.

Energy trading is a sensitive market, directly affecting the energy industry as a whole, service providers and households, and with weather constantly changing, so do prices. Since energy produced needs to equate energy used, production and use of energy is a strategic balance, and solely relying on industrial battery storage to balance the grid is not sufficient. There are many questions energy traders need immediate answers to so they can make calculated investments, and without proper weather projection tools, they are unable to make those trades without great risk.

Weather prediction and energy trading

Weather impacts energy trading based on many factors, including seasonal changes, geographical location, long and short-term weather patterns, temperature, wind, rainfall, snowfall, unforeseen extreme weather changes and more.

Seasonal and geographical changes can affect energy trading, for example, if a location with a warm climate is predicted to have a particularly hot day, more energy will need to be produced due to projected air conditioning usage and vice versa for colder climate locations using heating units.

Changes in weather over time also affect traders. Seeing changes from day-to-day, week-to-week or even month to month can affect the outcome of a positive return on investment, so seeing accurate information for weather patterns for short and long periods is crucial to making calculated investments.

Over longer periods, climate change can play a bigger role. In terms of research and data, one year's climate change record may not be enough to accurately predict new weather phenomena or drastic changes from year to year.

Extreme weather plays a huge role in energy prices fluctuating. For example, in the event of a natural disaster, like wildfires affecting California, smoke clouds can affect neighboring states like Arizona, making the weather cooler in a time where the climate is usually hotter, affecting the amount of energy used in Arizona. These natural disasters can affect the weather in a completely different part of the country, and without accurate weather prediction tools, it would be hard to account for this in trading.

If energy traders solely relied on data from a previous year, they would be left with blind spots to these weather changes. For example, solar energy farms could base their production quantity on how much sun they received the previous year, but due to unforeseen events, such as the wildfires, or even hurricanes, they risk not reaching their quota. This is also true for windmills producing energy. Without proper data collection, these are factors that are hard to account for.



The challenges of energy trading and weather forecasts

Relying on minute-by-minute weather forecasts is essential and could be the difference between considerable profits or loss in a short amount of time. Weather software and technology can prove great assets to companies in the energy markets as they can most accurately predict weather movements specifically affecting the market. Often energy traders turn to meteorologists for accurate weather predictions, but that acquisition could be costly and as human traits come, inaccurate. As an alternative, energy traders have been seeking technology weather prediction tools and adding overall long-term value.

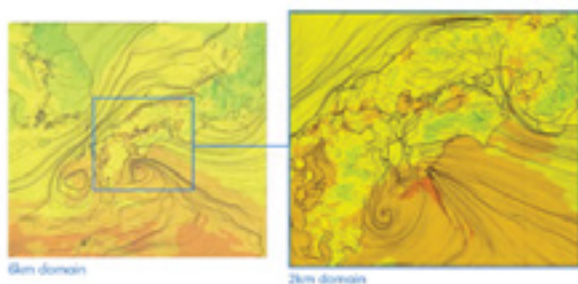
Without weather prediction tools energy traders have to trade semi-blindly making uncalculated decisions, affecting energy companies and consumers themselves. Lacking the proper tools would be detrimental to energy markets and it is hard to grasp how the energy trading world would look if these instruments did not exist. For the average person, weather might be a determining factor in how they might dress or how they decide to get to work that day, but for energy traders and the energy market, weather prediction is paramount.

Hedge funds that are in the business of commodities, supply and demand, are heavily reliant on weather, as mentioned. Weather impacts both the supply and the demand. Nowadays, weather is accessible to all via NOAA and HRRR – the governmental tools for weather prediction in the U.S. Other countries have similar tools. The problem arises when the governmental data isn't accurate enough, doesn't drill down to the resolution needed for energy trading or doesn't detail a specific weather parameter needed for energy trading, such as air quality.

Hence, energy traders use public governmental data, and weather vendors. But most energy traders use the same data and the same vendors. The problem is that in order to succeed in the field of energy trading, you need a competitive edge. Weather technology is a game-changer for some traders and grants them a competitive advantage. A small change in the accuracy of a forecast can result in millions of dollars.

One of the main and most important aspects is location: resolution is key in order to understand the accurate weather in a specific location. HRRR's resolution is 10-12km, while certain weather technology companies can reach a resolution of 100 meters. This can be crucial in understanding wind patterns at a wind farm, as an example.

