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MAGAZINE

KEY LESSONS LEARNED FROM IMPLEMENTING A MICROGRID

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FIRST ENERGY COMPLETES NINE-MILE TRANSMISSION LINE UPGRADE IN EASTERN OHIO

Project is part of larger 64-mile line rebuild to enhance reliability

June, 2023

American Transmission Systems, Inc. (ATSI), a subsidiary of FirstEnergy Corp. (NYSE: FE), has upgraded nine miles of a high-voltage power line in Carroll and Harrison counties in Ohio to strengthen the regional transmission system. The second phase of a larger 64-mile transmission line project, the rebuilt segment will enhance service reliability for Ohio Edison customers, improve system resiliency and accommodate increasing customer demand for electricity in the future.

The enhanced 138-kilovolt power line spans the Perry Township area of Carroll County and the Rumley Township and Archer Township areas of Harrison County. The approximately $50 million project involved replacing 57 wood pole structures with new steel structures and installing larger wires that can carry more electrical load. The larger wires can accommodate greater customer demand and the future connection of generation sources to the grid.

> *"With these infrastructure upgrades, our transmission lines can better withstand the effects of severe weather, reducing the number of service interruptions experienced by customers in eastern Ohio,"* said Carl Bridenbaugh, FirstEnergy's vice president of Transmission. *"The work will also help advance development in the region to meet the growing demand for safe and reliable power for many years to come."*

The segment was completed in late May and is the second in a series of projects that will rebuild 64 miles of transmission line over the next few years between a substation in Columbiana County and a substation in Belmont County, Ohio. The upgrade of the first 13-mile segment, located in the West Township area of Columbiana County and the August Township and Washington Township areas of Carroll County, was completed in January.

The project is part of *Energizing the Future*, a multi-year initiative designed to upgrade FirstEnergy's transmission system with advanced equipment and technologies that will reinforce the power grid and help reduce the frequency and duration of customer outages. Since 2014, FirstEnergy has upgraded or replaced existing power lines, incorporated smart technology into the grid and upgraded dozens of substations with new equipment and enhanced security features. Through 2022, FirstEnergy has invested more than $10 billion in the *Energizing the Future* initiative.

ATSI provides transmission services in Ohio and in the western portion of Pennsylvania and owns or maintains more than 8,100 miles of transmission lines, substations and other facilities.

FirstEnergy is dedicated to integrity, safety, reliability and operational excellence. Its 10 electric distribution companies form one of the nation's largest investor-owned electric systems, serving customers in Ohio, Pennsylvania, New Jersey, West Virginia, Maryland and New York. The company's transmission subsidiaries operate approximately 24,000 miles of transmission lines that connect the Midwest and Mid-Atlantic regions. Follow FirstEnergy online at www.firstenergycorp.com and on Twitter @FirstEnergyCorp.

ISO-NE EXPECTS SUFFICIENT ELECTRICITY SUPPLIES UNDER TYPICAL, ABOVE-AVERAGE 2023 SUMMER TEMPERATURES

June, 2023

New England is expected to have sufficient resources to meet consumer demand for electricity this summer under typical weather conditions, according to ISO New England Inc., the operator of the region's bulk power system and wholesale electricity markets. Tight supply margins could develop if forecasted peak system conditions associated with above average hot and humid weather occur. If this happens, ISO New England will take steps to manage New England's electricity supply and demand and maintain power system reliability.

This summer, under typical weather conditions, electricity demand is forecasted to reach 24,605 megawatts (MW). Above-average summer weather, such as an extended heat wave, could push demand up to 26,421 MW.

Planning for the summer

ISO New England prepares short-term forecasts for the summer and winter seasons, taking into account estimated contributions from all resources, including those with and without an obligation through the capacity market to supply electricity; unplanned resource outages; imports from neighboring regions; and resource additions and retirements. These estimates help inform ISO New England's planning on how to operate the grid during the upcoming summer season.

These forecasts also estimate consumer demand under a variety of weather conditions. Average summer weather is used to develop what is known as the 50-50 forecast, meaning there is a 50 percent chance that peak demand will be above or below the forecast. Above-average heat and humidity are used to generate what is known as the 90-10 forecast, which means there is a 10 percent chance that peak demand will surpass the forecast.

Tools in place to maintain reliability

Though ISO New England expects the region to have adequate supplies of electricity this summer, conditions could force system operators to take action to maintain system reliability. ISO New England operators have many tools at their disposal to maintain the overall reliability of the power system. These well-established procedures protect the region in the event of an unexpected power plant or transmission line outage, an extended heat wave that results in increased consumer demand, fuel supply issues, or emissions limitations that affect the amount of electric generation available, or a combination of these factors.

Procedures to deal with such issues include importing emergency power from neighboring regions, calling on power system reserves, and asking businesses and residents to voluntarily conserve energy. In severe events, system operators may be forced to call for controlled power outages to protect the overall grid. Climate change has caused weather to become more volatile and less predictable, increasing the potential for system operators to resort to these actions.

How the region will meet this summer's electricity demand

More than 30,000 MW of capacity is expected to be available to meet New England consumer demand for electricity and required reserves. ISO New England employs a variety of resources to meet demand: generators that produce electricity, using fuels such as natural gas, nuclear, oil, coal, hydro, biomass, wind, and sun; demand-response resources that reduce their energy use; and power imported into New England from New York and Canada.

MORE THAN **30,000** MW OF CAPACITY

This summer's forecasts incorporate the demand-reducing effects of more than 1,900 MW of energy efficiency measures. This decrease is made up of resources that are designed to save electricity across many hours, but cannot change the amount saved in response to instructions from system operators. Examples include the use of energy-efficient appliances and lighting, and advanced cooling and heating technologies.

