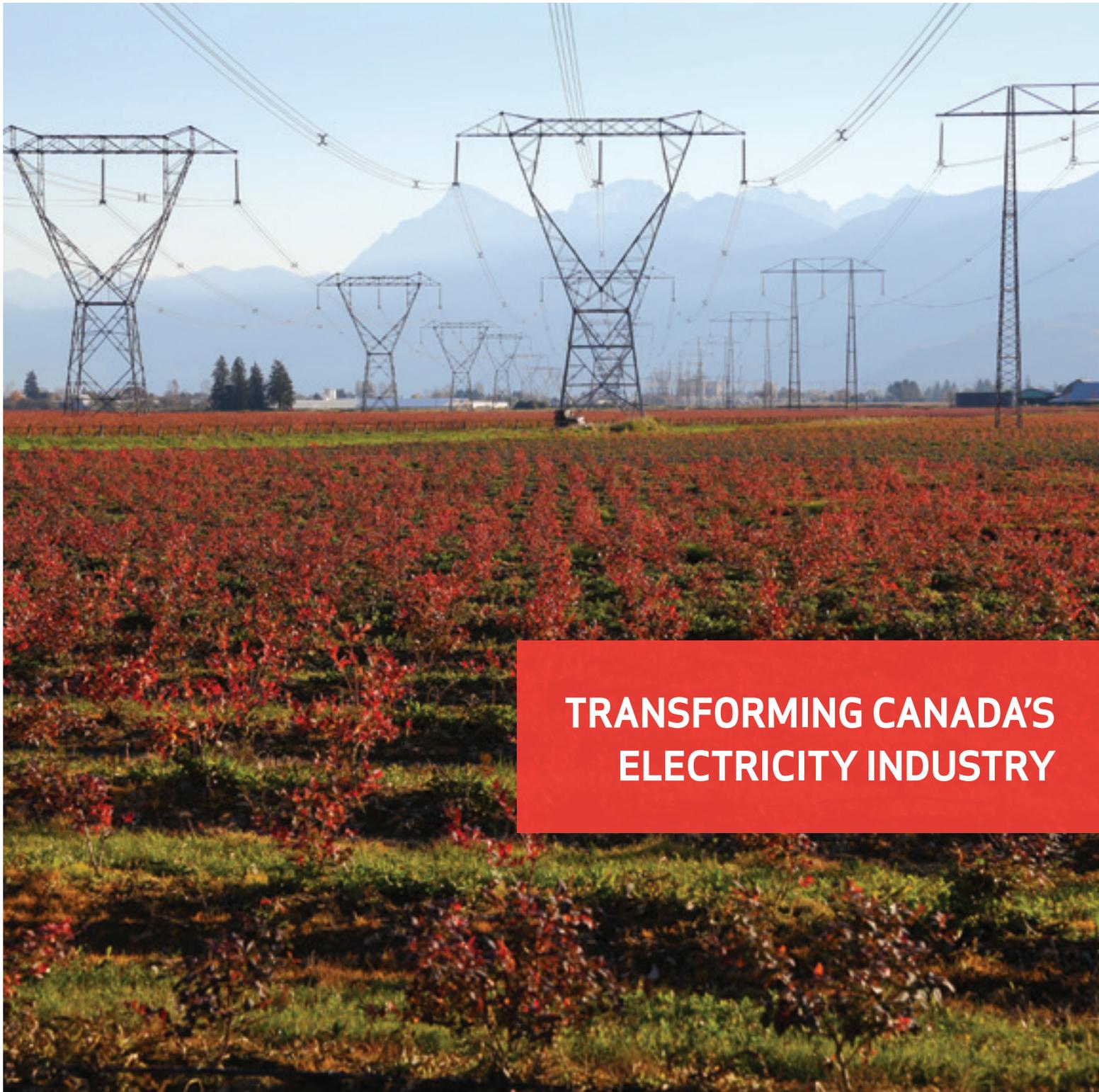


EET&D

MAGAZINE

Quarterly Issue 2, 2020 – Volume 23



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POWER POINTS

INNOVATION IN THE TIME OF A PANDEMIC (AND BEYOND)

Elisabeth Monaghan, Editor in Chief

With so much uncertainty during this phase of the COVID-19 pandemic, a lot of people are scared. The spread of the virus has been rapid, with long-lasting effects that we won't fully realize for months to come. And while the response to the outbreak has not always brought out the best in humanity, it has shown how adaptive and flexible people can be when faced with a crisis.

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GREEN OVATIONS

MOONSHOT

Marc-Andre Forget and Ron Denom, Ossiaco

It is only in the last 10 years that it became obvious something big was afoot in the electricity sector, and a market, where value which had been based on resource ownership, or infrastructure ownership or being a large utility, was beginning to be profoundly disrupted by technology.

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PROGRESSIVE REGULATORY REQUIREMENTS ADVANCE POWER RELIABILITY FOR BRAZILIAN UTILITY

Julio S. Omori, Copel and Andrew Jones, S&C

Utility regulatory landscapes are evolving across the globe. The convergence of such factors as aging infrastructure, a heightened commitment to the customer experience and grid modernization efforts are pushing the grid forward faster and more profoundly than ever. In particular, Brazil has experienced significant changes in electricity regulatory requirements over the past several decades.

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THE IMPACT OF IEEE STANDARDS ON THE ELECTRIC GRID

Doug Houseman, Burns & McDonnell

Since 2018, the IEEE has created or revised and approved more than 200 standards that impact the electric grid. From specialized standards on items like how to measure temperature rise in a transformer to broad standards like requirements for interconnecting generation and storage, the IEEE standards have an impact on the future of the grid.

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MULTI-TIERED APPROACH HELPS REDUCE WILDFIRE RISK

Tobin Vehmeier, Eaton

Although there is not a one-size-fits-all approach to reducing wildfire risk, many utilities are focused on approaches that prioritize speed, added intelligence and cost efficiency.

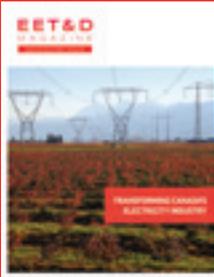
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GUEST EDITORIAL

THE NEXT WAVE OF IoT PROLIFERATION IN SMART BUILDINGS IS AROUND THE CORNER

Brad Pilgrim, Parity, Inc.

The Internet of Things is a network of sensors, meters, appliances and other devices that are capable of sending and receiving data. The total number of IoT connections worldwide is estimated to reach 5.3 billion by 2028. The first 5G IoT connections will emerge this year, and their number is forecasted to grow to 149 million by 2028.



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THE BIGGER PICTURE

**POTENTIAL FAULT LINES LIE BELOW THE UTILITY
CUSTOMER STRATEGY**

Jamie Wimberly, Kimberly O'Dell and Laurie Thompson, DEFG LLC

In late 2019, DEFG LLC and the Utility Customer Research Consortium conducted the Annual State of the Customer Survey, where consumers were asked questions to test the most basic assumptions underpinning utility customer strategy. The findings point to growing fault lines beneath the utility, especially the investor-owned utilities. Our collective assumptions around reliability, equity, and ownership may be outdated.

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SECURITY SESSIONS

ELECTRIC UTILITY PERSPECTIVES ON THE RANSOMWARE THREAT

Joe Slowik, Dragos

As ransomware activity persists – which all available data indicate will continue to be the case for the foreseeable future – and attackers get increasingly risk tolerant in targeting industrial operations, concerns for electric operations should increase.

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POWHERFUL FORCES

EMILIE NELSON

Elisabeth Monaghan, Editor in Chief and Alan Wechsler, NYISO

For the Q2 issue of EET&D, we are pleased to introduce Emilie Nelson, executive vice president of the New York Independent System Operator (NYISO).



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A NOTE FROM THE PUBLISHER

Dear Electric Energy T&D Community,

Over the past few weeks, I have heard people express their fears about what will happen as a result of the Coronavirus. While experts in the fields of medicine and science have let us know we can expect the effects of COVID-19 to be far-reaching, right now, it is difficult to know exactly what that means.

The Electric Energy Online team is committed to keeping you updated on the most critical issues taking place within our industry. We will also continue to spotlight the positive news as we receive it from our industry partners. In the meantime, we want to make sure all of you are taking care of yourselves and your loved ones by following the recommendations of the World Health Organization. Social distancing is necessary, but if you're feeling isolated, reach out. And if you know anyone who is quarantined, call or email them. Most importantly, we want you to remember that regardless of what providence, state or country you live in, we really are all in this together.

Steven Desrochers

ENMAX COMPLETES PURCHASE OF EMERA MAINE

March 2020

ENMAX Corporation (ENMAX) announced today (3/24) that the transaction to purchase Emera Maine for \$1,286 million CAD (\$959 million USD) from Emera Inc. (TSX: EMA) has successfully closed. Including the assumed debt, aggregate enterprise value is \$1.3 billion USD on closing. Emera Maine is a regulated electricity transmission and distribution utility in the state of Maine, servicing more than 159,000 customers.

"We are pleased to have completed this acquisition, as it reflects our strategy to grow ENMAX's regulated utility business in North America, leveraging our expertise in the provision of safe, reliable, regulated transmission and distribution electricity services," said Gianna Manes, President, and CEO, ENMAX. "ENMAX has made significant, long term commitments to Emera Maine's employees, customers, and Maine communities, and we look forward to delivering on our commitments and moving forward together."

With this acquisition, ENMAX has increased its regulated rate base by 50 percent, with 70 percent of ENMAX's future cash flows being derived from regulated and non-commodity sources. ENMAX is using its strong balance sheet to grow and is committed to paying down the acquisition debt over time. The acquisition will support ENMAX's continued provision of stable, high-quality dividends to its Shareholder, The City of Calgary.

Emera Maine will continue to operate as a stand-alone utility headquartered in Bangor and will operate under a new name to be announced in the future. In response to the COVID-19 global pandemic, both ENMAX and Emera Maine place priority on efforts to ensure the health and safety of employees and the continuity of safe, reliable service to customers. Both companies have also taken steps to support customers and communities during this difficult time.

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COVID-19-RELATED SHUTDOWNS SIGNIFICANTLY AFFECT REGIONAL ELECTRIC USE WITHOUT IMPACTING ELECTRIC SYSTEM RESILIENCY, RELIABILITY: EPRI ANALYSIS

March 2020

The Electric Power Research Institute (EPRI) published an analysis of the novel coronavirus (COVID-19) effects on electricity demand and use in Italy, Spain, New York, and California based on publicly available data.

These diverse electric power systems recorded reductions in peak demand and energy of 3 to 15 percent in the first two to three week days of each region's shelter-in-place order when compared with the previous week and the same week in 2019.¹

ITALY:

- During the first two days of the national shelter-in-place, the Italian system recorded reductions in weekday peak demand and energy use of 10 to 14 percent relative to that of the previous week and the same week in 2019.
- During days five through eight of the national shelter-in-place, Italy's system recorded reductions of 18 to 21 percent for peak and daily energy use relative to the same week in 2019.²

SPAIN:

- During the first week of the national shelter-in-place, the Spanish system recorded reductions in weekday peak demand and energy use of up to 15 percent relative to that of the previous week and the same week in 2019.
- During the second week of the national shelter-in-place, Spain's system recorded reductions of 7 to 10 percent for peak and daily energy use relative to the same week in 2019.

UNITED STATES:

- During the first days of city- and state-wide shelter-in-place orders in New York and California, these states recorded a 3 to 7 percent decrease in peak demand and energy use, compared with the previous week and previous years, with morning peak apparently particularly impacted.

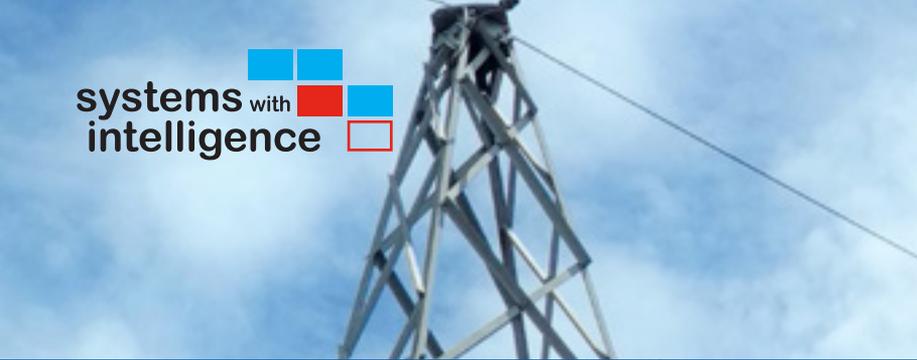
“The observed demand reductions are significant, but preliminary data indicate the electric power systems are resilient and can account for and respond to the reductions while reliably meeting customers' needs,” said EPRI Vice President of Integrated Grid and Energy Systems Daniel Brooks.