Another aspect of weather technology is that it can be tailored to the needs of the energy trader, based on the commodity they are trading. Not only that, an energy trader who is following hundreds of wind farms and thousands of solar farms can also be pinpointed to the most impactful weather sites they want to trade on.



The next generation for energy traders is now

When we think of weather and energy trading, the combination of predictive impact is key. But actually, historical weather data is a crucial factor as well, in order to learn how weather phenomenon behaved in a specific area and what was the outcome for the commodity.

As we think about the technologies and capabilities needed now across the energy trading market, a few core areas of need are apparent:

“A small change in the accuracy of a forecast can result in millions of dollars.”

Improved Accuracy: Specifically looking only at public and government weather data will only give traders a small piece of the puzzle. Systems that were built for large scale emergency and defense alerts, public data doesn't provide the level of granularity of refresh rates in real-time that are needed to make decisions confidently.

Hyperlocal Targeting Capabilities: Consider wind blowing across a city. The wind speed, direction and intensity or length could be and usually is, quite different on one side of the city versus the other. You need to be able to understand weather impact at a hyperlocal level, down to the street to be able to truly tell how things like crosswinds or other weather parameters will have an impact.

Time-based Insights: Being able to seamlessly plug into historical, real-time, and forecasted data is needed for traders to have a full understanding of weather impact over time. Being able to quickly understand in hyperlocal areas the impact of the weather in years past quickly gives confidence and meaning to real-time and forecasted data.

AI-powered Historical Modeling: With historical weather being of crucial importance, the only way to ensure traders have access to the most cutting-edge technology is to use artificial intelligence to help train past, present, and future models. An AI-powered modeling approach will be able to comprehend and analyze the more important and impactful data points by an order of magnitude. →



Customized Data Based on Specific Needs: While having access to the best weather data and technology is great, it needs to be flexible. The goal or approach of one trader or firm might be different from another. For example, some projects are happening in real-time while others are more long-term, and the level of detail for projects varies. Thus, being able to customize all of your weather data, sync it to impact, and tailor the final solution for your needs is essential for success. Examples of custom parameters needed on a global basis, including trading regions such as CAISO, MISO, ISO-NE, NYISO, ERCOT, SPP, PIM, etc., might include:

- Location
- Coverage
- Parameters
- Global coverage
- Temporal resolution
- Spatial resolution to 2 KM
- Millions of virtual sensors

The most successful traders in the coming months and years will be the ones with full access to a high-resolution forecast impact model, combined with automated decisioning software and API integrations. The needs include historical, real-time, and forecasted data, in addition to global coverage. Having access to this type of weather intelligence means having the best technology, and the benefits to traders are significant.

ABOUT THE AUTHOR:

Evan McNamara is the director of energy trading and account management at ClimaCell, the weather intelligence platform.

ELECTRIC UTILITIES NEED SECURE APPLICATIONS, NOT JUST SECURE COMMUNICATION NETWORKS



ROMAN ARUTYUNOV

Today's electric utility substations and distribution feeders contain and interact with a variety of assets, including substation computers, intelligent electronic devices (IEDs) and software applications. They are serviced by utility personnel who must access certain systems and IEDs but are not permitted to log into others. Permissions may vary depending on the organization, individual roles, training, skillset and authorizations.

Managing access control is complicated, especially when assets number in the hundreds of thousands, as is the case with electric utility substations and distribution feeders. Adding distributed energy resources (DERs) — which may be owned and operated by third parties — to electric utility distribution networks further complicates securing assets and access control authorization.

Comprehensive access control requires more than simple communication network protection. Otherwise, it's all too easy for malware to make its way through protected communication network connections, even those secured by firewalls, via transient systems such as laptops used as human-machine interfaces (HMIs) by service technicians, remote access tunnels or other means — with devastating consequences. Protecting the distribution network is even more challenging and complex as hundreds of thousands of sensors from various manufacturers are deployed to automate various functions or provide deeper operational awareness within the grid.

Focusing solely on communication network security means a hack on any asset inside the utility's electric distribution network can cause a contagion that could compromise the entire utility. Utilities must protect and manage every application and interaction to protect their entire infrastructure. This can only be done if security is as distributed as the assets and applications themselves and based on a higher-level understanding of access control and authorization.

The article describes how utilities can use a security fabric that touches every application, device and HMI in their electric distribution network, from core-to-edge, to protect the entire system from unauthorized access, rogue devices, malware and other threats. The protection provided by a security fabric is effective even if the attempted intrusion comes from within the security perimeter.