The forecasts also include a reduction of just more than 980 MW during the peak hour that can be expected from the region's behind-the-meter solar photovoltaic (BTM PV) installations. Though New England has over 5,400 MW of BTM solar PV installed, these systems produce their highest output in the early afternoon hours. The increase of solar power in New England has, in effect, pushed the peak hour of grid demand later in the day, when the sun is lower in the sky and production from solar PV systems is also lower. Rather than peaking during the mid-afternoon, as was customary during the summer before PV installations became more widespread, demand for grid power now tops off in the early evening hours.

Last summer's demand peak was 24,780 MW and occurred on August 4, 2022. The all-time record for electricity demand was set on August 2, 2006, when demand reached 28,130 MW after a prolonged heat wave. In New England, consumer demand for electricity is highest during the summer because of air conditioning use.

NYSERDA ANNOUNCES $10 MILLION AVAILABLE FOR CARBON NEUTRAL COMMUNITY ECONOMIC DEVELOPMENT PROJECTS

Funding Will Advance Building Decarbonization Work and Stimulate Economic Development

June, 2023

The New York State Energy Research and Development Authority (NYSERDA) today (June 5) announced $10 million available under the fifth round of the Carbon Neutral Community Economic Development Program as part of Round XIII of Governor Kathy Hochul's Regional Economic Development Council initiative announced on May 15. Projects funded through this program are advancing decarbonization and stimulating economic development in disadvantaged communities in support of the State's Climate Leadership and Community Protection Act goal to reduce greenhouse gas emissions 85 percent by 2050 and ensure at least 35 percent, with a goal of 40 percent, of the benefits of clean energy investments be directed to disadvantaged communities.

> *Doreen M. Harris, President and CEO, NYSERDA said,* **"***The Carbon Neutral Community Economic Development Program provides critical statewide support for community revitalization through building projects that incorporate energy efficiency, electrification and renewable energy efforts. By addressing emissions from key buildings within communities, we are advancing the transformation needed to ensure vibrant healthy living, recreation and workspaces for all New Yorkers.***"**

The Carbon Neutral Community Economic Development program is administered by NYSERDA in partnership with Empire State Development (ESD) and the New York State Department of State's Downtown Revitalization Initiative. It provides incentives with focused support for projects located in Disadvantaged Communities and Downtown Revitalization Initiative districts, to reduce emissions and improve quality of life for residents and visitors. In addition, NYSERDA prioritizes investments in building modernization projects that result in jobs that provide family-sustaining wages and benefits, helping to support the transition to a clean energy economy. The deadline for applications is Friday, July 28, 2023, at 4:00 p.m. Interested proposers can find more information or apply to this program.

The fifth round of the Carbon Neutral Community Economic Development program includes **two categories** in which funding is available:

Category A:
- Eligible New York State commercial, industrial, institutional, municipal and mixed-use Site Owners may apply for incentives for the construction of high-performance buildings, or renovation of existing buildings to high performance standards, that demonstrate how the approach is replicable to more buildings in a reliable, cost effective way. The decarbonization of an existing central plant is also eligible. Project awards will be up to 75% of eligible costs or $2 million, whichever is less.

Category B:
- Eligible communities, neighborhoods, campuses and owners of large real estate portfolios in New York State with projects of at least 500,000 square feet (of new construction or rehabilitation), or a total project implementation cost of at least $50 million, may apply for incentives for the planning, energy modeling and design necessary to convert the proposed building portfolio to achieve carbon neutral or net zero energy performance. Project awards will be up to 75% of the eligible costs, with a maximum project award amount of $2 million.

A total of 50 projects have been awarded to date through the Carbon Neutral Community Economic Development program, with over $56 million in incentives since it was launched in 2018. Six of the 10 projects awarded in 2022, and 20 of the 50 projects receiving funding from the first four rounds, are examples of adaptive reuse of an existing building to carbon neutral performance. These projects maintain the heritage and local character of New York communities, demonstrate the feasibility of applying clean energy technologies to existing buildings and have lower embodied carbon than new construction. They often serve as the anchor project for surrounding neighborhood redevelopment.

PROJECT AWARDS
WILL BE UP TO 75%
OF ELIGIBLE COSTS OR
$2 MILLION

Buildings account for more than a third of greenhouse gas emissions in New York State, and most of the State's current building stock was constructed before energy codes were passed and were, therefore, not constructed to be energy efficient. Decarbonizing buildings will help improve building resiliency, occupant health and productivity.

The 2023 funding round for the Carbon Neutral Community Economic Development program is part of the State's Consolidated Funding Application (CFA) enabling businesses, municipalities, not-for-profits and the public to apply for assistance through a single application from dozens of state programs for job-creation and community development projects. It is designed to give project applicants expedited and streamlined access to a combined pool of grant funds and tax credits from dozens of existing programs. Regional Economic Development Council (REDC) will review projects and provide scores that reflect how well a project aligns with a region's goals and strategies.

The REDC process continues to support and empower regional stakeholders in developing strategic plans and funding priorities that meet local economic needs. To date, through the REDCs, more than $7.5 billion has been awarded to more than 9,200 job creation and community development projects consistent with each region's strategic plan.

Funding is available through the State's 10-year, $6 billion Clean Energy Fund and through the Regional Greenhouse Gas Initiative (RGGI). →

New York State's Nation-Leading Climate Plan

New York State's nation-leading climate agenda calls for an orderly and just transition that creates family-sustaining jobs, continues to foster a green economy across all sectors and ensures that at least 35 percent, with a goal of 40 percent, of the benefits of clean energy investments are directed to disadvantaged communities. Guided by some of the nation's most aggressive climate and clean energy initiatives, New York is on a path to achieving a zero-emission electricity sector by 2040, including 70 percent renewable energy generation by 2030, and economywide carbon neutrality by mid-century. A cornerstone of this transition is New York's unprecedented clean energy investments, including more than $35 billion in 120 large-scale renewable and transmission projects across the state, $6.8 billion to reduce building emissions, $3.3 billion to scale up solar, more than $1 billion for clean transportation initiatives, and over $2 billion in NY Green Bank commitments. These and other investments are supporting more than 165,000 jobs in New York's clean energy sector in 2021 and over 3,000 percent growth in the distributed solar sector since 2011. To reduce greenhouse gas emissions and improve air quality, New York also adopted zero-emission vehicle regulations, including requiring all new passenger cars and trucks sold in the State be zero emission by 2035. Partnerships are continuing to advance New York's climate action with nearly 400 registered and 100 certified Climate Smart Communities, nearly 500 Clean Energy Communities, and the State's largest community air monitoring initiative in 10 disadvantaged communities across the state to help target air pollution and combat climate change.