The EPRI analysis also summarizes COVID-19-related actions to protect critical power system workers taken by transmission and distribution operators in various affected regions. It is available for download at EPRI.com.

EPRI is taking steps to minimize the spread of novel coronavirus and to help protect its employees, stakeholders, and communities.

¹ Each region underlying mix of residential, commercial, and industrial electricity demand is different, and the analysis does not normalize the demand data for weather variations that also impact on demand.

² Despite the reductions in magnitude, the load shape remained largely unchanged, according to preliminary data.



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CALIFORNIA ISO BOARD APPROVES 2019-2020 TRANSMISSION PLAN

March 2020

The California Independent System Operator (ISO) Board of Governors yesterday (3/25) approved the 2019-2020 Transmission Plan that ensures consumers are served by a reliable bulk electric system and sets the foundation to meet the state's renewable energy goals.

The 2019-2020 Transmission Plan, a comprehensive assessment of the transmission needs of the electric system over a 10-year period, recommends only a modest capital increase when compared to previous plans.

Over the past 15 months, the grid was analyzed to identify upgrades needed to successfully meet the system's reliability needs, California's policy goals, and transmission projects that can bring economic benefits to consumers.

A total of nine transmission projects at an estimated cost of \$141.7 million were identified as essential for maintaining reliability of the ISO transmission system.

\$141.7 MILLION

Of this year's projects, seven are located in Pacific Gas & Electric's service territory at an estimated cost of \$120.7 million. The remaining two projects are located within the Valley Electric Association/GridLiance West and Southern California Edison service territories at an estimated cost totaling \$21 million.

This year's plan recognized there was no additional need for any policy driven projects to be approved at this time to achieve the state's Renewable Portfolio Standard (RPS) goal of 60 percent by 2030.

In a separate item, the ISO Board of Governors also approved establishing reliability must-run designations for Greenleaf II Cogen, Channel Island Power and E.F. Oxnard Incorporated to keep these resources online.

The ISO's analysis demonstrates these generation resources, which are earmarked for retirement, are necessary for the reliable operation of the ISO transmission system as well as the local distribution systems.

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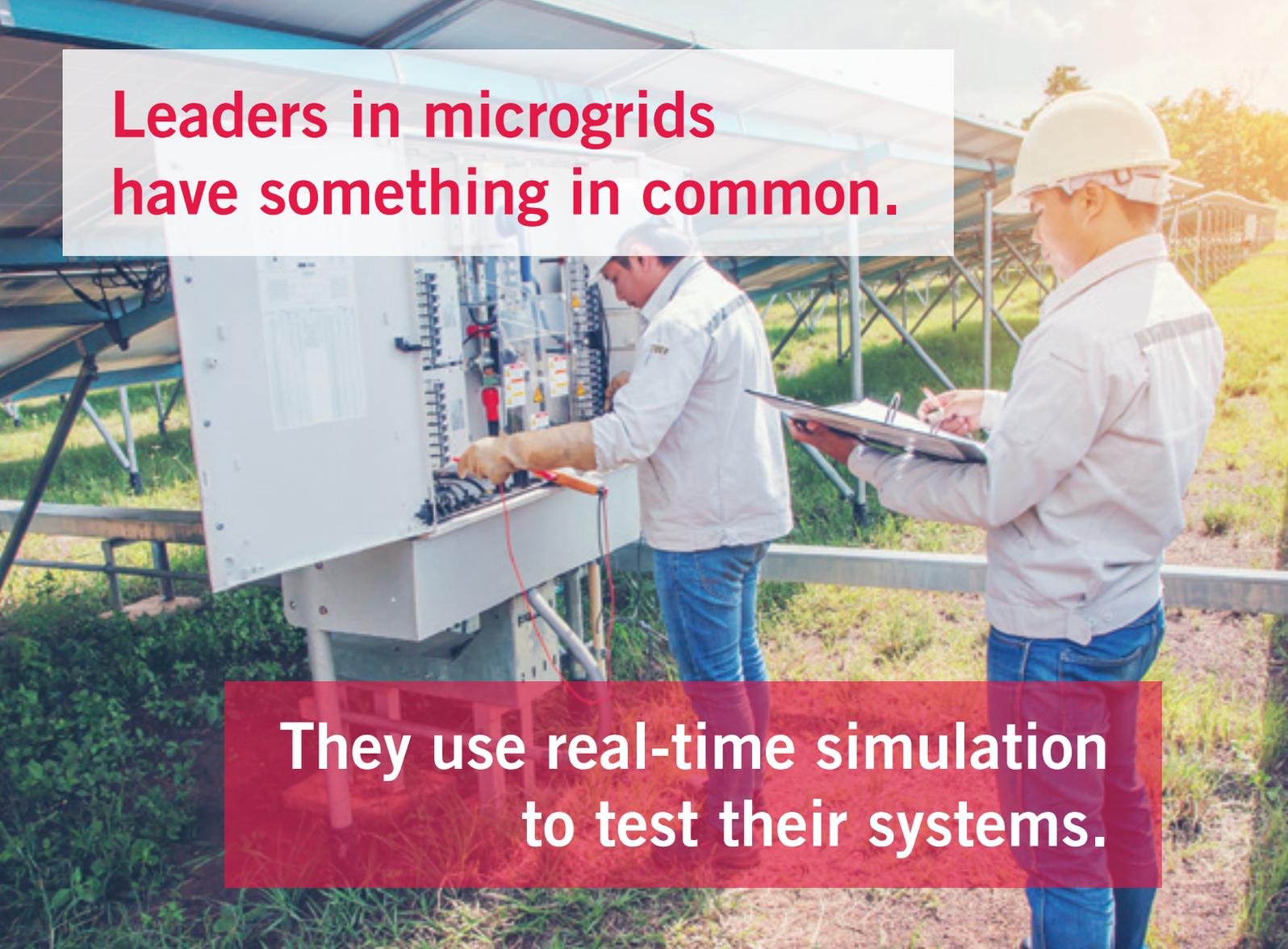
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ORANGE & ROCKLAND CHOOSES OSI TECHNOLOGY TO PROVIDE ADVANCED SMART GRID PLATFORM

March 2020

Orange and Rockland Utilities, Inc. (O&R) has selected Open Systems International, Inc. (OSI) to supply O&R with a new smart grid computer platform. This state-of-the-art technology will enable O&R to operate a more reliable, resilient, flexible, and efficient electric delivery system.

The smart grid integrates state-of-the-art equipment and technology with advances in computer analysis, communications, monitoring, and control to significantly enhance system reliability, efficiency, and overall quality of service. The new platform will further enable O&R to support New York State's drive to build a cleaner, more resilient and affordable energy system for all New Yorkers by stimulating investment in clean energy technologies like solar, wind, and energy efficiency.

The new platform is designed to ease O&R's transition to a new distribution system platform (DSP) and speed the adoption of distributed energy resources (DER), such as solar, into its system.

This new Advanced Distribution Management System (ADMS) is based on OSI's monarch operational technology (OT) platform and will be introduced in phases into O&R's delivery system.

The initial phase of implementation will include OSI's secure and scalable SCADA Supervisory Control and Data Acquisition technology and CHRONUS, OSI's next-generation, time series-based historian. The second phase will add a full complement of advanced distribution applications, and the third phase will incorporate Distributed Energy Resource Management System (DERMS) functionality.

“This project is part of our 10-year vision to enhance safety, customer experience, and operational excellence at O&R,” said Keith Brideweser, O&R's Section Manager of Engineering. “Our new platform from OSI will serve to organize and manage the functionality required to provide near real-time visibility and control of grid assets and distributed energy resources, such as solar, on the O&R system.”

“OSI welcomes O&R to our growing community of leading utilities implementing OSI's OT platform,” said Hormoz Kazemzadeh, VP of Distribution and Smart Grid at OSI. “We look forward to implementing OSI's state-of-the-art ADMS at O&R and supporting their grid modernization efforts.”

Orange and Rockland Utilities (www.oru.com) serves approximately 300,000 electric customers in six counties in New York and northern New Jersey, and more than 130,000 natural gas customers in New York. O&R is a subsidiary of Consolidated Edison, Inc., one of the nation's largest investor-owned energy companies.

The background of the advertisement features a close-up of a large, cylindrical conductor with a yellow core, set against a blurred landscape with a power line tower and a blue sky with clouds. The text 'ACCC Conductor' is prominently displayed in large white letters, with a registered trademark symbol (®) next to the second 'C'. Below this, a green banner contains the text 'High-Capacity, Low-Sag Conductor' in white.

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Between 2005 and 2010, the newly introduced ACCC[®] Conductor was used to increase the capacity of 3,500 circuit kilometers of transmission lines in a handful of countries. Today, over 27,000 circuit kilometers of ACCC Conductor are in service in 51 countries (as of 12/2019). While the ACCC Conductor was initially deployed to increase the capacity of existing transmission lines to alleviate congestion, mitigate sag clearance violations, accommodate load growth and enable the integration of renewables, its improved conductivity is also reducing electrical line losses which serves to reduce fuel consumption and associated CO₂ emissions— subsequently helping combat climate change.

Based on the International Energy Agency's "Global Energy & CO₂ Status Report" of March, 2019 (using 2018 data), which reports that the average CO₂ emissions created from all combined sources of generation is 475 grams (1.047 pounds) per kWh, the ACCC Conductor is currently reducing CO₂ emissions by over 2.6 million metric tons per year. This is the equivalent of removing nearly 600,000 cars from the road. The cumulative CO₂ reductions saved via the use of the ACCC Conductor exceeds 12 million metric tons.

To put this in perspective, consider the cost of purchasing 600,000 electric cars. Assuming they were powered by

100% renewable energy and the cost per vehicle was \$30,000 dollars, that would represent an \$18 billion dollar investment. Assuming the average cost of installing ACCC Conductor is \$100,000 per circuit kilometer, the all-in cost would be \$2.7 billion dollars – a fraction of the cost, with arguably far greater benefits.

While the efficiency of the grid previously had taken a back seat to the efficiency of generators, transformers and demand side appliances, entities such as the Asian Development Bank and World Bank are now funding transmission projects not only to support economic development, but also *specifically* to achieve emission reduction objectives. In the coming months, our industry will also see a substantial influx of Green Bond Financing in the U.S.

This is a very good thing and CTC Global is ramping up its production to meet the challenge. Please give this some thought as you contemplate upgrading your transmission system. If you'd like more information please call us or email info@ctcglobal.com

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INNOVATION IN THE TIME OF A PANDEMIC (AND BEYOND)



ELISABETH MONAGHAN
Editor in Chief

As the *EET&D* team is working on this issue of the magazine, the world is reeling from the COVID-19 pandemic. Many locations throughout the world are under "Shelter at Home" orders, including Denver, CO, where I live. Regardless of what people are being asked to do to prevent the spread of the Coronavirus, everyone is expected to use common sense and be willing to make adjustments to how we live our lives. Some of the more obvious adjustments include improving personal hygiene habits, like washing our hands frequently for at least 20 seconds or keeping at least six feet from those nearest to us at grocery stores or banks.

With so much uncertainty, a lot of people are scared. People who have been furloughed or laid off from their jobs are having to figure out how to make ends meet, and whether this situation will end in as little as two weeks or as long as 18 months.

In response, businesses are coming up with new approaches to daily life. Those that are considered essential operations, like medical facilities and banks must adhere to strict protocols of sanitizing their sites and making sure their employees are keeping the appropriate distance from their colleagues, as well as being safe themselves. Many commercial and residential landlords are not evicting tenants who have lost their jobs and cannot pay their rent. In the electric energy sector, utility companies throughout the United States are suspending service disconnects for the next few months to help customers who are unable to pay their bills.

The spread of COVID-19 has been rapid, with long-lasting effects that we won't fully realize for months to come. And while the response to the outbreak has not always brought out the best in humanity, it has shown how adaptive and flexible people can be when faced with a crisis.

Companies like HP are using 3-D printers to manufacture face masks and respirators for hospitals and medical professionals. It has been reported that one automobile company may team up with a medical device manufacturer to make ventilators. Many individuals who own sewing machines are creating face masks for frontline health workers. Despite the fear so many may have about what the next months have in store, it is not preventing people from coming up with innovative solutions.



I hope that by the time this issue goes to press, we will have benefitted from those lessons, and all of us, regardless of our ages or incomes, will emerge from this pandemic, stronger and smarter.



When it comes to electric energy, innovation is nothing new. Case in point is our conversation President and Chief Executive Officer of the Canadian Energy Association Francis Bradley. In this issue's "Grid Transformation Forum" column, Bradley reminds *EET&D* readers that the electric energy sector has a culture of innovation. Innovation has brought us the likes of EVs, solar power, IoT and Distributed Energy Resources. It is also innovation that will see industry partners and utility companies guide consumers through this pandemic.

Innovation will continue to play a role in how utilities ensure the safety and security of the electric grid. In his article, Joe Slowik, who is a "principal adversary hunter" for cybersecurity expert Dragos, writes about the role ransomware plays in the utility industry.