Electric utility application security requirements

Electric utility distribution networks are composed of devices and software applications that cooperate with each other and humans in real-time. With DERs and grid edge devices added, electric distribution utilities may have hundreds of thousands of intelligent electronic devices (IEDs). Just one compromised component may create the potential for contagion. Security from core-to-edge, despite inherent challenges, is an absolute necessity.

Assets and applications in a utility's distribution network are deployed in the field, which may span thousands of square miles. Some assets lack innate security capabilities and reliable connectivity. In addition to securing devices and applications, communication between them must also be secured. Security from core-to-edge is an absolute necessity.

Core-to-edge security can be implemented using a security fabric to centralize security policy creation while decentralizing security policy enforcement throughout the distribution network. This is a departure from the traditional centralized patchwork of disparate security tools commonly deployed in utility distribution networks.

Key requirements for electric utility distribution network's security fabric include:

- Authenticating and authorizing all applications, devices, and humans
- Securing access to all applications, devices, and HMIs
- Securing all interactions, whether core-to-edge or edge-to-edge, between all applications, devices, and humans
- Securing data both in transit as well as at rest at the edge and in the core

The following section describes a model security fabric architecture that forms the foundation for meeting these requirements.

Model architecture for electric utility application security

Decentralized operation is inherent to electric utility distribution networks. Substation computers, intelligent electronic devices (IEDs) and other assets are spread out through the utility's service territory. Interactions between them are distributed as well. As a result, the architecture for electric utility distribution security enforcement must be distributed, too. The reasons include:

- **Scale:** Distribution systems can contain hundreds of thousands of IEDs and other distributed assets. Centralizing computation, communication, control and security for such large systems is cost-prohibitive and simply not feasible.
- **Many-to-many data exchange:** Field operations require many-to-many data exchange to scale and to provide real-time reaction to changes. All these data exchanges must be secured.
- **Access by multiple entities:** Decentralized system operation enables cooperation between multiple entities, (e.g., an electric utility, its suppliers and its contractors). Decentralized security eases the task of ensuring that each participant accesses only permitted equipment and systems, enabling data and system owners to define their sharing and access policies.
- **Decentralization avoids single-points-of-security-failure:** Field assets are, by nature, exposed. Distributing security data and enforcement avoids contagion in the event of a localized compromise.

The model architecture (see **Figure 1**) for a security fabric to protect electric utility distribution networks includes four main elements:

- A policy manager that sets security policy, and manages the security fabric
- Brokers that interface to corporate IT systems, e.g., Active Directory or certificate servers, and nodes (see below)
- Nodes that authenticate and authorize interactions in-field throughout the entire electric utility distribution network
- Enforcement points that provide filtering to protect IEDs and other assets that lack innate password or secure protocol protection

The role of each of these elements is explained in the following sections.

Policy manager

A policy manager enables human operators to administer the security fabric in a highly automated fashion. It is usually deployed in a data or operations center.

Using a policy manager, administrators can centrally set the policies to be applied by the security fabric. These policies are propagated throughout the system by automatically and accurately replicating security parameters across all devices, applications and humans in an electric utility distribution network. Administrators can create groups of devices, applications and humans, prescribing how these groups interact.

The policy manager also ensures compliance with emerging regulations and policies for critical infrastructure security including NERC-CIP. It automates the gathering, recording and preservation of critical historical information.

The policy manager does not sit in the security fabric's data or control plane. If it fails or loses communication with the security fabric, the fabric will continue to operate fully, without interruption.

Brokers

Brokers provide an interface between nodes and corporate IT systems. They also propagate security policies set by the policy manager to nodes in the field. Brokers usually reside in control/operations centers. However, brokers may be installed in the field, if security services such as domain controllers are based in the operational network.

Brokers interface with security services such as LDAP, Active Directory, trusted certificate authorities (CAs), etc., but can also provide user and device directory services and host LDAP internally.

To provide maximum reliability for the security fabric, the brokers must enforce existing security policies if communication with the policy manager is interrupted.