About NYSERDA

NYSERDA, a public benefit corporation, offers objective information and analysis, innovative programs, technical expertise, and funding to help New Yorkers increase energy efficiency, save money, use renewable energy, and reduce reliance on fossil fuels. NYSERDA professionals work to protect the environment and create clean-energy jobs. NYSERDA has been developing partnerships to advance innovative energy solutions in New York State since 1975. To learn more about NYSERDA's programs and funding opportunities, visit nyserda.ny.gov or follow us on Twitter, Facebook, YouTube, or Instagram.

NYSERDA HAS BEEN DEVELOPING PARTNERSHIPS TO ADVANCE INNOVATIVE ENERGY SOLUTIONS IN NEW YORK STATE SINCE 1975.

About the Consolidated Funding Application

The Consolidated Funding Application was created to streamline and expedite the grant application process. The CFA process marks a fundamental shift in the way State resources are allocated, ensuring less bureaucracy and greater efficiency to fulfill local economic development needs. The CFA serves as the single-entry point for access to economic development funding, ensuring applicants no longer have to slowly navigate multiple agencies and sources without any mechanism for coordination. Now, economic development projects use the CFA as a support mechanism to access multiple State funding sources through one application, making the process quicker, easier, and more productive. Learn more about the CFA at https://regionalcouncils.ny.gov/cfa.

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JOB CREATION AND COMMUNITY DEVELOPMENT PROJECTS

PGE CLOSES OUT 2021 RFP WITH PROCUREMENT OF 75-MW BATTERY STORAGE PROJECT

June, 2023

Portland General Electric Company (NYSE: POR) today (May 31) announced the **procurement of the Evergreen battery energy storage system, a new 75-MW facility** to be located at a soon-to-be-constructed substation in Hillsboro, Oregon. This battery project, owned by PGE and built by Mortenson, is expected to begin service in 2024, adding critical non-emitting dispatchable capacity to Oregon's clean energy transition.

This announcement builds on PGE's recent procurement of 400 MW of battery projects - the second largest commitment to standalone energy storage made by any U.S. utility to date. Battery systems offer a number of grid benefits, providing flexibility and consistency as PGE integrates more intermittent renewable resources. Stored energy can be reliably deployed within seconds to customers during extreme weather events or times of high demand, reducing dependence on energy markets and fossil fuel generation.

> *"Mortenson is proud to be helping PGE build a clean energy future for their customers by adding energy storage to the grid"* said Brent Bergland, vice president, project development at Mortenson. *"Projects like Evergreen enable greater use of renewable energy and are a powerful way to help decarbonize our planet, and our energy storage team is excited to engineer, procure, construct and deliver a complete world-class facility to PGE."*

The Evergreen facility represents the final procurement from PGE's 2021 Request for Proposal (RFP), which resulted in landmark projects including the 311 MW Clearwater Wind Farm, scheduled to begin operations by the end of 2023.

> *"From Clearwater to Evergreen, Portland General Electric is building Oregon's clean energy future,"* said Maria Pope, PGE President & CEO. *"Our wind, solar, hydro and battery storage facilities work together as part of a resilient grid to provide safe and reliable energy while helping us to manage costs."*

Earlier this month, **PGE filed its 2023 Draft RFP with the Oregon Public Utility Commission**, initiating the process to bring new clean energy resources online. PGE expects to seek bids for additional non-emitting dispatchable capacity resources, like batteries, which will continue to play a growing role in the utility's portfolio, as well as renewable generation projects, such as wind and solar farms. Most importantly, the draft RFP aims to maximize reliability and customer value by seeking to procure projects that can leverage Bonneville Power Administration's long-term transmission capacity to deliver energy to PGE customers.

Together, these actions demonstrate PGE's continued focus on decarbonization while prioritizing reliability and managing costs for customers. To get involved visit portlandgeneral.com/rfp.

About Portland General Electric Company

Portland General Electric (NYSE: POR) is a fully integrated energy company that generates, transmits and distributes electricity to over 900,000 customers in 51 cities across the state of Oregon. For more than 130 years, Portland General Electric (PGE) has powered the advancement of society, delivering safe, affordable, reliable and increasingly clean energy. To deliver on its strategy and meet state targets, PGE and its approximately 3,000 employees committed to partnering with stakeholders to achieve at least an 80% reduction in greenhouse gas emissions from power served to customers by 2030 and 100% reduction by 2040. PGE customers set the standard for prioritizing clean energy with the No. 1 voluntary renewable energy program in the country. Additionally, for the fifth year in a row, PGE was recognized by the Bloomberg Gender-Equality Index which highlights companies committed to creating a more equal and inclusive workplace. As a reflection of the company's commitment to the community it serves, in 2022, PGE employees, retirees and the PGE Foundation donated nearly $5.5 million and volunteered more than 18,000 **hours with more than 400 nonprofits across Oregon. For more information visit PortlandGeneral.com/news.**

About Mortenson

Mortenson is a U.S.-based, top-20 developer, builder and engineering services provider serving the commercial, institutional, and energy sectors. Mortenson's expanding portfolio of integrated services helps its customers move their strategies forward, ensuring their investments result in high-performing assets. The result is a turnkey partner, fully invested in the business success of its customers. For additional information, visit www.mortenson.com .