In addition to offering a history lesson on ransomware, Slowik points out how, regardless of whatever challenges the energy sector and utilities face, the industry must be prepared to mitigate ransomware and other cyber threats. Even more important is that the electric energy industry must prepare now to mitigate whatever security issues arise down the road – whether they are a threat to one substation or millions of consumers. Slowik does not just mention the threats ransomware pose. He also offers steps utilities can take to prepare for, and stave off those threats.

Communication and best practice-sharing will make it easier for utilities and their customers to rebound from, if not avoid threats to the energy grid. Identifying and developing innovative solutions is another step – bringing us full circle to Francis Bradley with CEA's belief that innovation will remain a critical component to making sure the electricity sector will survive the most challenging times. Innovative technology and business practices also will ensure a promising future for the industry and those of us who work with or are consumers of electric energy.

And regardless of whether we are in the beginning, peak or flattening phase of the COVID-19 outbreak, those in leadership positions within the utility industry must implement policies to ensure a protected workforce and a resilient electric grid. We have seen how COVID-19 has affected China and Europe, which means we, in North America, have a chance to learn from their successes and mistakes. I hope that by the time this issue goes to press, we will have benefitted from those lessons, and all of us, regardless of our ages or incomes, will emerge from this pandemic, stronger and smarter. However, if we are going to rise from the ashes, we are going to need to be innovative – not only in terms of technology and medicine – but also in how we adapt to connecting, interacting and working together to provide sustainable solutions for our local and global communities.

Elisabeth

TRANSFORMING CANADA'S ELECTRICITY INDUSTRY

BY THE CANADIAN ELECTRICITY ASSOCIATION AND ELISABETH MONAGHAN



Last month the Canadian Electricity Association (CEA) released the State of the Canadian Electricity Industry 2020 at GLOBE Series, which convenes leaders from business, government and civil society to share knowledge to accelerate the transition to a cleaner energy future. Emphasizing the pace and scope of transformation in the electricity sector, the recommendations within the report will guide CEA's thought leadership and advocacy in the year ahead.

For the Q2 issue of *EET&D*, we spoke with President and Chief Executive Officer of the Canadian Electricity Association CEA Francis Bradley to discuss the report, its findings, and how CEA intends to address the recommended next steps.

EETD – How has the Canadian electricity sector transformed over the last number of years?

FB – For more than 100 years, Canadian electricity companies had a simple mandate: provide reliable, safe power to all. Keep the lights on. And they did just that.

For many decades, the business model was remarkably stable. An electricity utility or other company in 1980 interacted with its regulators and business partners, managed its operations and served its customers in fundamentally much the same way it did in 1970 or even in 1960.

Today, these same companies are expected to also provide a broad range of energy services. New technology, renewable sources of energy and customer convenience and personalization are the drivers of grid innovation.

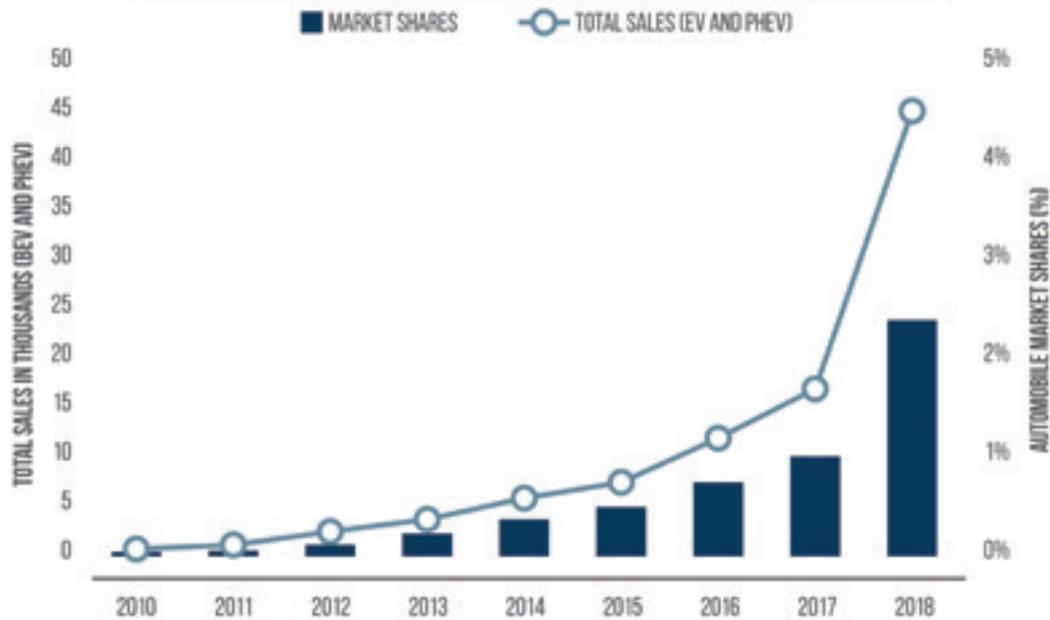
Proactive communication capabilities are endless. System outage updates can be communicated via text linking to an outage map while pending weather challenges are communicated via Twitter. These advancements are now basic customer expectations.

Similarly, sensors, smart home energy management assistants and resulting data provide the opportunity in achieving nearly net-zero consumption. Smart lighting in homes and businesses can be connected and controlled. Utilities are now evolving from the traditional one-directional pipeline delivery system to a platform-based relationship with customers.

The Canadian electricity industry is undergoing a period of unprecedented change through decarbonization. This is the backdrop against which our State of the Canadian Electricity Industry 2020 was presented. →



Electric Vehicle Market Shares and Sales Growth (2010-2018)



EETD – What does electrification mean to CEA and its members?

FB – Actually, our focus is on decarbonization. Many people think electrification is just the growth of electric vehicles. But it is more than that.

Our members are focused on the process of expanding the use of low-carbon electricity for Canada’s energy needs. By 2050, electricity will play a substantially greater role in Canada’s overall energy use.

This shift is largely driven by consumer and political demand to reduce greenhouse gas (GHG) emissions in a sector already 80 percent GHG free. And only about 20 percent of the sector’s energy use is electric.

While the transportation sector including passenger vehicles, mass transit and heavy-duty trucking is positioned to lead this move towards electrification, buildings and industrial applications will be just as impactful.

The Electric Power Research Institute noted that electrification could increase the U.S. demand by 24 percent to 52 percent by 2050. These numbers provide a baseline for prospective Canadian demand. This challenge will stretch current infrastructure to its maximum capacity. As the industry continues to migrate from carbon-based generation, the limitations of renewable energy will become obvious. Energy storage, distributed energy resources and grid modernization will be critical in bringing a new generation to the customer.

EETD – If Canada is going to reach net-zero carbon by 2050, what is the key driver in getting there?

FB – Innovation. Innovation is key to the change needed in the electricity industry.

The electricity sector has a culture of innovation. In 2018, CEA hosted Canada’s first electricity Centre of Excellence. The Centre of Excellence (CoE) is dedicated to recognizing and celebrating electricity innovation from coast-to-coast. The CoE showcases cutting-edge development in the way that electricity is produced, delivered and consumed, and highlights transformational progress in how electricity yields economic, social and environmental benefits for Canadians.

The industry will continue to evolve as the expectations of the customer continue to grow. Whether the project is tailored to EV owners, allowing utilities to charge cars overnight during off-peak hours, or the development of the largest ever off-grid, solar and storage microgrid project in Canada – all Centre of Excellence projects are positively impacting the lives of Canadians and transforming our ever-changing industry.

As we look ahead, one of the challenges Canada will have to address is the framework for energy regulation and innovation. Federal, provincial, and territorial governments must work collaboratively to ensure energy regulators are given the mandate to accommodate infrastructure investments and innovation into the rate-making processes. The industry appreciates the need for utilities to control costs, but strategic innovation can result in significant benefits and produce cost-savings over-investment as usual.



EETD – In this era of transformation, how will the industry meet the needs of customers and communities?

FB - Perhaps the most fundamental of many current transformations relate to the emergence of a more diverse, distributed and technology-enabled electricity system.

One of the challenges we have in today's electricity system is that it is built to meet peak demand. And sometimes that peak is only reached for a very short time each year, with summer and/or winter peaks depending upon the system.

In some jurisdictions, we see the complexity and market impacts of surplus baseload, which can result in spilling water, or even negative pricing in some regional wholesale markets.

The challenges of juggling system resources with variable demand is now becoming even more complex, with the addition of variable generation resources, both at grid scale and on the customer side of the meter. The future will see even greater variability of both demand and supply.

Storage is a solution to some of these issues, potentially enabling more efficient plant and system operation, allowing for peak-shaving and valley-filling. Much of the discussion about storage is about batteries, pumped storage, compressed air and other such technologies.

In this era of technology and personalization, companies will be challenged to meet increasing customer expectations and to maintain relationships through new touchpoints such as electric vehicle charging, smart homes and consumption dashboards.

Innovation will depend on first understanding what drives customer behaviour, as well as what changes are likely to emerge and how fast.

The introduction of distributed energy systems will also fundamentally alter customers' relationship with power. They will have the ability to sell and trade energy to one another enabled by two-way communication between utilities and customers. This will make the current electricity grid more efficient and will potentially save customers money while benefiting the environment.

The franchise of a utility company will change as utilities become essentially distribution system operators. And the rising demand for clean energy to transform transportation, heating, ventilation, air conditioning and industrial processes means we will need every single kilowatt that we can find.

The impact of distributed systems and increased consumption is something that every electricity company is thinking about. They are developing their plans on how they will fit into this future model. Based on conversations I've had with energy experts on my podcast, the Flux Capacitor, CEOs, CEA member companies, regulators, thought-leaders and customers are focused on what the future might bring and what it means for them.

But when I ask integrated utility companies if promoting distributed energy resources will cannibalize their generation business, the response is "no." That's because the sentiment is that the pie will be so big and the demand so large that we won't have a choice but to integrate a more distributed energy system as we also expand generation. We need to make sure we are building as much grid as we can. →



An effective investment and regulatory environment will be critical as Canada moves to a more resilient, low-carbon economy.



EETD – Is the electricity sector affected by regulatory burdens?

FB – At the federal level alone, the electricity industry is affected by more than 90 different regulations that are either in force or pending. These stretch across 31 different statutes, covering issues as diverse as greenhouse gas (GHG) emissions, species at risk, migratory birds, navigation protection and more.

The electricity industry recognizes the vital role of regulation. However, legislative and regulatory requirements should be outcomes-driven, predictable and, to the greatest extent possible, non-duplicative. In the absence of that, the cumulative impact of a myriad of regulations has the effect of inhibiting new investments and increasing costs to electricity end-users, including residential, industrial, commercial and institutional customers. An effective investment and regulatory environment will be critical as Canada moves to a more resilient, low-carbon economy.

In 2012, the Conference Board of Canada (CoB) estimated that the electricity industry would need to invest at least \$350 billion by 2030 to meet demand growth and modernize its aging infrastructure. Considering the growth in regulatory requirements, particularly related to GHG reductions, this estimate for the industry has now been updated to \$1.7 trillion by 2050.

Meeting this investment requirement requires an efficient and effective investment and regulatory system in Canada. These investments are crucial for growing Canada’s economy and reducing our carbon footprint. They create good jobs, promote clean economic growth and ensure that businesses and households can continue to benefit from access to safe, sustainable and reliable energy. Addressing issues related to competitiveness, investment climate, and cumulative regulatory burden will pay dividends into the future.

“Digital technologies are set to transform the global energy system in coming decades, making it more connected, reliable and sustainable.”

Potential Participants in Interconnected Electricity Systems by 2040:

1 BILLION+ HOUSEHOLDS
11 BILLION+ SMART APPLIANCES

Source: International Energy Agency



EETD – What are CEA’s key recommendations for the remainder of 2020?

FB – In order to reach Canada’s climate targets, we need to develop innovative solutions across all sectors. The creation of a national strategy to guide decarbonization and electrification remains a key CEA policy objective and is at the forefront of our recommendations.

Business as usual is not an option. Advances in technology are shifting what the future will look like. Electrification of the economy, including electric cars and beyond, will increase demand. Smart grids, renewables and distributed generation options will shift how electricity is generated.

Governments, Indigenous Peoples, communities and the energy sector must work collaboratively to build the social license for new projects and create the regulatory structure to have them approved. That will mean identifying areas where regulatory requirements are duplicative or have a burden greater than their public benefit. It will mean focusing on what we want to achieve: access to reliable, clean and competitively priced power. Federal and provincial governments will need to work together and ensure new innovative projects are approved.

We live in exciting times. Electricity is transforming at an unprecedented rate that will have major implications for how we live and the Canadian economy. We can build a clean energy future together, but we must start now.