Nodes

Nodes securely store identity and policy information, as well as some operational data, and authenticate and authorize interactions between applications, devices and humans. They are installed at selected locations throughout the electric utility's distribution network and can run on ruggedized computers, commercially available industrial IoT gateways, communication network devices such as routers and switches -- and lightweight computing devices such as the Raspberry Pi 3. Because they consume few resources from their host systems, they can run on existing

computing and communication networking equipment in the field and operate independently of central services (e.g. policy manager and brokers). A node should need less than 100 MB of memory and be able to operate on narrowband connections with as little as 10 kbps of bandwidth.

Enforcement points

Enforcement points (EPs) enable role-based access control and single sign-on to secure intelligent electronic devices (IEDs) and other assets that lack innate password or secure protocol protection.

Using an enforcement point to secure assets in the field gives administrators visibility into and control of all access attempts, whether successful or not. Enforcement points ensure that assets are isolated individually -- if compromised -- protecting the rest of the electric utility distribution and permitting other assets to continue operating normally.

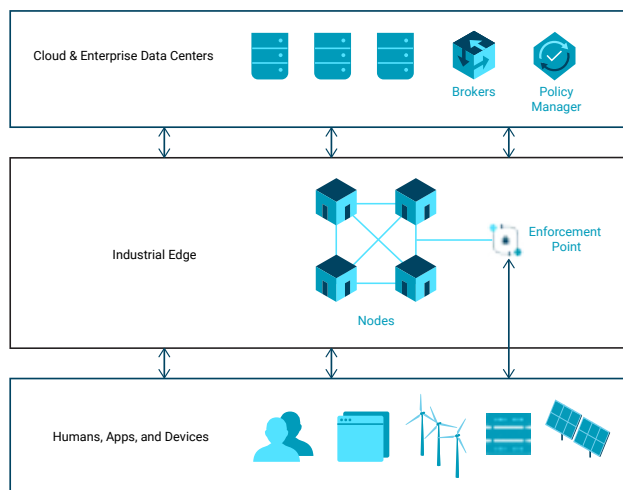


Figure 1: Model Electric Utility Distribution Network Security Architecture

Information flows bi-directionally through the security fabric. Identity and policy information, e.g., authorized device and user lists and privileges, flows from brokers (at the system core) to nodes and optional nodes (at the system edge). Operational information, such as asset inventories and device profiles, flows in both directions. →



Services to secure electric utility applications

A security fabric provides numerous services to safeguard applications, devices and HMI in an electric utility's distribution networks. Many of the key services are described in this section.

Enforcing role-based access control (RBAC)

The security fabric enforces role-based access control (RBAC) based on the managed identity of the user, regardless of whether the device supports managed passwords, local passwords, or no passwords at all.

For devices with passwords, the security fabric enforces RBAC by acting as an application proxy, ensuring only trusted devices can interact with applications. The security fabric automatically sets and stores device passwords, which are complex, hidden and can be regularly rotated per policy defined by the broker.

The security fabric also supports inline filtering, which can enforce RBAC for all devices regardless of their ability to support passwords or other access control mechanisms. Only applications, devices and humans that are authorized to interact will be able to communicate; all others are flagged and reported. For humans, the security fabric grants only the access that policy allows, restricting access to authorized applications and devices in specified geographic areas.

This access control enforcement goes beyond what can be done at the network layer. Even if a hacker obtains network-level access, the fabric's policies ensure they cannot access networked operational systems and cause them to malfunction or be hacked in turn.

Discovering applications, devices and humans

The fabric discovers and inventories devices, applications and humans when they request connection to the electric utility's distribution network. Login attempts are monitored and discovery is conducted at the edge based on passive, network-based scanning and active scanning for selected protocols, such as DNP3, Modbus and IEC 61850. Discovery at the edge, ensures unauthorized assets are blocked from accessing any distribution network components.

Creating trust for applications, devices and humans

The security fabric creates trust by working with other systems including:

- Directory and authentication services such as Active Directory, LDAP and RADIUS
- Trusted certificate authorities
- Asset management systems such as those from SAP

For each application and device, the security fabric stores certificate information, if available, and a fingerprint, containing information such as hardware, software and firmware identifiers, typical memory use, configuration and register settings and filesystem hashes. Fingerprints enhance certificates and create trust for applications and devices that lack them. The fabric allows only applications and devices with a valid certificate (if available) and matching fingerprint to join the system.

The fabric rechecks fingerprints and passwords to detect compromised applications and devices. An unauthorized fingerprint change indicates the application or device has been tampered with, and the fabric isolates the compromised asset. If an old password is used, the security fabric reports the attempted intrusion.