MORE THAN
130
YEARS

OVER
900,000
CUSTOMERS
IN **51** CITIES
ACROSS THE STATE
OF OREGON

AI: HERE, THERE AND (SOON) EVERYWHERE

ELISABETH MONAGHAN
Editor in Chief

When industries rely upon technology to improve their operational efficiencies, better serve their customers and remain competitive, they cannot afford to be late adopters. This is especially true of the electric energy sector, where new technology is introduced at a rapid-fire pace, making it difficult for utilities and other industry partners to keep up.

I enjoy hearing industry leaders discuss which technology has had the greatest impact on electric energy over the past few years, as well as what up-and-coming technology they're keeping an eye on. When I first stepped in as editor in chief of EET&D, the majority of these discussions focused on IoT, DERMs, DERs and microgrids. While these remain among the technologies that continue to shift how energy is generated, transmitted and consumed, EVs have moved further up the list of the industry's most impactful technologies. And recently, it appears that artificial intelligence (AI) may be eclipsing the latest technology in how it is shaping the electric energy sector.

For several decades, AI has been the stuff of science fiction movies and fantasy books. As it becomes more common, there are unknowns. Right now, there is not an army of AI-based, sentient robots running around and making our decisions for us, (at least, not yet), but AI has already become a tool that many of us use in our daily lives. Amazon's Alexa and Apple's Siri are IA-based, as are apps used for personalized shopping, facial recognition, autonomous driving cars and countless other applications. And while subject matter experts working in the utility space have written about AI and machine learning in past issues of EET&D, more experts are beginning to explore the role AI plays and will continue to play in our industry.

A number of the articles in this issue touch on AI's expanding role in the business world. In his article, "How Energy Firms Can Leverage IT Tools," Dijam Panigrahi with GridRaster Inc. discusses how industries across the board are embracing AI.

Panigrahi writes, "Artificial Intelligence (AI) tools are becoming more mainstream today, and an increasing number of professionals, such as designers, engineers and manufacturers of energy, utilities and oil and gas producers are looking at ways to incorporate various AI-driven technologies into their workflows."

Why does Panigrahi consider AI technology to be the "next best thing?" Perhaps it is because, as he points out, not only is AI technology flexible in its implementation but in what it is compatible with. "This technology can work with diverse business applications and structured or unstructured data," writes Panigrahi.

In his article on how AI and other technologies are drastically reshaping electric energy fleet vehicle management Co-founder and COO of CerebrumX Sumit Chauhan describes how AI will make it easier for companies to collect large amounts of data, analyze it and leverage the information to better meet the needs of its customers. Chauhan explains that one of the benefits of using AI in connected cars is the ability to improve safety, both for the drivers and the vehicles. "By analyzing data from various sources, including traffic patterns, weather conditions and the behavior of other drivers, AI can help drivers make better decisions on the road, reducing the risk of accidents, writes Chauhan. "AI can also be used to monitor drivers' behavior and alert them to potential risks, such as drowsiness or distracted driving."

While these articles support why AI is such a powerful tool and has the potential for increased profits, proficiencies and productivity, not everyone knows where to begin with implementing the technology.

Fortunately, John Villali who is a research director for IDC Energy Insights offers guidance to address that implementation. In The Bigger Picture section of this issue, Villali talks about how AI is catching on in the power and utility industry and suggests that although there has been an uptick in AI adoption and use cases, many are still trying to comprehend AI's capabilities.

Villali identifies key areas that organizations in the power and utility sector should consider when looking into AI technology. What's more, for those planning to invest in AI, Villali lists the necessary steps they should take to avoid the pitfalls of AI technology. According to Villali, whether they apply the technology in operations, at the enterprise level or in the back office, more power and utility companies that have implemented AI are seeing positive results. AI may have further to go before it is more widely adopted, but based on how many companies and individuals have already embraced it, it is clear the potential for the technology is practically limitless.

As AI becomes more commonplace within our industry, and as more of our industry partners find new ways to deploy the technology, we will share their successes and challenges with our readers.

As always, if you would like to contribute an article on an interesting project – whether it involves AI, or not, please email me:

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Elisabeth

KEY LESSONS LEARNED FROM IMPLEMENTING A MICROGRID

KATE CUMMINGS

For the Q2 Grid Transformation Forum, Kate Cummings, who was instrumental in implementing G&W Electric's microgrid, addresses what organizations must do if they're thinking about installing their own microgrid.

Premium power is a must-have for a growing number of organizations, and installing a microgrid can be a viable option. Even a minor outage can have a significant negative impact on a business that can lead to lost revenue, damaged product and frustrated customers. The impact becomes even more pronounced for organizations such as hospitals and military bases, that rely on always-on power for public safety or national security reasons.

In our experience, even the smallest glitch in the power system caused downtime in our molding facility, so we decided to build and install our own microgrid. This will allow us to virtually guarantee continuous, high-quality power – ensuring that business could continue as usual even when the outside grid failed. Our experience may help other organizations determine whether a microgrid might be right for them and, if so, how to go about implementation.

The decision to install a microgrid

Located in the greater Chicago area, our company produces intelligent electrical devices, including switchgear, reclosers, high-accuracy sensors and other distribution and transmission cable accessories. Our campus consists of two buildings, one of which uses highly sensitive, automated molding equipment, while the other primarily serves as an assembling facility and R&D lab. While we did have a backup generator on site, transitioning to it during a power interruption wasn't instantaneous.

Because our molding equipment was highly intolerant to power outages that lasted more than five cycles, the lack of a way to bridge long outages represented a significant risk. Starting with the sixth cycle in an outage, for every minute of downtime, tens of thousands of dollars were lost. Maintenance teams would then have to clean the equipment out and throw away the scrapped material.

After evaluating the costs, in 2017, we decided to install a microgrid on our campus to provide premium power that would minimize – if not eliminate – the impact of occasional power outages. →

Image credit: G&W Electric

The components of the microgrid
Our microgrid consists of six primary components:

- **Rooftop solar array:** A 2-megawatt (MW) solar farm was installed on the roof of the larger building on campus. Consisting of nearly 6,000 bi-facial photovoltaic solar panels covering more than 370,000 square feet, the solar farm is designed to generate energy from both sides of each panel by utilizing direct sunlight and reflection.