ABOUT FRANCIS BRADLEY

Francis Bradley is the president and CEO of the Canadian Electricity Association (CEA). Beginning as a junior in communications, Bradley has worked at CEA for 33 years in a variety of roles, most recently as Chief Operating Officer since 2014 and interim Chief Executive Officer beginning December 2018. A frequent speaker on security, technology, industry transformation and the future of the electricity industry, he was a co-author for five years of the annual North American Electric Industry Outlook published jointly by the Washington International Energy Group and CEA.

MOONSHOT





MARC-ANDRE FORGET AND RON DENOM

The electricity sector remains an industry that is driven mostly by regulation and capital expenditure. With customers still being mostly captive, the drivers for change are less intense. This probably explains why, for so many years, the market for technology in the electrical sector was mostly large industrial companies providing products to large utility companies. The progress towards new technologies was measured and incremental as the prevailing feeling was that we had mastered electricity a century ago, and life was more about marginal improvements than about hunting for breakthrough innovation.

Asset management technology? Well, with the PUC's imposing rates of return based mostly on CAPEX depreciation, it made more sense to just replace assets than to try to extend their useful life. The biggest change in the last decades was probably the FERC ORDER 888 and 889 that enabled wholesales markets. This led to the establishment of ISO / RTO and power trading desks, creating a fresh need for new technology.

The arrival of Distributed Energy Resources (DER) should have imposed the need to have a more holistic view of the technology required, but the reality on the ground is that the industry tends to identify and build all its technology needs based mostly on pilot projects... or on a committee looking at mostly only one aspect or issue at a time. →

It is only in the last 10 years that it became obvious something big was afoot, and a market, where value which had been based on resource ownership, or infrastructure ownership or being a large utility, was beginning to be profoundly disrupted by technology.

And it was not the kind of technology that the long-established, large industrial companies were used to providing to utilities. It was technology that empowered the consumer.

Residential DIY solar panels began to appear around 2005. Tesla launched its Roadster in 2008. Nissan launched its LEAF in 2010, and by 2012 was already deploying "LEAF-to-home" in Japan. By 2013, it was clear that utilities were caught in the gradually tightening vise of declining revenues caused by increasing customer self-generation and increasing grid investment requirements to accommodate electric vehicle "hotspots."

Toss into the mix, the increasing frequency and intensity of extreme weather events and the emergence of IoT and the smart home, and the basic parameters of a distribution grid that is distributed, digitized and decarbonized begins to emerge. This new grid is a mix of behind-the-meter consumer investment and in-front-of-the-meter utility investment with a topping of new business models. The homeowner and the prosumer-centric load-serving entity (utility, ESCO, CCA, etc.) can now have a new, more balanced, business relationship that equitably shares the benefits of the two-way power flows and the respective investments made on both sides of the meter.

A very neat win-win package from the business point of view but can it work technically? Very few homes have an electrical engineer "on staff" to be the counterpart to the utility. So where is the "brain" the "intelligent assistant", the "operating system" - that is available 24/7/365 to talk to the utility distribution management systems? And this is a relationship between a giant and a flea. The media world was moving from broadcast TV to peer-to-peer programming - but could electric distribution go there? Was there the breakthrough technology, desired by, and affordable to consumers, that could make this work?

This was an intriguing challenge for a new generation of innovation companies that decided to breach the competitive barriers that had been built around this, one of the largest business sectors in the world, and to take this on this very demanding, high-risk moonshot. The game was on.

We're now in 2020, and the answer to the prosumer-facing side of the challenge is being worked on and solved by several companies. These companies are using either conventional or exotic materials in their power electronics and conventional or breakthrough designs for the constant conversion and reconversion of AC to DC, DC to AC and DC to DC. Solutions are a mix of hardware, embedded software and/or cloud computing. Some products are reaching commercial launch.

But what about the utility-facing side of the challenge? Have the issues been properly identified and met? Let's explore this further.

One of the first issues is communications protocols. Many of the protocols were developed within industry silos, and as the EV, residential solar power and smart home industries converge with the legacy electrical distribution sector, we find ourselves in a Tower of Babel. At the highest level, the utility DMS communication with EVs, EV chargers and aggregators may meet IEEE 2030.5 and Open ADR 2.0b.

Even at this level, we can get conflicting instructions between demand (charge my EV more quickly) and demand response (curtail some load). Move one level down, and the number of protocols begins to explode with multiple protocols for demand response, solar inverter management (Rule 21, for example), distributed stationary storage, EV charging management (OCPP 2.0, for example) and EV discharging management (V2G). It has been 20 years since the first publication, and we are still having problems turning IEC 61850 into a real standard, and many players are still using IEC 61850 and DNP3 as main protocols. The industry needs to get its [deleted] together. Multiple protocols add up to multiple points of weakness, and this segues nicely into the second issue: Security.



“
One of the many benefits of this new bi-directional grid for the utility is better feeder load forecasting.
 ”

The utility industry is not amused by toys. Ten “fast,” bi-directional residential DC chargers on a feeder can swing power on a feeder by half a MW in five milliseconds. Safe, reliable feeder management requires communication and control between the utility DMS and the behind-the-meter assets on the feeder. No open ports to give hackers a backdoor to the network and encrypted communications throughout. Regulations have not yet caught up to the technology, but compliance with NERC/CIP standards and the use of TPM hardware encryption chips look like the way forward. The grid will only be as strong as its weakest point.

One of the many benefits of this new bi-directional grid for the utility is better feeder load forecasting. When the distribution grid was only consumers, forecasting a feeder load for the hours and days ahead at an acceptable level of accuracy was relatively straight forward. With the appearance of the prosumer, adding both generation and storage behind the meter, and the appearance EVs which can randomly pop up anywhere on the network, forecasting accuracy has been lost, and the costs of standby reserve and dealing with over-generation have significantly increased.

Up to now, the smart devices behind the meter were “worm-brain smart.” And it is only with this leap forward in advanced control, censoring and processing hardware, powerful algorithms, sophisticated grid edge and cloud computing, big data architectures and artificial intelligence that we see the emergence of a worthy behind-the-meter counterpart that begins to make sense to the utility industry.

And it couldn’t come at a better moment.

There is a lot of talk these days about reducing carbon emissions to fight global warming. But the appearance and adoption of attitudes, behaviors and technologies that reduce or limit carbon emissions are fragmented, and uptake is slow.

Can something be done to change this? Is there a catalyst to achieve the mass adoption of something that makes a difference? Something that “moves the needle?”

From a technology point of view, it means that we need to provide people a better option for what they currently have. This option must not impose any compromise to quality of life, and people who adopt it must see a lower cost compared to whatever they are doing or using now. Residential solar power and electric mobility are both promising areas for significant reductions in carbon emissions, but something is still holding people back, preventing their adoption at a scale that makes a difference. Until now. →



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Single-family suburban residences, which combine domestic energy use and the propensity for higher automobile use, provide a convenient way to involve many individuals and families in carbon footprint reduction. Given the size of suburbs around medium and large size cities everywhere in the world, a breakthrough, new solution, strongly supported and promoted by the utility industry, would certainly have the possibility of making a substantial difference in the fight against climate change.

Under this scenario:

- The Load-Serving Entity (utility, ESCO, CCA, etc.) is prosumer-centric promoting a win-win vision of the next-generation electric distribution grid.
- The homeowner is transformed into a smart and active partner in a next-generation electric network that is distributed, digitized, and decarbonized.
- The family electric vehicle is now an important home energy asset that reduces consumption charges and powers the family home during grid outages.
- The sun partially or fully powers the home and charges the car.
- The homeowner and the load-serving entity have a bidirectional business relationship that equitably shares the benefits of the two-way power flows and the respective investments made on both sides of the meter.

The smart home starts with smart energy – good for the family, good for the community and good for the planet!

ABOUT THE AUTHORS:

Marc-André Forget, is the CEO and co-founder of Ossiaco, a technology company that sits at the nexus of residential solar power, electric vehicle charging, the smart home and customer-centric utilities. As an electrical engineer with a law degree, Forget co-founded and served as the CEO of Utilicase Inc. An author of five patents and a participant in many conferences and publications, he has been invited to speak at both the European Network of Transmission System Operators (ENTSO-E) in Brussels and the World Energy Council (WEC) in Istanbul for the 23rd World Energy Congress. Forget is also an invited member of the American Energy Bar Association, the International Council on Large Electric Systems (CIGRE) and the Institute of Electrical and Electronics Engineers (IEEE).

Ron Denom is co-founder of Ossiaco. Denom graduated from McGill University with degrees in engineering and international business management. He has an extensive background in thermal and nuclear power and electricity transmission and distribution with Combustion Engineering and SNC-Lavalin Inc. He has more than 40 years of global engineering-construction experience, where he served in both senior technical and senior executive roles.



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PROGRESSIVE REGULATORY REQUIREMENTS ADVANCE POWER RELIABILITY FOR BRAZILIAN UTILITY

JULIO S. OMORI AND ANDREW JONES

Evolving regulatory structures

Utility regulatory landscapes are evolving, in North America, as well as across the globe. The convergence of such factors as aging infrastructure, a heightened commitment to the customer experience and grid-modernization efforts are pushing the grid forward faster and more profoundly than ever.

In particular, Brazil has experienced significant changes in electricity regulatory requirements over the past several decades. Chief among them, Brazil's electricity regulations were restructured to allow for foreign investment in power generation. New legislation reformatted the electricity sector, requiring all utility concessions to be granted through a public bidding process.

In response to Brazil's new competition in the electricity sector, an electricity regulatory agency was created. Agência Nacional de Energia Elétrica (ANEEL) is responsible for inspecting and regulating service quality for utility customers and for preserving service providers' economic viability. The agency manages utility concession contracts in Brazil, and it revises corresponding System Average Interruption Duration Index (SAIDI) and System Average Interruption Frequency Index (SAIFI) requirements every five years.

In 2015, ANEEL's influence began to change Brazil's utility regulatory structures. The regulatory agency enacted a strategic plan that required utilities with suboptimal SAIDI and SAIFI performance and low customer reliability to improve their services, presenting the risk of losing the concession for contracts that were being renewed in 2015. The agency individually monitored utilities' financial results and SAIDI and SAIFI scores yearly. →





Then, during a periodic concession contract renewal in 2016, ANEEL established unprecedented measures to hold utilities accountable for improving SAIDI and SAIFI indices on a yearly basis. The first of these measures centered around a dividend payment restriction. ANEEL approved a new resolution that restricts utility dividend payments to a new legal minimum – 25 percent of their net profit. The restriction is applied if a utility exceeds the SAIDI and SAIFI indicator limits for two consecutive years or three times within five years. In 2018, five Brazilian utilities had their dividend payments restricted to the legal minimum because they failed to meet the new requirements. This demonstrated a clear need for reliability improvements across many utilities in Brazil.

The second measure declared that, if utilities exceed the new SAIDI and SAIFI thresholds for two consecutive years or during the last year of the five-year period, they would lose their concessions. ANEEL's latest requirements have given Brazilian utilities an ultimatum: substantially improve reliability or lose their concession contracts entirely.

Five years after the new regulatory requirements were enacted, 2020 is a landmark year for these organizations because ANEEL will evaluate its progress during the final year of the five years.

“There are significant shifts in utility regulatory structures around the world right now, and Brazil is one example of how these changes are pressuring utilities to reevaluate conventional practices,” said Andrew Jones, senior vice president of global sales for S&C. “COPEL's swift response to these changes demonstrates how quickly utilities can see success even in more complex and intensified regulatory environments.”

Advanced lateral protection: A strategy for reliability improvement

One of the largest service providers affected by ANEEL's recently enacted standards was COPEL, Brazil's fourth-largest utility located in the state of Paraná. Its distribution system consists of 195,459 kilometers (121,452 miles) of lines serving 11 million customers. Although the state has many businesses and dense populations in its 395 municipalities, many of important industrial operations, such as large-scale poultry and tobacco farms, are located in rural areas. This means electric loads, especially those in key commercial locations, are spread across COPEL's system throughout Paraná and are not concentrated only in cities.

Because of ANEEL's recent mandates, COPEL had to quickly decrease its SAIDI performance, mainly in its rural-service areas, which had the poorest reliability. Reducing SAIDI motivated COPEL to search for new solutions to meet ANEEL's requirements while in turn reduce operating costs and provide a return on investment.

To rapidly achieve considerable SAIDI improvement, COPEL targeted rural laterals with the poorest reliability. Outages that occurred from temporary faults in rural service areas had a large negative impact on COPEL's SAIDI score because of the time required to send crews to remote rural areas. In addition to the reliability consequences, the cost to send crews to these locations inflated the utility's operations and maintenance expenses. Electrical feeders in Paraná are typically very long, some stretching across more than 600 kilometers (372.8 miles). Single-wire earth return (SWER) transmission lines provide power to distribute in COPEL's rural areas but pose substantial challenges operationally.