Tracking changes, documenting compliance

The fabric automatically tracks changes in application and device inventories and profiles, creating audit logs, documenting compliance with evolving regulations and standards for critical infrastructure security, including NERC-CIP.

Safeguarding data privacy and integrity across multiple parties

The security fabric safeguards the authenticity, privacy and integrity of data shared by multiple parties, e.g., different suppliers and contractors, in an electric utility's distribution network. The data's originator or owner controls access policies for the data, which the fabric replicates and enforces across the multi-party operation.



Using a security fabric to protect DERs: Threats and solutions identified by major U.S. utility

When planning to integrate DERs into their electric distribution network, a leading U.S. utility identified specific threats they would need to mitigate. They also determined that a security fabric would be the best way to defend against these threats. Examples of the threats and solutions that were identified appear in this section.

Unauthorized access to DERs

Real-time automation controllers (RTACs) are used to collect information from devices in DER installations, store it and provide it to monitor and telemetry systems. They also execute logic based on the data they collect and send commands to the intelligent electronic devices (IEDs) at DER sites. RTACs use industrial protocols such as Modbus, DNP3 and IEC 61850.

Unfortunately, many of these protocols lack security. For example, a Modbus slave will respond to any valid write request from a Modbus master. This makes the Modbus slaves in the DERs vulnerable to unauthorized access attacks. For example, an unauthorized device or application could reset the set point for a power inverter to disrupt the power balance of the DER.

Using a security fabric, an enforcement point prevents Modbus commands from unauthorized devices from reaching the power inverter while allowing authentic traffic to proceed unhindered. (See **Figure 2**)

Additionally, via the policy manager, the enforcement point will notify the human operator of the attempted attack by the rogue device.

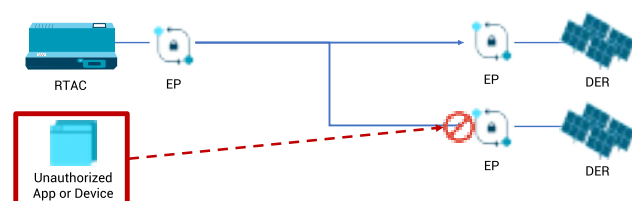


Figure 2: Security Fabric Prevents Unauthorized Commands from Reaching DERs

Isolating a malfunctioning or suspect DER

When a remote device in a DER sends incorrect data, perhaps because an attacker compromised it to send data at variance with the actual power output to unbalance the DER, it is difficult to exclude that device's data from the data stream. It may require reprogramming the governing RTAC, a burdensome process.

A security fabric will remove the suspect device from the active data stream and notify the human operator that inaccurate data is being blocked. The operator can then check the device for malfunctioning or tampering. (See **Figure 3**)

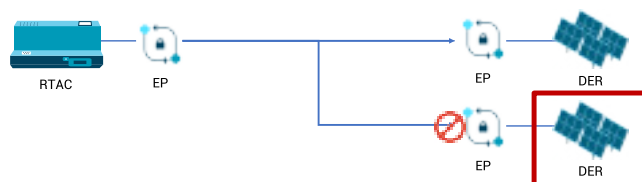


Figure 3: Isolating a Malfunctioning or Suspect DER

Detecting DER tampering

Protocols such as Modbus do not uniquely identify devices. Many devices used in DERs do not have tamper alarms. An attacker could replace a Modbus slave with a faux device. The faux device can attack the system by sending seemingly correct data that does not accurately reflect the power output of the device or masks the fact that the device has been removed.

A security fabric can detect such an attack by constantly monitoring the communication link between the node or enforcement point and each device in a DER. When communication with a trusted device stops or is interrupted, the fabric alerts the human operator that the event should be investigated.



Summary

Securing electric distribution networks requires that utilities look beyond communication network security. They must protect and manage every application and interaction to protect their entire infrastructure. Otherwise, a hack on any device inside the electric distribution network can cause a contagion that compromises the entire utility.

A security fabric that touches every application and asset in a utility's operational network, from core-to-edge, provides an essential foundation to secure interactions between applications, devices, humans and data. The protection provided by a security fabric is effective even if the attempted intrusion comes from within the security perimeter. By providing policy enforcement plus logging, the security fabric can also automatically manage and document compliance with emerging cybersecurity regulations and standards for electric utilities.