- **Battery storage system:** As the "heart and soul" of the microgrid, a modular Flow Battery Energy Storage System (BESS) can store power generated by the solar array and dispatch backup power in the event of an external outage. The system has four 500 kilowatt (KW) blocks, leading to a total capacity of 2 MW for four hours. If needed, it can go over capacity to 3 MW for up to two hours. It also utilizes a vanadium electrolyte solution, which is both non-degrading and fireproof.

- **Flywheel:** One of the most critical components of the whole system, the flywheel detects an outage in ¼ cycle and rapidly provides backup power for a short amount of time while the battery and solar farm kick in. All told, it can provide 1 MW of power for up to 68 seconds.

- **Generator:** A 2 MW diesel generator serves as a reliable backbone for the microgrid by providing a steady source of power for the molding facility during extended outages. The solar farm is entirely dependent upon getting enough sunlight to generate power, which is not guaranteed depending on the time of day or weather. The generator can produce dispatchable power when no other energy sources are available.

- **Medium-voltage switchgear:** To tie the campus together electrically, we utilized our own magnetic actuated, 15.5 kilovolt (KV) switchgear. These also provide us with greater overall control of the microgrid and allow us to continuously read data from the system.

- **Pole-mounted reclosers:** While technically on the utility side, we also utilized our own reclosers to improve power reliability. Within 10 seconds of losing power from the primary feeder, the reclosers automatically transfer our campus to the alternate power source.

The microgrid components combine to give us a reliable system that can provide high-quality, renewable power almost instantaneously in the event of a utility outage. And in the event of a prolonged outage or unfavorable weather conditions, we can still be confident in our ability to manufacture products thanks to the diesel generator.

A few challenges
We were through envisioning, planning and preparing for potential roadblocks. But given the scale of the project, we expected to encounter unforeseen challenges, and we did.

These challenges fell into three main categories: structural, utility-related and local government-related. And while every microgrid project is unique, any organization thinking about implementing its own microgrid should incorporate these as key considerations in the planning process.

Structural challenges
The first challenge we encountered was related to the rooftop solar array. The building selected for the solar array had recently had its roof entirely replaced, along with a weather-proofing membrane. During installation, installers had to be extremely careful not to pierce the membrane, which would have voided the warranty on the nearly new roof.

To anchor the solar panels to the roof without penetrating the membrane, we developed a specialized cinder block ballast solution to weigh the panels down. However, certain sections of the roof couldn't handle the weight of both the panels and the ballast, so we had to avoid those areas.

The support pad for the battery proved to be a major engineering challenge as well. The batteries' combined weight was several hundred tons, meaning that building the pad wasn't as simple as digging a hole and pouring concrete. The pad area had to be highly engineered and specially designed to not only support the weight of the batteries but also to ensure that it wouldn't crack as it settled over time. To accomplish this, we needed to maintain a continuous pour of concrete during construction, which also presented logistical and traffic challenges.

Utility challenges
Most of the challenges on the utility side are related to technical limitations of the current infrastructure. For example, before we could switch over to an alternate source, we needed to isolate the solar generation and battery storage to prevent problems that the utility's feeder couldn't handle. Although the utility does plan to upgrade the equipment in the future, programming that isolation "handshake" between the microgrid and utility did pose a technical challenge.

Establishing the interconnection agreement with the utility also took six months – a significant amount of time. This type of agreement is critical for any organization

Image credit: G&W Electric

looking to construct, install and operate its own distributed energy system that's connected to the grid. Since the agreement must be submitted, reviewed and approved before construction starts, it's important to have all the proper documentation in place beforehand. In our case, some of the delay was due to the COVID-19 pandemic.

Our agreement allowed the utility to install a Distributed Energy Resource Management System (DERMS) so that we don't necessarily need to isolate generation while on the alternate power source. In our case, the utility determines how much energy we can generate and manages it.

Local government challenges

We also encountered several unforeseen challenges related to the local governmental requirements. For example, the batteries in the storage system are housed in shipping containers to help protect them from the elements and extreme weather. However, shortly after construction was completed, our village informed us that local ordinances didn't allow shipping containers

to be visible from the road – even though the site was in an industrial-zoned area. As a result, we had to build an enclosure wall around the battery storage system, which was an unexpected expense.

The project also encountered a unique challenge that resulted from the campus's location along the border between two municipalities. Although the company itself is located entirely in one town, the neighboring village has an underground well less than 400 feet from the manufacturing site. Because of this, we had to move some components of the project, as well as secure additional permits from the neighboring municipality. We also had to take steps to ensure that nothing could leak into the water supply if a disaster occurred.

Finally, we needed to make a slight change to the rooftop solar array to comply with safety codes. Initial plans called for a centralized inverter, but we decided to switch to string inverters. Centralized inverters could not incorporate a rapid shutdown device, which was a vital safety concern if firefighters or other first responders needed to access the roof in the event of an emergency. →

Image credit: G&W Electric

Know before you go: Key lessons learned

While the microgrid has been a major success and an investment that has already paid for itself, there are several key lessons and takeaways that organizations should consider if they are looking into their own microgrid.

- **Lesson 1 – Understand your goals:** Every organization will have different reasons for implementing a microgrid. Some may do it to help meet environmental initiatives, while others might do it for financial reasons, to guarantee premium power or some combination thereof. Whatever your reason, clearly defining and understanding your unique goals will help ensure that your solution best meets your needs.

- **Lesson 2 – Do your homework:** Conduct any studies or surveys well ahead of time so you have time to change plans if needed. Understand any environmental regulations you may have to contend with. Learn the local laws and safety codes that you'll need to comply with. Know the technical capabilities – and limitations – of your utility and the equipment they have. Prepare for contingencies and other extreme situations, such as what would happen if overvoltage occurred. This may require a lot of work on the front end but can save you valuable time, resources and headaches on the back end.