It was evident to COPEL that meeting ANEEL's strict reliability goals required a departure from the utility's previous protection strategy. Therefore, as a replacement for fuse cutouts, the utility piloted several varieties of simplified single-phase reclosers.

Ultimately, the utility selected a Chicago-based, global equipment and electric power systems solutions provider and its single-phase, cutout-mounted recloser to meet ANEEL's requirements to improve overall system reliability. This advanced lateral-protection solution detects whether faults are permanent and restores power automatically when they are temporary, preventing unnecessary sustained outages.

After the first-phase of COPEL's deployment, the utility experienced a 68.1 percent reduction in SAIDI, reducing the average outage duration by 45 minutes and permitting the utility to meet the stringent performance requirements ANEEL had set. The initial deployment also enabled the utility to avoid long, costly truck rolls. Because of this, COPEL realized an operating-cost reduction equivalent to 20 percent of its investment value from the initial deployment. This strategy change frees up COPEL's crews so they are available for other, higher-value-added services that benefit its end customers.

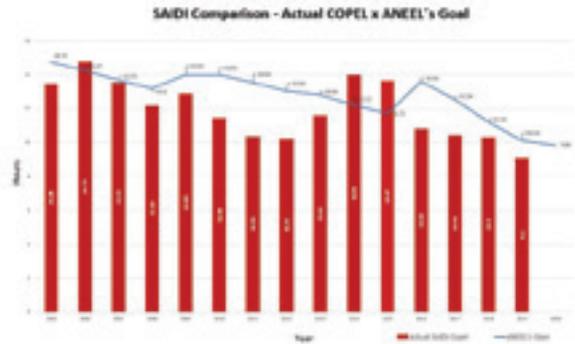


Figure 1: ANEEL's imposed SAIDI limits (blue) versus COPEL's actual SAIDI performance (red).

As shown in **Figure 1**, the blue line represents the aggressive SAIDI limits ANEEL imposed on COPEL. The red bars indicate the actual yearly SAIDI results COPEL achieved after deploying the single-phase, cutout-mounted recloser on its system in 2016. COPEL was not only able to meet ANEEL's limits but surpassed the necessary reduction in SAIDI.

After installing the single-phase reclosers systemwide in subsequent deployments, the power-reliability improvements were immediate. COPEL realized an overall SAIDI reduction of 58.6 percent and avoided 140,000 truck rolls in three years. "Adopting an advanced lateral-protection strategy with [the provider's single-phase, cutout-mounted reclosers] enabled us to significantly reduce our SAIDI rating and meet ANEEL's strict utility regulatory requirements," said COPEL's Smart Grid and Special Projects Superintendent Julio S. Omori. In 2019, COPEL's SAIDI score for the first time ever was in the single digits.

End-customer satisfaction

Beyond the SAIDI improvements that the single-phase cutout-mounted reclosers offered COPEL, the devices also improved reliability for the utility's end customers. Outages can cause costly disruptions to businesses and households alike, especially those at the edge of the grid that typically wait longer for power to be restored. Because many of COPEL's customers include important industrial operations located in rural areas, providing them with reliable power is essential for the country's economy. Long outages significantly impact those customers and have the potential to shutter their critical operations for extended periods, given their location at the grid edge. →



COPEL Customer SAIDI Contribution

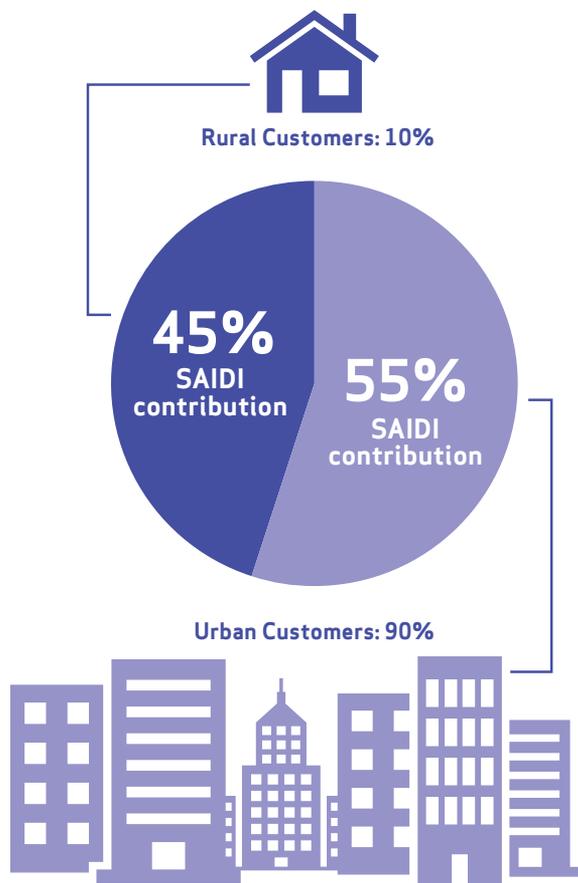


Figure 2: The average SAIDI contribution shared between COPEL's urban and rural customers.

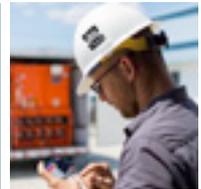
As shown in **Figure 2**, the bulk of COPEL's customers are located in urban areas, with only 10 percent of total customers located in rural locations. However, a great disparity existed between the service reliability of the utility's urban and rural service areas. Though rural customers represented the minority of COPEL's base, they experienced significantly more outages on average than urban customers, contributing to 45 percent of the utility's overall SAIDI score. This disproportion of reliability between urban and rural customers was the impetus for COPEL to invest in advanced lateral protection in their rural service areas.

COPEL learned the solution provider's single-phase, cutout-mounted reclosers were an essential tool to improve the performance reliability on its distribution networks and its three-phase 13.8-kV and 25-kV laterals and single-phase 34.5-kV laterals. Not only do the devices prevent temporary faults from becoming sustained outages, keeping important operations online — even at the grid edge, they only blink affected laterals, avoiding momentary interruptions on feeders.

"These single-phase, cutout-mounted reclosers have brought numerous benefits to our system and our operations," said Omori. "Not only are we keeping even momentary interruptions from impacting our customers, but we're also avoiding numerous trips to the field. This allows our crews to focus on bigger issues and restore power faster to better serve our customers."



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Andrew Jones is the senior vice president of global sales at S&C Electric Company. He previously was the managing director for the S&C Europe Middle East and Africa Business Unit-based in the United Kingdom. Jones holds an MBA from Sheffield University and a degree in mechanical engineering from Swansea, UK. He is a member of the Institute of Quality Assurance UK. Through his work with and membership in trade associations, he served as an advisor to government in the UK and most recently was the chair of the European Working Group for the Market Design for Energy Storage. Andrew is a member of the UK Institute of Directors.

THE IMPACT OF IEEE STANDARDS ON THE ELECTRIC GRID

DOUG HOUSEMAN

Since the beginning of 2018, the IEEE has created or revised and approved more than 200 standards that impact the electric grid. From very specialized standards on items like how to measure temperature rise in a transformer to broad standards like requirements for interconnecting generation and storage, the IEEE standards have an impact on the future of the grid.



IEEE 2030.5, the IEEE Standard for Smart Energy Profile Application Protocol, lays out a protocol that will provide a common way and data dictionary for talking to devices in the internet of things. This will mean that if the standard is followed, the number of protocol translators and interfaces required to talk to different manufacturers' devices will fall, and the ease of adding new devices and new manufacturers to the system will have a lower cost.

IEEE 1547-2018, the IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces, will have an even greater impact. The old version of the standard did not allow for changing power angles, monitoring operation, or allowing ride through. Germany spent more than 3 billion euros to change inverters, due to the hard-wired settings in the inverters that were installed. The rest of the world was faced with either replacing their inverters when they hit 10-25 percent of power coming from inverters or putting a hard limit on inverter-based resources. With the update to 1547, settings can be adjusted after installation, meaning more inverter-based resources can operate efficiently and be installed. In the United States, 1547 made it feasible for the Federal Energy Regulatory Commission (FERC) to release new orders like FERC-841 and 842. →





IEEE 1052, the IEEE Draft Guide for the Functional Specifications for Transmission Static Synchronous Compensator (STATCOM) Systems will help keep the transmission system capacity at current levels as current central stations are decommissioned. This means the current investment in transmission will continue to retain its capacity and value even when the facilities the system was originally designed for are decommissioned.

IEEE 1159, the IEEE Recommended Practice for Monitoring Electric Power Quality, provides guidance for — as the name indicates — monitoring power quality. With increases in the amount of power-sensitive equipment in communications systems, manufacturing plants and hospitals, this standard provides the means and methods for monitoring the quality of the power received by these facilities. With that monitoring in place, the effort to minimize power quality issues can be focused on locations that need it and the records of the issues can be analyzed without having to spend large amounts of time hunting for the problem and localizing it.

IEEE 1071, the IEEE Approved Draft Application Guide for an Engineered Restoration Program for Failed Transmission Structures, provides a method for rehabilitation of transmission towers and other structures. With the majority of the transmission system built from the 1960s to the 1980s, more structures are showing signs of deterioration. This guide helps maintenance workers restore the structures to improve integrity and increase the resiliency of the transmission system, without requiring massive rebuilding programs.

As students are sent to work from home via the internet, IEEE 1222 IEEE Approved Draft Standard for Testing and Performance for All-Dielectric Self-Supporting (ADSS) Fiber Optic Cable for Use on Electric Utility Power Lines, sets up a common testing procedure for the lowest cost way to deploy communications for the electric grid and potential middle mile use for rural and low-income community broadband. While the broadband issues cannot be solved overnight, this standard makes it faster and easier to deploy over the next few years.

IEEE 1234, the IEEE Guide for Fault-Locating Techniques on Shielded Power Cable Systems, provides a guide to finding the location of a fault on some underground systems, and as the power system moves to more and more underground service, locating breaks in the cable faster means that service can be restored faster and crews can deal with more problems in a day. With less digging required to identify breaks, property restoration can be achieved faster.

IEEE 1307, the IEEE Standard for Fall Protection for Electric Utility Transmission and Distribution on Poles and Structures, is a result of large hurricane events and other disaster incidents. The standard helps minimize hazards to people and buildings from falling lines. While it was in the works long before the fire issues that have made news recently, much of the standard is now being directly applied to areas where fires are an issue. This standard offers guidance for any utility to build a better grid.



ABOUT THE AUTHOR:

Doug Houseman is an industry leader in grid modernization with more than 40 years of experience in the energy and utility industry. He is a principal consultant with 1898 & Co., a business, technology and security solutions consultancy, which is part of Burns & McDonnell. Houseman is chair of the IEEE PES Intelligent Grid and Emerging Technologies Coordinating Committee and a former member of the GridWise Architecture Council.

Some of the standards – including IEEE 1578 (IEEE Approved Draft Recommended Practice for Stationary Battery Electrolyte Spill Containment and Management), IEEE 1657 (IEEE Recommended Practice for Personnel Qualifications for Installation and Maintenance of Stationary Batteries), and IEEE 1584 (IEEE Guide for Performing Arc-Flash Hazard Calculations) – deal with reducing hazards, both for the personnel working on equipment and for the general public.

The IEEE 1609 series deals with wireless communications infrastructure to vehicles and provides the support for wireless communications for charging, autonomous vehicles and road hazards. This series of standards will mean that a communications system built to these standards will communicate with all the vehicles that adhere to these standards, instead of manufacturer-specific infrastructure needing to be built for each and every manufacturer's vehicles. The reality of 5G is that each major carrier will build its own network in the urban areas, meaning a large number of antennas. For each automotive manufacture to build infrastructure on top of the 5G systems would have been impossible. The other issue is that having vehicles from different manufacturers not able to communicate with each other would have had profound safety issues. As utilities replace their fleets or install public chargers, this is a series of standards to watch.

IEEE 1889, the IEEE Guide for Evaluating and Testing the Electrical Performance of Energy Saving Devices, offers a standardized method for determining how these devices are making it easier to create new EnergyStar requirements in the U.S. and similar standards elsewhere. As laboratories use this as the basis for their testing standards, there will be a single benchmark from this standard that will be used to approve those tests and the instruments they use. This means that apples-to-apples testing will be possible.

There are more than 200 additional standards, either with an IEEE standards number or an ANSI standards number, that were facilitated by the volunteers from IEEE. Most of those volunteers are supported by their employers and work on one of the hundreds of IEEE working groups, taking their knowledge of the industry and putting it into documents that provide guidance to the electric power industry. As many of these volunteers retire, it is important for the future of the industry to identify and encourage members in younger generations to step up and help develop standards that will take the industry into the future. These standards make it possible to develop, maintain and operate the grid in a safe and effective manner. As more energy sources are transitioned to the grid, it will become more and more important to develop standards like these to provide low-cost and reliable energy to all.