Advancing beyond traditional security models, the proposed security fabric distributes authentication and policy enforcement across the network of devices, to ensure security at scale. The security fabric supports many-to-many communication, secures access to even legacy utility systems that lack inherent security capabilities and underpins continuous operation even in the face of intermittent connectivity.

ABOUT THE AUTHOR:

Roman Arutyunov is co-founder and VP of products at Xage, leading product and market vision. He has 15+ years of experience solving network, security and data analytics challenges for enterprises enabling millions of IoT devices and holds a B.S. in applied mathematics from UC Berkeley and an MBA from Columbia University.

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COMMUNICATION SYSTEMS

S&C Electric Company
Tel: 773-338-1000
www.sandc.com

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

COMPRESSION DIES

Condux Tesmec, Inc.
Tel: 507-387-8069 | 1-888-980-1209
www.conduxtesmec.com

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Meyer Utility Structures
Tel: 905-632-9301 | 800-268-7809
www.meyerutilitystructures.com
StressCrete Group
Tel: 905-632-9301 | 800-268-7809
www.scgrp.com/utilitypoles

CONDITION ASSESSMENT SYSTEMS

Doble Engineering Co.
Tel: 617-926-4900
www.doble.com
OMICRON electronics Corp. USA
Tel: 1-713-830-4660
www.omicronenergy.com

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Doble Engineering Company
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www.doble.com
Morgan Schaffer Ltd.
Tel: 514-739-1967
www.morganschaffer.com
OMICRON electronics Corp. USA
Tel: 1-713-830-4660
www.omicronenergy.com

CONDUCTOR - HIGH CAPACITY, LOW SAG - ACCC

CTC Global Corporation
Tel: 949-428-8500
www.ctcglobal.com

CONDUIT - ACCESSORIES

ABB Installation Products
Tel: 1-800-326-5282
www.tnb.abb.com
ABB Installation Products (Canada)
Tel: 1-905-635-7855
www.tnb.ca.abb.com

CONDUIT - PLASTIC

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Tel: 1-800-326-5282
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CONNECTORS - BOLTED - DISTRIBUTION

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

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CTC Global Corporation
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CONNECTORS - COMPRESSION, TRANSMISSION

CTC Global Corporation
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CONNECTORS - DEADEND, TRANSMISSION

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Tel: 1-800-326-5282
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CONNECTORS - TECK CABLE

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Tel: 1-800-326-5282
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www.ampjack.ca

Asplundh Construction
Tel: 1-888-884-5426
www.asplundhconstruction.com

PLH Group, Inc.
Tel: 214-272-0500
www.plhgroupinc.com

Utility Lines Construction Services (ULCS)
Tel: 1-877-884-5426
www.ulcs-llc.com

CONSTRUCTION AND PROJECT ENGINEERING

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Tel: 773-338-1000
www.sandc.com

CONSTRUCTION SERVICES

Easi-Set Worldwide
Tel: 540-439-8911 | 1-800-547-4045
www.easisetbuildings.com

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Tel: 773-338-1000
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Tel: 312-269-2000
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Tel: 416-207-6000
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Tel: 312-269-2000
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Doble Engineering Co.
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Tel: 773-338-1000
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Tel: 312-269-2000
www.sargentlundy.com

CONTAINMENTS, INDUSTRIAL & RADIOLOGICAL

Solidification Products International, Inc.
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CONTRACTORS

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Tel: 773-338-1000
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Tel: 1-888-884-5426
www.asplundhconstruction.com

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www.easiset.com

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Tel: 214-272-0500
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Sargent & Lundy
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www.sargentlundy.com

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Meyer Utility Structures

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www.pickettusa.com

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www.sandc.com

FIELD INSTALLATION SERVICES

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Tel: 773-338-1000

www.sandc.com

Southern States, LLC

Tel: 770-946-4562

www.southernstatesllc.com

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Solidification Products International, Inc.