- **Lesson 3 – Communication is key:** Building and installing your own microgrid will involve numerous vendors. Coordinating and communicating with them – and ensuring they communicate with each other – is critical. Will the products and equipment arrive on time? Can equipment from different vendors "talk" to each other? We worked with vendors around the world, and while coordinating conference calls in numerous time zones was challenging, it ultimately helped ensure success.

- **Lesson 4 – Be nimble:** Even the most meticulous planning can't account for every potential scenario, and unforeseen challenges will happen. When they do, agility is critical. Vendors may go out of business or stop making a crucial product. Supply chain delays may interfere with scheduling. New laws or regulations might require sudden adjustments. Unexpected costs may arise. The ability to pivot quickly and successfully can make all the difference.

- **Lesson 5 – Metering considerations**: One of the primary reasons for installing a microgrid is to essentially own your means of power generation. Moving from secondary to primary metering ensured that the utility didn't own our microgrid, but required coordinating and ensuring that the right equipment and connections were in place. It also meant that we had to understand who was responsible for the various components of moving from secondary to primary metering.

An investment that paid for itself

Our main goal with this project was to minimize disruption and product loss by guaranteeing reliable, high-quality power – and the microgrid has been a resounding success. In the few months since being commissioned, the microgrid has given us uninterrupted coverage during almost a dozen instances that would have been power outages before implementation, including one that would have resulted in nearly $500,000 in lost product and material. Additionally, some days have even resulted in being able to "spin the meter back," where the rooftop solar array has generated enough power to cover its load during the day and sell power back to the grid or charge the battery system as well.

While these takeaways should prove valuable to any organization considering a microgrid – whether that organization is a business, large hospital campus, or small municipal building – every microgrid project is unique and will present its own challenges.

For organizations thinking about implementing a microgrid, the most important thing is to make sure it fulfills their unique needs. That could be meeting clean energy goals, reducing electricity bills, and guaranteeing reliable access to power, for instance. Clearly defining those goals upfront will help ensure ultimate success.

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HOW DEMAND RESPONSE TECHNOLOGIES WILL GUIDE UTILITIES, PROPERTY OWNERS AND CONSUMERS

JEFF HENDLER

Demand response technologies provide an opportunity for building owners, individuals and residential consumers to play a significant role in reducing energy consumption during peak periods for the benefit of their local utility and the environment. With increasing regulations on building energy usage, these platforms will spearhead the advancement of energy efficiency tools and technologies and facilitate the reduction of carbon emissions.

Current state of utilities

Original analog metering systems require utility workers to go out and physically read meters every month. With more than five million meters in New York City alone, this creates a large burden on utilities to provide accurate energy data. Traditional meters provide less usable energy metrics than smart meters, leaving gaps for upgrades that can produce energy-saving information.

When utilities face high demand, they rely on large peaker plants powered by fossil fuels. They are also less efficient, more expensive and risk strain to the grid, leading to an increased probability of outages. Upgrades and advanced systems like demand response programs take away the need to depend on peaker plants. →

Regulations and implications

Regulations like Local Law 97, part of New York City's Climate Mobilization Act of 2019, are among the country's boldest climate laws, with the goal to cut carbon emissions by 40% by 2030. The Climate Mobilization Act and Local Law 97 create implications for building owners and utilities to drastically reduce cumulative emissions. Starting in 2024, Local Law 97 will impose mandatory greenhouse gas limits with regulations tightening again in 2030. Emissions limits will affect all local buildings, not just residential properties, which will be based on the size and occupancy of buildings.

Buildings over 25,000 square feet will be required to reduce their emissions or face extreme penalties. Under Local Law 97, over 30,000 NYC buildings will be at risk of receiving fines for exceeding the carbon emissions cap. Most buildings will not comply with the 2030 limits without changes to emissions through building efficiency upgrades, electrification of HVAC systems and other efforts.

Additional regulations targeting carbon emissions are expected to be introduced across the U.S. in the coming years to meet net-zero commitments. Clearer standards and development in clean energy technology would dramatically reduce carbon emissions.

The necessary changes

Utility Upgrades

Infrastructure and smart meter upgrades will be necessary to meet these emission reductions. Utilities will bear the brunt of these changes, but ultimately the investments they have made will facilitate new channels for owners to see real-time energy usage and, by extension, track the building's carbon emissions. Efficiency starts with democratizing high-quality utility-grade energy data. New smart meters of any size can access electric and gas usage data. Third-party programs can use smart meter data to analyze and identify opportunities to deploy

new tools at scale for all energy users. This could include smart thermostats, efficient appliances and other connected devices. Utilities investing in infrastructure upgrades can follow these initiatives by introducing rebate and incentive programs for customers that encourage installation of these products, which will increase the impact of smart meters and energy monitoring platforms.

Demand Response Platforms

Virtual Power Plants (VPPs) decentralize energy sources located behind the meter to provide a reliable power supply that can be called upon to support the grid in times of high demand. Compared to traditional power plants, VPPs draw their energy from multiple locations in order to maintain grid stability. Most traditional power plants operate at high capacity, whereas VPPs can tap into these energy sources only when energy demand spikes. One of the biggest challenges in the broader utility rollout of VPP programs has been identifying ways for grid operators to see and access available capacity in real-time and drive shifts in customer behavior to benefit the grid when needed. Demand response platforms will provide financial incentives to users who can shift energy demand during peak times to help balance strain on the grid. While demand response technologies help to comply with carbon emission standards, the added value goes beyond smart thermostats stretching into EV charging, battery storage and smart appliances. Each offers the opportunity of accumulating cost credits, additional reliability and feeding power back into the grid. The incentive for utilities lies in the preference for rewarding users to use less energy, lowering the use of peaker plants during peak hours.