MULTI-TIERED APPROACH HELPS REDUCE WILDFIRE RISK

**SPEED, INTELLIGENCE AND COST EFFICIENCY
ARE CRITICAL ENABLERS**

BY TOBIN VEHMEIER

There are many unique dynamics at work that create the need for a more resilient and reliable electrical grid. Fortifying the electric grid against the threat of wildfires has become a major priority for utilities, and many are already accelerating prevention efforts.

Although there is not a one-size-fits-all approach to reducing wildfire risk, many utilities are focused on approaches that prioritize speed, added intelligence and cost efficiency. Here's how you can implement these strategies to strengthen the grid:

1. Implement solutions delivering immediate results over large areas

This approach includes immediate methods for reducing risk over wide areas. There are a variety of traditional and widely used equipment – such as fuses, reclosers, switchgear, distribution class arresters – that can be upgraded or replaced with site-ready, advanced solutions.

For example, fuses are effective and ubiquitous across distribution systems. By upgrading from other fuse styles to current-limiting fuses, utilities can significantly reduce the risk of a sparking incident, especially in exposed, dry areas surrounding distribution equipment.

Full-range current-limiting fuses can be used for transformer protection, capacitor protection and sectionalizing. These solutions typically incorporate a design that avoids sparking. Additionally, their design helps limit electrical and mechanical stresses on the protected equipment.



Taking resilience a step further, advances in products designed to support underground power systems are becoming a more cost-effective option for some applications. Solutions like solid dielectric switchgear, which offer a smaller footprint and wide range of configuration options compared to traditional switchgear solutions, are helping many utilities support a retrofitted underground strategy for high-risk areas.





2. Targeted upgrades of utility distribution systems with digital solutions supporting a smarter and more resilient grid

Creating a more resilient, intelligent grid will be essential to help mitigate the risk of wildfires and support the energy transition underway. While it is difficult to predict when an incident may happen, a fortified electrical distribution system can help utilities address issues quickly to minimize customer and environmental impact.

At the turn of the twentieth century, lookout towers were the primary means to spot a wildfire. We've come far from that approach. There are early warning systems based on precise condition monitoring and rapid communications. These systems can be configured to trigger alarms for management and maintenance teams to let them know exactly when, and where, dangerous conditions exist so they can be addressed efficiently.

Utilities around the country are working to incorporate cutting-edge intelligence to provide insight into grid conditions through powerful software. For example, the largest utilities in California are using grid planning software to provide powerful modeling capabilities and analytics to gain cutting-edge intelligence into the grid.

Utilities can also use intelligent grid automation schemes to automatically and remotely isolate and manage imminent risks. Solutions such as feeder automation software work with recloser controls, not only to isolate impacted areas of the grid but also to automatically reconfigure the system for significant reliability improvements and minimal customer impact.

Further, there is hardware that can support more in-depth and accurate data acquisition. High-fidelity sensors based on optical technology can provide new levels of accuracy and precision for both voltage and current, painting a more detailed picture of what's happening on the grid.

By implementing these technologies across the distribution system, utilities can closely monitor high-threat conditions and automatically gather the data needed to flag dangerous conditions for further analysis and corrective action.

3. Continue research and development investments that advance grid modernization through innovative and field-proven strategies

Collaborations between utilities, industry organizations, manufacturers, universities and research organizations will ultimately develop new strategies to help reduce risk. Through these partnerships, the electric power industry is innovating, testing and deploying new approaches to address complex challenges such as wildfires.

For example, manufacturers are working closely with utilities in every region of the world to integrate modeling software solutions into daily operations that can help utilities better manage their grid modernization efforts.

Wildfire prevention efforts continue to expand

Utilities are prioritizing effective wildfire mitigation strategies and regional codes and standards such as California's Senate Bill 901 are helping address risk. In California, the three largest investor-owned utilities (IOUs) are estimating a \$10 billion investment over the next three years to reduce the risk of grid-sparked fires (source: GTM Grid Edge, Feb. 10 2020).

Utilities can work closely with manufacturers to expand and accelerate their wildfire prevention efforts and incorporate solutions that strengthen and modernize the grid. Creating a more fortified electrical system today, with intelligent digitalized solutions and site-ready fire-hardening technologies, will not only help address wildfire risk – but also help better prepare the electrical grid for the demands of tomorrow.



ABOUT THE AUTHOR:

A director with Eaton's Power Reliability division, **Tobin Vehmeier** has been with Eaton since 1994. He brings more than 25 years of experience in sales, division marketing and plant operations to the company. Vehmeier holds a bachelor's degree in electrical engineering from Southern Illinois University in Carbondale, IL.

THE NEXT WAVE OF IoT PROLIFERATION IN SMART BUILDINGS IS AROUND THE CORNER





BRAD PILGRIM

The Internet of Things is a network of sensors, meters, appliances and other devices that are capable of sending and receiving data.ⁱ The total number of IoT connections worldwide is estimated to reach 5.3 billion by 2028ⁱⁱ. The first 5G IoT connections will emerge this year, and their number is forecasted to grow to 149 million by 2028,ⁱⁱⁱ which will increase speed and access to information.

IoT has transformed the way we communicate and organize information. Adopting IoT in sectors that manage large numbers of data sets, such as cybersecurity, can effectively replace the manual coordination of systems, where instead of a physical person sitting behind a desk inputting numbers into a database, IoT, paired with other smart technology like AI and analytics, can autonomously sort data for us and make the process more streamlined. In residential buildings, for instance, IoT is revolutionizing the collection and use of information.

IoT devices are quickly becoming a new yet integral part of smart buildings' digital ecosystems. IoT devices attach to any number of elements within a building, monitoring the building's operations, and helping reduce operation costs, improve operations, efficiency and effectiveness.

Residential and commercial buildings have a significant impact on local, national and global carbon emissions; globally, they contribute an estimated 40 percent of total emissions. And as the density of residential buildings in urban areas increases and the sophistication of technology rises, finding ways to minimize carbon emissions from buildings is imperative for property stakeholders if they want to take sustainability metrics as seriously as profit metrics.

Outdated building automation systems lack efficiency

Before we talk about IoT within the new generation of smart buildings, we first have to understand how we managed building operations before this digital revolution.

The first wave of energy-efficient equipment, known as Building Automation Systems (BAS), was developed to make building HVAC systems within residential buildings more efficient. They are essentially built to tie existing HVAC components together and implement basic scheduling and control logic. It's a relatively simple relationship.

As useful as they are, they don't incorporate deeper intelligence to monitor and/or predict energy consumption trends. As a result, they have failed to improve HVAC energy consumption the way real estate owners had hoped.

Their simple makeup, local data confinement and time demanding manual monitoring have led the end-user to abandon BAS infrastructure. Without exploring smart technology solutions, like IoT, for residential building operations, property managers risk stunting their property's energy performance ratings and potentially risk unnecessarily inflated costs.

But all hope isn't lost. Current disruptive technology in this field is estimated to be able to save property owners 30 to 50 percent in operational costs. By merging contemporary smart systems with existing infrastructure, it can open the doors to cost-saving opportunities.



Enabling new tech in outdated systems

Thankfully, modern-day smart technology has become more dynamic and readily available to various sectors, including real estate. We first saw IoT emerge in smart buildings in the form of physical sensors that attach within the walls of the building. The sensors collect data in the form of room temperature, measuring electrical power, ventilation, and air conditioning (HVAC)^{iv}. For example, a CO2 meter can estimate the number of people in a room and tell your HVAC system to increase the ventilation rate of fresher air in response.

So how exactly do these small sensory attachments work to help smart buildings run smoother? It's all thanks to the cloud.

With the cloud, IoT can collect, parse through and deliver adaptive data to identify inefficiencies within a building. It then works in tandem with other smart technologies, like data analytics and AI algorithms, to deliver this information to remote controls that execute in real time to address the gaps in efficiency.

IoT sensors fastened throughout buildings are called data points. If you have 100 data points providing information, many of those are really just discreet IoT sensors. Those data points can be used to measure CO2 levels in hallways, the amount of fresh air in condo units, humidity levels, resident comfort, mechanical operations- the list goes on.

It's worth mentioning that these data points, the physical sensory attachments, currently pose a challenge for third-party installers. Sensors can technically go anywhere, but cabling them through existing concrete walls limits the number of data points each building can accommodate.

The physical networking requirement means splicing the sensors between floors to calculate data in a distributed fashion. Technicians have to wire up an entire building by entering through existing cabling networks to install each attachment.

Despite physical design limitations, IoT data points are proving a necessary component within smart technology tool kits for residential buildings to improve resident comfort and optimize energy controls.

To give you a sense of the scope, energy management providers have deployed within some of the world's tallest residential buildings where the capacity to collect data points is approximately 200. Every single one of those 200 data points provides invaluable information about building operations in real time. Having this data means it can feed back instructions for better control, which dynamically regulates equipment (such as pumps, motors, boilers, chillers) in a building to minimize energy waste while ensuring resident comfort.

Wireless networks will proliferate IoT

As 5G networks are announced starting this year, the industry is excited to see where it will take IoT. 5G will allow IoT devices that can work on a wireless network, as opposed to physically fastening the IoT sensors, to be totally wireless. This will provide access to even more data to help improve system efficiencies.

Wireless network IoT has significant potential benefits including low power, low-cost communication networks enabling IoT to transition into faster, more intelligent arenas of big data, among other niche, smart technologies, such as cloud computing or smart home devices.

Having access to this enormous amount of data will continue to fine-tune the way that we are run large scale applications in building energy management. Not to mention, further proliferation of devices will help accurately monitor resident comfort.

Thanks to advances in smart building technology, residents experience improved comfort as a result of more consistent fresh air management in hallways, temperature regulation in the building and more consistent hot water availability.

From a financial perspective, each resident has the potential to see the operating costs of their buildings reduced significantly (10-15 percent) and this has translated into more financially-viable condominium corporations and owned apartment buildings.

Looking at the broader impact, smart technology can significantly lower the carbon footprint by millions of pounds of CO2 in cities across the world.

In conclusion, the next wave of IoT will enable more focused, accurate and concrete energy efficiency in urban residential buildings.

Technological advancements open the doors to extend IoT's current capabilities from a local, data-driven, cloud-based system into a broadband network of mass-scale data that can strategically reduce operational costs, improve resident comfort and strongarm the greater pursuit to improve sustainable smart buildings in urban centres globally.

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ABOUT THE AUTHOR:

Over the past three years, **Brad Pilgrim** has led Parity Inc. to develop and deploy an AI-powered energy management platform for multi-residential buildings in order to eliminate energy waste in buildings and cultivate more sustainable urban environments.

Using this platform, Pilgrim and his team have helped prevent more than 4 million lbs of CO2 emissions from their customers' buildings since 2017.

POTENTIAL FAULT LINES LIE BELOW THE UTILITY CUSTOMER STRATEGY





JAMIE WIMBERLY, KIMBERLY O'DELL AND LAURIE THOMPSON

Could customer satisfaction scoring be hiding more than revealing fundamental truths around the customer in the utility sector? While there is generally high customer satisfaction with utility customer service, there are fault lines that could lead customers to reduce their engagement with utilities or even exit from their utility if given the opportunity.

In late 2019, DEFG LLC and the Utility Customer Research Consortium conducted the Annual State of the Customer Survey, where 1000+ consumers across the U.S. were asked a series of questions to test the most basic assumptions underpinning utility customer strategy.

There are several tracking questions from prior years to provide trend analysis. Just as important, we added new questions to explore new dimensions or offerings, e.g., residential solar or electric vehicles, or questions not typically asked, e.g., the level of customer trust of the utility.

The findings provide plenty of fodder for further analysis. As in past surveys, there is good news. Most customers believe utilities provide excellent customer service and value their utility over other service providers.