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FUSELINK - CUTOUTS

S&C Electric Company

Tel: 773-338-1000

www.sandc.com

FUSES

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Tel: 773-338-1000

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GLOVES - TESTING

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www.phenixtech.com

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ABB Installation Products

Tel: 1-800-326-5282

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www.systemswithintelligence.com

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www.ampacimon.com

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INSULATORS - GLASS

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INSULATORS - POLYMER

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www.polycast.ca

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INSULATORS - SUSPENSION

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METAL - CUSTOM MADE PARTS

Ampjack Industries Ltd.
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www.novatechautomation.com

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METERS - MICRO-OHMMETER

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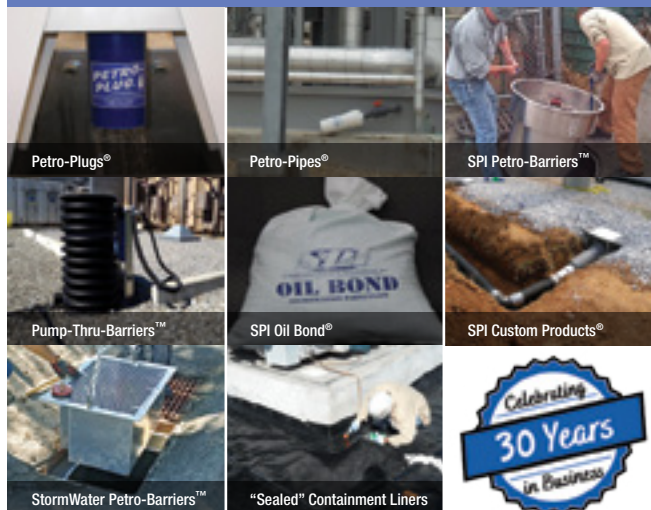
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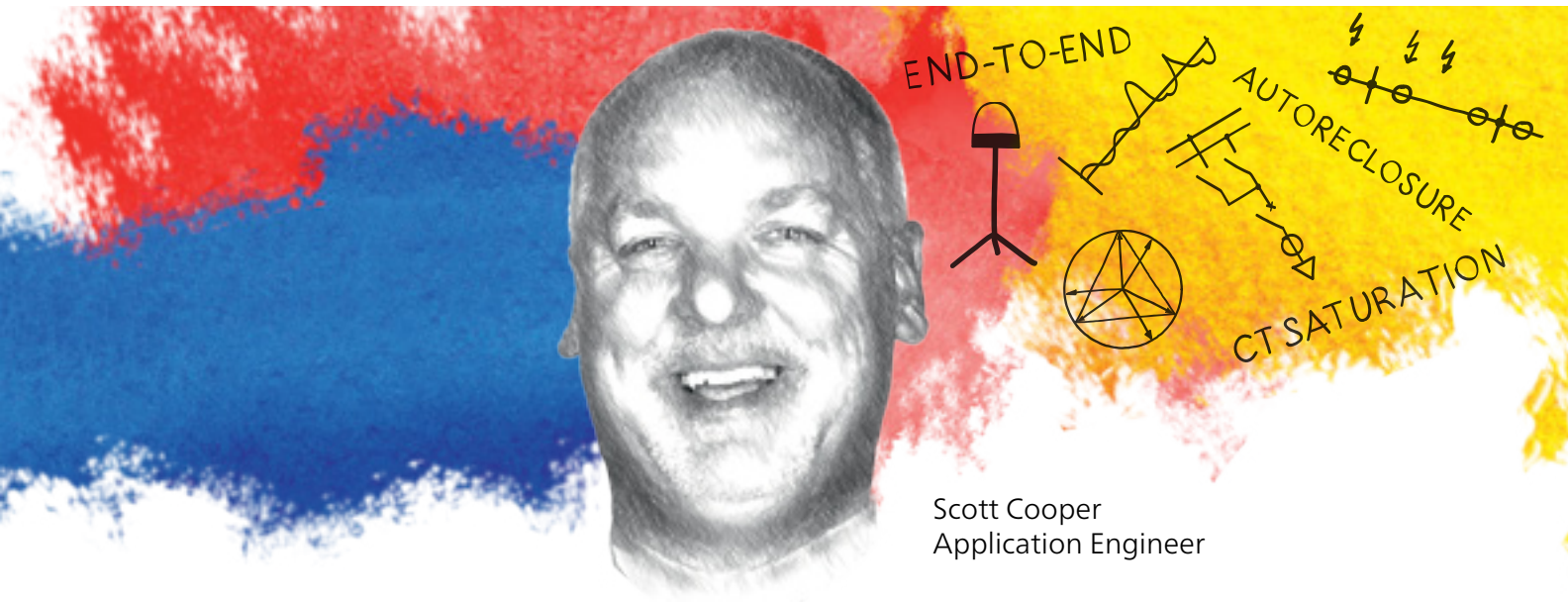
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