Demand response technologies allow visibility of usage data to understand how and when buildings are using energy. Building operators can then take that information to adjust schedules, set points and assess the impact of energy allocation. Reducing the added work of meter readings while gaining usable data will give an advantage to comply with local and national regulations. In markets where hundreds of buildings and thousands of residents are participating in demand response programs, the data gathered also offers actionable insights into utilities that can help them make more informed decisions on where to invest in infrastructure upgrades, clean energy deployments and more. In these markets, utilities should look to play an active role in the energy transition at the customer and building level as much as they can. Collaborating on digital checklists that are tailored to every building and investing in new training for operators are other ways utilities can keep peak energy usage low.

ABOUT THE AUTHOR:

Jeff Hendler is a co-founder and CEO of Logical Buildings. Prior to establishing Logical Buildings, Hendler co-founded IDT Energy, Inc. and served as chief commercial officer. Hendler has served as Innovation Member of the Smart Cities Council and board member of the Green Button Alliance and is currently a board member of NYC2030.

HOW ENERGY FIRMS CAN LEVERAGE AI TOOLS

LIKE CHATGPT AND AR/VR

DIJAM PANIGRAHI

Artificial Intelligence (AI) tools are becoming more mainstream today, and an increasing number of professionals, such as designers, engineers and manufacturers of energy, utilities and oil and gas producers are looking at ways to incorporate various AI-driven technologies into their workflows.

Automation technology using AI can be programmed to complete logical processes for energy firms and equipment manufacturers. With the already large array of technological applications and programs businesses use, what makes AI technology the next best thing? First, AI technology is flexible. It can be used by many industries in their own unique way, such as aiding them in data mining, targeted marketing or constructing precision-based financial models.

AI today can also be found in other markets such as medical equipment manufacturers, construction equipment producers, tech and engineering firms for aerospace and automotive, mining precincts, utilities and oil and gas. Not only is the technology flexible in its implementation, but in what it is compatible with. This technology can work with diverse business applications and structured or unstructured data.

ChatGPT is the latest technology driven by AI that uses natural language processing. It leverages deep learning algorithms to enable users to converse with chatbots. What has captured the attention of designers and engineers is that it is an advanced system that can understand complex questions and provide very accurate answers almost immediately. Because it was developed with conversational AI capabilities, it can immediately comprehend user queries and generate natural-sounding responses that are tailored to the conversation context. It also has built-in memory capability that stores information from past conversations to better respond to subsequent messages.

However, engineers and designers are also realizing that many projects throughout vertical industries require more than just the development of text and responding to prompts. That is why these professionals are combining the powers of AI tools with other progressive technologies like mixed immersive reality (augmented reality and virtual reality). They are building AI models like ChatGPT to help create virtual worlds in the metaverse to run simulations and increase productivity/efficiency metrics. More specifically, AI tools like ChatGPT and the metaverse can help create a 3D environment that replicates the real world, and the data used can be harnessed for analysis, running simulations and interacting with data more efficiently. →

There are still some limitations with ChatGPT. As an example, when engineers are designing tools or products, AI technologies cannot recognize when physical items move and must be manually told that it is in a different location. That being said, technology such as ChatGPT can significantly assist with coding the virtual 3D world and running simulations. Historically this coding has been done manually, but with AI tools the developer time can be increased ten-fold.

Developers writing code will benefit because ChatGPT can create the vast majority of the code, while developers are then left to use resources to debug much less of the code. They can actually spend more time on innovation. Workers on the manufacturing floor will then better understand the code and language produced by ChatGPT through its natural language ability. As an example, the tools can provide alerts that increase safety standards when entering a hazardous section of the plant floor or when operating heavy equipment. Training and test simulations conducted within metaverse environments will also benefit from increased safety practices.

AI tools such as ChatGPT will also play a leading role in helping to create code and language used in the development of digital twins – the virtual world where people, consumers and workers all gather to communicate, collaborate and share through a virtual presence on any device. This means companies will build immersive virtual spaces, and it will allow employees to virtually collaborate using their digital twin through chats, emails, video calls and even face-to-face meetings.

The power of simulation will be an exact game-changer for enterprises and businesses throughout the metaverse in a variety of industries, such as optimizing production planning in the automotive sector, accelerating design in the aerospace industry, improving overall production efficiency for manufacturers and increasing accuracy for consumer packaged goods companies, many companies are poised to leverage virtual simulation to make better business decisions and generate the greatest return on investment. Following are several other examples of how AI tools such as ChatGPT will benefit designers, engineers and manufacturers:

Automation Support. Engineers will have proximity to leading technology that supports automation processes and reduces time spent on manual tasks, like collecting data, preparing reports and monitoring trends in their industry.

Task Planning and Management. This is particularly critical for engineers since it requires a vast amount of organization, discipline and time management when completing tasks effectively. Technology like ChatGPT can improve the process by enabling an intuitive platform for task planning and management.

Knowledge Sharing. Engineers and their teams will be able to increase collaboration and efficiency in the workplace since tools like ChatGPT allow for streamlined knowledge sharing between engineers and other employees at work.

Error Detection. This is an area that has always been a large issue for engineers as they continue to seek the most efficient ways to identify errors, which leads to time and cost savings. The use of natural language processing will now be leveraged to visualize errors in text-based data faster than ever before, critical in code review, error analysis, or debugging.

Security and privacy: Security and privacy are some of the biggest issues facing today's world. Since metaverse environments have the digital twin as an integral part, the metaverse will have much richer data. The security and privacy in metaverse environments cannot be solved by traditional security tools. However, technologies like AR/VR leveraging leading AI tools are better equipped to handle security and privacy related to digital twins.

Engineers, designers and manufacturing employees will continue to leverage virtual worlds built with metaverse environments because they will be important for all businesses, enterprises and consumers. Today, with the help of AI tools such as ChatGPT, businesses will see an increase in productivity like never before.