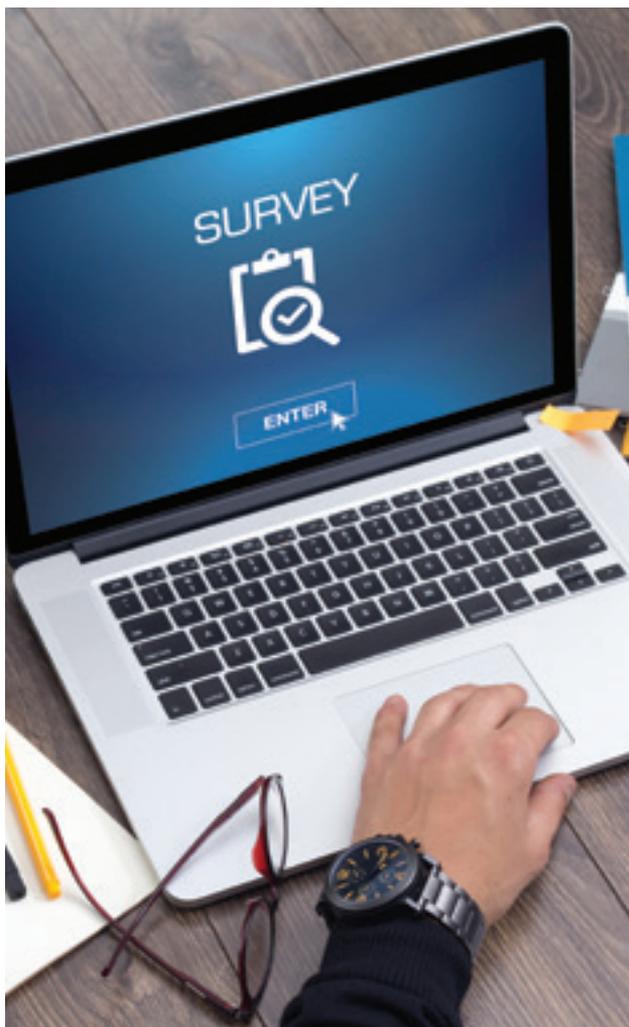
However, the findings also point to growing fault lines beneath the utility, especially the investor-owned utilities. Our collective assumptions around reliability, equity, and ownership may be outdated. Like all fault lines, though, it is necessary to dig to see them. In this case, we began to ask the tough questions of consumers to get their input. →

Americans generally feel that their electric utility service is reliable in terms of keeping the lights on. Yet, only half believe that utility companies are prepared to meet their obligations during natural disasters or other emergencies. Only one-fourth of customers are willing to pay more to get an increased level of reliability.

Utility reliability is viewed better by those who are in an older demographic at 75 percent versus 65 percent among 18-54. Homeowners are significantly more likely than renters to believe their electric utility is adequately prepared to maintain service during emergencies and natural disasters (54 percent vs. 43 percent of renters).

Twenty-nine percent of customers, who are in a higher income bracket, would pay slightly more for increased reliability. At the same time, younger adults and renters are more willing to pay less for less reliability.

If given a choice, three out of 10 customers would choose a \$10 gift card and wait to have their service restored. The interest in this option was higher among young adults (33 percent vs. 18 percent 55+) and those in a lower income bracket.



Billing and payment

The 2019 survey findings point to customers believing that their utility company gives them the right amount of information to help manage monthly usage and costs. More than half of the American adults surveyed say they get “just the right amount of information” to help them manage their electric usage and monthly bills.

When asked what was most important in terms of their utility company’s billing and payment options, consumers are most likely to be looking for:

more detail, incremental payments, paying each bill themselves, monthly payments, and interest in flexibility and going paperless. Consider the following:

- Younger adults (57 percent vs. 40 percent of older adults), lower-income brackets (58 percent of those with lower incomes vs. 47 percent with higher incomes), and renters (62 percent vs. 43 percent of homeowners) lower-income brackets consider flexibility to be significantly more critical.
- Making incremental payments was more important to women (81 percent vs. 70 percent of men), lower-income households (83 percent vs. 69 percent of higher-income households), and renters (82 percent vs. 79 percent of homeowners).
- Women (74 percent vs. 66 percent of men) and lower-income households (75 percent vs. 66 percent of higher-income households) were significantly more interested in paying each bill themselves rather than making automatic payments.
- Nearly half of American consumers think this is very important that utility companies offer the ability to pay bills using a mobile phone on a mobile platform in the future. Significantly more women (53 percent vs. 46 percent of men), younger adults (61 percent vs. 21 percent of those 55+), and renters (62 percent vs. 41 percent of homeowners) expressed the importance of mobile payment options.

The green challenge to utilities

The 2019 survey findings point to more than half of Americans felt it was important that their local utility reduce emissions and support environmentally friendly practices. Yet, only one-third of consumers feel that their utility company is supportive of solar and other renewable energy. →



Without cost in the equation, there is a decent level of interest from consumers in obtaining solar power or purchasing an electric vehicle during the next two years. Consumers also expect that they will need more customer assistance from their local utility to help them work with the new technology.

- Nearly half (47 percent) indicated they would be interested in owning or leasing solar power in the next two years (putting aside cost). Interest was highest among younger adults (50 percent vs. 41 percent of those 55+).
- Approximately one third also expressed interest in purchasing an electric vehicle. Interest was highest among younger adults (34 percent vs. 18 percent of those 55+) and those with higher incomes (33 percent vs. 27 percent of those with under \$50k household income).

Utility ownership

Due to the unique circumstances related to wildfires in California, utilities have been shutting off power to local residents to avoid sparking new fires. The governor of California has argued that utilities should pay \$100 to consumers whose lives were disrupted by these shut-offs. Americans, regardless of where they live, were asked their thoughts on this proposition.

More than half of Americans agree that consumers in California should be compensated when their power gets shut off, specifically concerning the wildfire issue. The youngest adults (58 percent vs. 49 percent of those 55+) and renters (63 percent vs. 50 percent).

Americans believe that the best form of utility ownership is either public power/local governments or coops/customers (with approximately three out of ten choosing each of these options). Relatively few believe they should be owned by private investors/shareholders (13 percent).

Potential fault lines for utilities

The utility sector continues to do well on the basics of customer service; however, there are growing signs that the sector is falling behind when serving specific segments of the customer base.

Probably the most significant divide facing the utility sector is an increasing segmentation of the customer base. The 2019 survey findings point to a majority of customers that believe they receive the right amount of information from their utility. But there are statistically significant differences between younger Americans that want to receive more information from the utility (24 percent) versus older Americans who wish to receive more information (17 percent).

The generational gap continues to segment the utility customer strategy. The “average” customer does not exist, yet the customer service model was built on that assumption. The survey questions around customer preferences were riddled with significant deviations in the demographic breakdowns. There is a large and growing generational gap. The customer service model of utilities is a perfect fit for senior citizens.

There is a stark generational divide on the importance of being able to pay the utility bill using a mobile phone or platform. 61 percent of younger Americans considered it either “extremely important” or “very important” as compared to only 21 percent of older Americans.

What do customers want regarding bill pay? The obvious answer is lower bills. However, the second desire was to have more flexibility in how they pay the bill. Flexibility was significantly more important to younger adults (57 percent vs. 40 percent of older adults), those in lower-income brackets (58 percent of those with lower incomes vs. 47 percent with higher incomes), and renters (62 percent vs. 43 percent of homeowners).

Additionally, nearly half of American consumers think it is extremely or very important that their electric utility offers the ability to pay their bills using a mobile phone or other electronic devices in the future. Significantly more women (53 percent vs. 46 percent of men), younger adults (61 percent vs. 21 percent of those 55+), and renters (62 percent vs. 41 percent of homeowners) expressed the importance of mobile payment options.

Customer satisfaction is not customer loyalty. Customer satisfaction and trust is an issue that needs to be addressed, especially for engagement with younger customers. All of the survey questions focused on questions around customer service had many instances of statistical deviation from one demographic to another.

The good news is that less than half of the respondents on this survey still fully trust what their utility says and does. With older Americans (55+) more trusting with 53 percent giving high marks as compared to 45 percent of younger Americans (>55+) giving top marks.

The survey also discovered that 41 percent of respondents would highly recommend the utility as a place of potential employment for young people.

To bridge the growing generational gap, utility companies should consider the following:

- Accessible and prompt customer service
- Lower bill prices or ways to lower the price
- Flexible bill payment options
- Compensation for power outages
- Mobile phone / electronic bill payment options
- Investment in solar power and renewable energy

ABOUT THE AUTHORS:

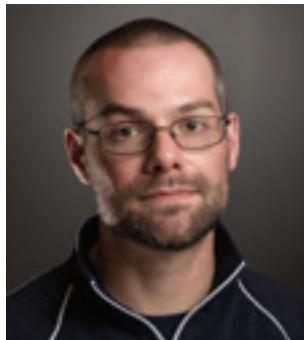
Kimberly O'Dell serves as the vice president of marketing for DEFG LLC. She has spent her career in marketing and communications, working for hospitality and facilities maintenance companies before joining the utility sector.

Laurie Thompson is the director of content for DEFG. She has spent more than eight years working in marketing and communications for companies throughout the U.S.

Jamie Wimberly has served as CEO of DEFG LLC since it was founded in 2003. With more than 25 years in the utility sector, Wimberly's expertise includes general management and operational consulting, customer engagement and strategy, program and offering design, marketing and communications, and customer service.

ELECTRIC UTILITY PERSPECTIVES ON THE RANSOMWARE THREAT





JOE SLOWIK

The rise of ransomware

Ransomware has technically existed for decades – the first known example was distributed via floppy disk to AIDS researchers at a conference in 1989. However, the past five years have seen an incredible profusion of ransomware variants and threats. While business email compromise (BEC) remains the most costly type of cybercrime, ransomware is unique. That uniqueness is due to the imposition of financial loss along with business and operational disruption. On average, ransomware victims experience disruption or downtime for 16 days following an incident. Ransomware may also provide a cover for even more malicious actions delivered by state-sponsored or state-directed adversaries, as seen in the NotPetya event from 2017, and potentially, in the Norsk Hydro incident from 2019.

Ransomware events and the industrial landscape

Overall, ransomware has evolved into an increasingly disruptive, and at times, dangerous, threat. Yet, for most of this criminal activity's existence, victims consisted of individual users or machines, or victims hit with malware spreading indiscriminately through networks. High-profile, large-scale events such as WannaCry – which impacted many industrial entities – followed this pattern, with control system assets affected by the rapid, uncontrolled propagation of the malware.

Matters began to change in late 2018 and early 2019, as ransomware activity shifted from what almost appeared to be indiscriminate victim selection to methodical, targeted intrusions. As described in detail in multiple resources, ransomware deployers combined this trend in tradecraft, with an increasingly concerning focus on industrial entities as victims. While the Norsk Hydro event is anomalous for several reasons, there are multiple other examples of industrial entities being deliberately targeted for ransomware infections.

Concurrent with persistent targeting of local government entities, ransomware authors and deployers have become increasingly brazen in target selection and subsequent disruption. In addition to several high-profile municipal ransomware incidents, recent years have also witnessed events at water utilities and multiple manufacturing organizations. Financial impacts aside, the effects on the delivery of essential services and industrial operation continuity are significant and deeply concerning.

More recently, 2019 saw the development of ransomware variants with primitive industrial control system (ICS) specific functionality. First identified in a variant called EKANS and later traced back to activity associated with MegaCortex and LockerGoga, ransomware functionality began targeting data storage and licensing systems associated with industrial operations. Specifically, malware or associated scripts would attempt to terminate processes, most likely to remove process “locks” on files such as in-use databases and licensing files, to extend ransomware encryption activity and make an infection significantly painful to industrial operations.

Specific concerns for electric sector organizations

The above is deeply concerning, but remains relatively general in scope, even with a shift to “industrial” operations. However, the electric sector has dealt with ransomware for several years. In 2016, ransomware disrupted the corporate IT network of the Lansing Board of Water & Light. While significantly impacting business operations, the event did not extend to critical control systems. More recently, a similar event took place at Reading Municipal Light Department (RMLD) in 2020. Although again concerning, the event only impacted IT systems with no known operational impact.

At present, there is no publicly known event where ransomware at an electric utility or related organization has produced an operational impact or outage. However, as shown in recent incidents such as a Ryuk event at a natural gas pipeline facility, the industrial and operational impacts of ransomware events are increasing. In this specific case, pipeline operations for the impacted facility ceased for over two days due to operational and safety concerns from the incident.

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Financial impacts aside, the effects on the delivery of essential services and industrial operation continuity are significant and deeply concerning.

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As ransomware activity persists – which all available data indicate will continue to be the case for the foreseeable future – and attackers get increasingly risk tolerant in targeting industrial operations, concerns for electric operations should increase. As seen in 2019 incident impacting a wind energy control center in Utah, even inadvertent, untargeted events can have significant repercussions on operations, such as inducing loss of view or loss of control conditions. Yet, the current trend toward focused, targeted intrusions covering entities within critical infrastructure means that previous concerns of untargeted, self-propagating ransomware variants has evolved.

Organizations must now deal with entities that may deliberately attempt to impact operations. Events to-date have largely focused on IT infrastructure, which is more easily accessible; however, there is no indication that ransomware entities have deliberately avoided more vital networks. As seen in the evolution of ransomware variants such as EKANS, attackers are moving toward deliberate targeting of industrial-related activities. Based on this and that electric sector entities have already been targeted at least on the IT level, asset owners and operators should anticipate intrusions attempting to impact electric operations as well as business networks.

Even if not deliberately designed to induce disruption of electric operations, ransomware entering into operational environments in generation or transmission networks has the potential to wreak havoc. For example, ransomware locking systems associated with energy management systems (EMS) will produce an unsafe condition for utility operations management and an inability to adjust to grid activity. Drives towards greater efficiency in utility operations and network management also mean that networks and systems that were once relatively isolated from each other and managed separately are increasingly interlinked. In addition to remote connections that can be used to facilitate adversary access into sensitive networks, shared infrastructure for management, such as Windows Active Directory and data links from operational assets to business intelligence services in IT networks, all provide for potential ingress mechanisms. This access can then be weaponized to impact sensitive systems such as SCADA management or other control-oriented devices, with the possibility of system compromise inducing physical disruption or even damage.

Defensive measures and response planning

Organizations in the utility sector and electric operations must recognize the growing threat ransomware operations pose to industrial organizations and make appropriate plans and mitigations now. Nearly all the actions most useful for either preventing or responding to ransomware also address many other security issues, allowing electric sector organizations to make investments that mitigate many problems at once.

First, electric operators and asset owners must understand that even the most well-defended, well-prepared organization can still be breached. Therefore, building and maintaining accurate plans and responses to cyber events that could either cause disruption or downtime is critical. This includes system and data restoration, to ensure that items such as configurations, license files, and other items are regularly backed up and securely stored. Rapid response to a breach and incident can ensure that any downtime is minimized.

Second, electric sector operators must understand and accept greater network connectivity and communication between standard IT systems and previously isolated control systems – but work to minimize such connections to only those that are necessary. Additionally, such connectivity must be done securely, by either ensuring the use of vulnerable, deprecated protocols is avoided (e.g., SMBv1), or traffic is limited to only required type and direction (e.g., configuring firewalls and other appliances to only allow outbound traffic for data transfer to business intelligence systems). These steps will help minimize available attack surface and potential infection or propagation routes. In this scenario, a breach may still occur, but it will be limited to immediately impacted systems instead of spreading to include control systems as well.

Third, electric sector networks must increase and improve visibility into network and process activity. The former is an increasing push, and one that has resulted in significant leaps in IT defensive posture. Similar steps – such as improved network security monitoring but also host-based visibility and log analysis – are not required in control system environments to identify when or if an attacker has gained access to these resources before they are able to execute something disruptive. The latter, process monitoring, is something operators already engage in for day-to-day running of the plant, but the identification of industrial-specific activity (such as EKANS) will require marrying operational data with improved security visibility to gain greater insight into potential intrusions.



Conclusion

Overall, the electric sector is yet to experience a catastrophic, physically disruptive incident due to ransomware – but the broader trendlines of ransomware activity indicate this will likely not last forever. To meet this challenge while also ensuring the consistent and safe delivery of power to consumers, electric sector operators and asset owners must begin preparing and investing now to harden networks and improve security postures. Electric utilities and related operations already do a commendable job in preparing for uncontrollable circumstances from storms to consumer demand shifts. Applying this same mindset of preparation and readiness to operationally focused cyber and information security will be necessary as the threat landscape begins to incorporate cyberattacks as well.

ABOUT THE AUTHOR:

Joe Slowik works as a principal adversary hunter at Dragos— finding, tracking, and defeating ICS-focused malicious actors is his job and passion. Slowik's primary missions include analyzing malware, identifying infection vectors, and profiling campaigns.

Prior to joining Dragos, Slowik ran the Computer Security and Incident Response Team (CSIRT) at Los Alamos National Laboratory within the US Department of Energy (DOE). Before his time at LANL he was an Information Warfare Officer in the US Navy. Outside of catching and defeating ICS adversaries, Slowik continues to live in Los Alamos, New Mexico.

EMILIE NELSON



For the Q2 issue of *EET&D*, we are pleased to introduce Emilie Nelson, executive vice president of the New York Independent System Operator (NYISO).

Perhaps it's fitting that two decades ago, as a college student majoring in mechanical engineering, Emilie Nelson's curriculum included such far-flung subjects as electronics, economics, history and women's studies.

Today, as executive vice president of the New York Independent System Operator (NYISO), she is overseeing a sea change in the energy industry that encapsulates all of those topics.

"My interest has always been places where you have a confluence of factors, how they move forward," Nelson said. "From that point of view, this is a fascinating time to be in the energy industry, and it is an honor to be helping to lead the charge."

NYISO, a private, non-profit organization, manages the energy grid in New York State and oversees the wholesale energy markets in the state. Part of the NYISO's efforts includes aligning these markets with state goals and changing energy needs and generation types. New York State has recently adopted a law to move to 70 percent renewable energy generation by 2030 and 100 percent emission-free generation by 2040. It's known as the Climate Leadership and Community Protection Act, or CLCPA for short.

The NYISO will play a major role in turning these numbers into reality. As one of its top leaders, Nelson must balance the need for reliability on the energy grid with the introduction of new energy resources and the mandate of providing the "least-cost" option to protect consumers. Some have described the task as akin to repairing the engine while the airplane is flying.

"As part of the senior leadership team, it's my job to make sure this work happens smoothly and with alignment across the organization and our external stakeholders," Nelson said.

She approaches this complex and demanding goal with a management style borne of 20 years of experience in the energy industry. In 1999, Nelson graduated from Tufts University and took an engineering position with a company that owned power plants. In order to do this job well, it was important to be present within the power plants, working with the operations and maintenance teams, and close to the machinery. Inspecting equipment often required clambering through massive, dark boilers to look over the condition of boiler tubes, or climbing scaffolding to inspect burners several stories high.

"I was willing to get my hands dirty and learn from these more experienced people," Nelson said. "There are a lot of great people in the energy industry who are willing to share their knowledge, as long as you are working hard to get the job done."

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Carbon pricing would provide an incentive to lower emissions from existing generators and attract new, more efficient generation to replace older, higher-emitting generators.
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Nelson's position allowed her to learn how generation equipment works and understand how a megawatt-hour of electricity is made. But after five years, she decided to move on and took a job at the NYISO. At the time, it was more of a lateral move, but she knew it would afford her more opportunities for learning additional aspects of the energy industry.

“It's valuable to get out of your comfort zone,” she recalled. “But ultimately, I thought working on electricity markets might be a better fit over the long term.”

At NYISO, Nelson not only learned the complexities of how the power grid functions and how the markets worked, but she was able to shape solutions to some of NYISO's more challenging problems. Just a few examples include broadening regional markets by increasing the frequency of energy transfers with neighboring control areas, integrating wind forecasting within the Control Room, and developing new analytics to further connect grid and market operations.

She continued to take on new and greater responsibilities within the organization, eventually becoming vice president of market operations in 2014 and executive vice president in 2019.

Today, her overarching goal is to prepare the NYISO for a grid in transition, as intermittent resources such as wind and solar power continue to come online.

The organization is facing such fundamental questions like how will the NYISO provide reliability during periods of peak demand on days without wind or at night? How will it go about integrating power from the increasing amounts of distributed energy resources, which generate small amounts of power at a specific site (such as an energy storage or combined heat and power system)? The NYISO is developing new market-based programs that would create the opportunity for a larger role for energy storage and other types of distributed energy resources, and more is certainly to come.

“There's a tremendous amount of change that we need to embrace and effectively manage to continue to provide the critical services that we do,” she said. “We are rising to that challenge.”

Much of the work she does today relates to the aforementioned state CLCPA. NYISO is promoting a carbon pricing plan that is seen by many in the industry as the best path forward to help meet the state's aggressive clean energy numbers. Under carbon pricing, the NYISO markets would incorporate a cost per ton of carbon dioxide emissions into the wholesale cost of power. Carbon pricing would provide an incentive to lower emissions from existing generators and attract new, more efficient generation to replace older, higher-emitting generators.

With the energy industry facing dramatic change, how does Nelson approach the goal of leading the organization through this period of uncertainty?

As she did at the start of her career, Nelson believes in projecting respect for all staff. Creating a culture of trust, where all employees feel welcomed to express their ideas and opinions is critical. In addition, communication in both directions is equally important, she said.

“Although simple in concept, it actually takes quite a lot of time and commitment to communicate effectively with a broad team,” she said. “Achieving the ambitious goals established for energy in New York will require all of our staff working together to lead us on this path.” →



As a leader, Nelson knows the importance of analyzing all angles of a topic, to encourage open discussion and know when the time for a decision is right.

“When ideas start to repeat, when you’ve got all the research you could possibly have, or simply when it is imperative to meet a deadline, it’s time,” she said. “Part of being a leader is being able to say: ‘we’ve discussed it enough.’”

As a leader in a male-dominated field, Nelson is proud to have played a major role in creating and promoting a program called Women in NYISO, or WIN. WIN was created as a way to build additional support and opportunities for connection for women (and men) at NYISO.

At one WIN program, long-tenured employees told frank stories about their career paths. Other sessions welcomed guest speakers or created networking opportunities. The group has also made connections to national organizations such as the Society of Women Engineers.

“What started as a casual conversation about supporting women in the industry has become this incredibly empowering program,” she said. “I am proud to see how successful and well-attended our WIN events have become.”

ABOUT EMILIE NELSON:

Emilie Nelson leads the System Planning, Information Technology and Market Structures organizations of the NYISO with a focus on proactively addressing the evolving challenges of the industry. Nelson joined the NYISO in 2004 and most recently served as vice president, market operations with a focus on the capacity market, energy market and demand response areas. She has 20 years of experience in the power industry and worked for several years in power generation. She earned a B.S. in mechanical engineering from Tufts University and an M.B.A. from Pace University.

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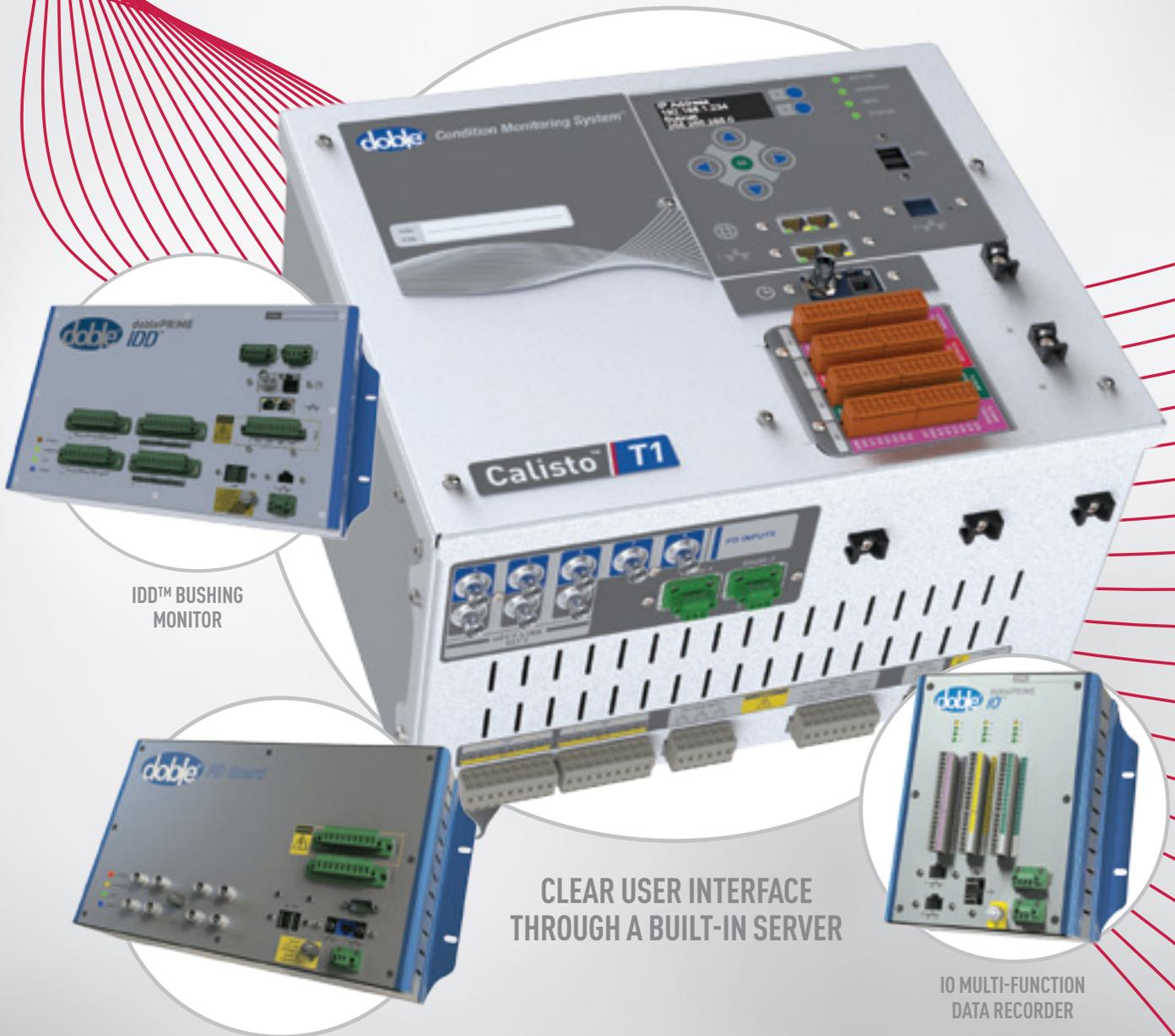
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