ABOUT THE AUTHOR:

Dijam Panigrahi is the co-founder and COO of GridRaster Inc., a provider of cloud-based AR/VR platforms that power compelling high-quality AR/VR experiences on mobile devices for enterprises.

HELPING CANADA'S LARGEST SOLAR FARM

MAXIMIZE ENERGY OUTPUT

LEON HAILSTONES

As the effects of climate change become increasingly apparent across the globe, Canada is working hard to mitigate its contributions. Part of its multi-pronged action plan is to significantly cut its emissions, striving to have 90% of its electricity coming from non-emitting sources by 2030. This includes providing its inhabitants with universal access to affordable, reliable and sustainable clean energy.

While Canada has made significant progress on this front, achieving these ambitious clean energy goals hinges on the continued growth and stability of electricity generated from renewables. To this end, Canada recently commissioned the Travers Solar Project, its largest utility-scale PV plant to date. The 465 MW project spans 3,300 acres and is expected to provide enough electricity to power 150,000 homes, offsetting more than 472,000 tons of greenhouse gas emissions annually. Projects of this scale are critical to Canada's transition to renewables; their reliable performance is another vital part of the equation.

Better measurements for better energy outcomes

When a solar developer is planning a potential PV project, they perform solar resource assessment campaigns to determine how much energy is available at a given site. The resulting data is critical to creating achievable energy production targets and securing project financing. Thus, the accuracy of this pre-construction data is paramount as any missteps could lead to poor performance once the project becomes operational.

It is equally important to collect high-quality resource monitoring data once a solar plant is operational and producing energy. One way that solar developers ensure their projects are producing the amount of energy they have projected is to install weather stations that monitor a variety of site-specific parameters. Together, the data collected by these systems play a critical role in determining a project's performance ratio, an IEC-mandated requirement that compares the measured output against expected output for a given reporting period. →

Image credit: NRG Systems

Image credit: NRG Systems

The Importance of reliability and experience

When it came time to select a resource monitoring solution for the Travers Solar Project, the EPC responsible for Travers' engineering, procurement and construction, reached out to the SCADA engineering and integration provider on the project for assistance. That provider then turned to a global resource measurement and intelligence leader they had worked with frequently in the past on a wide range of solar monitoring campaigns.

The monitoring solution for Travers not only had to accommodate the project's impressive scale, but it had to comply with the Alberta Electric System Operator (AESO)'s stringent requirements per ISO Rules, Section 304.9. AESO is responsible for operating Alberta's power grid and the requirements outlined in Section 304.9 dictate the meteorological data that must be captured by wind and solar generating facilities that are connected to the local electric system. An additional consideration when selecting a resource monitoring solution for Travers was system durability, given Alberta's harsh conditions.

> **The company worked with the EPC to create a system design that would provide an even distribution of measurements across the site.**

The resource monitoring solution was selected for several reasons. The system was entirely turnkey, featuring all components needed to capture the relevant, AESO-mandated meteorological parameters for the project, including solar irradiance, module temperature, soiling conditions and albedo. While flexible enough to be configured to meet Travers' unique requirements, the system could easily be standardized for repeatable installation across the plant, making deployment straightforward and efficient.

As a 40+ year veteran in the renewable energy space, the resource measurement and intelligence company also provided critical input to determine an installation layout that met AESO guidelines for the systems. The company worked with the EPC to create a system design that would provide an even distribution of measurements across the site.

Finally, the resource measurement solution selected for the project has been proven to operate reliably in harsh conditions. The company even created project-specific power supplies designed to keep the stations running autonomously, should grid power fail in the challenging environment.

Mike Crawford, a senior program manager for the SCADA engineering and integration provider, said, "We have worked extensively with this resource measurement and intelligence provider and their solar solutions. Their systems offer a unique combination of flexibility and repeatability, allowing for project-specific customization within a framework that is easily replicated across a single plant or multiple plants. This has been an especially important feature for the Travers project, given the project had strict requirements and contains more than one-million PV modules across the 3,300 acres. Having reliable meteorological stations distributed across the site is critical to the project's performance, and we can count on this company to deliver."

Powering the future

With assistance from the resource measurement and intelligence provider, all monitoring systems were installed and commissioned ahead of Travers becoming fully operational in early 2023. With reliable solar resource monitoring systems in place, the project owner can ensure that this remarkable site is achieving its peak performance potential for years to come.

ABOUT THE AUTHOR:

Leon Hailstones drives NRG's marketing strategy and new product development. He has over a decade's worth of international channel development, product management and marketing experience in solar and microgrid technologies. He previously served as a product manager with the global Schneider Electric Solar Business and holds an MBA from Simon Fraser University in Vancouver, Canada.

SIX CHARACTERISTICS OF LEADING PERFORMERS

IN THE UTILITY SECTOR

ARNOLD J. LOWENSTEIN, DAVID J. WALLS AND ZACK WU

With the backdrop of energy transition, growing pressures for a more sustainable future, as well as an evolving policy environment, companies in the electric and gas utility sector are facing unprecedented change and uncertainty. Additionally, the volatility and uncertainty in both financial and energy markets more broadly are contributing to a challenging business environment for the utility sector.

To provide context for utility management on how to address these challenges, we analyzed the performance of 48 publicly listed U.S. utility companies over the past seven years. The primary objective was to draw lessons on how leading performers have navigated these challenges. As would be expected in a time of change, it observed a wide gap between the top and bottom quartile performers in terms of total shareholder return (TSR) and terms of EV/EBITDA multiples, suggesting that the market sees very different growth and return potential across companies in the sector.

This article highlights six characteristics of top-tier performers and explores the drivers contributing to superior performance. Table 1 summarizes the financial performance of the 48 utilities in the analysis and highlights some of the factors that underlie the performance differentials. →

	1st Quartile (Top 12 companies)	4th Quartile (Bottom 12 companies)	Overall Average (Of 48 companies)
7-yr TSR[1] (2015-2022)	14%	3%	8%
TEV/EBITDA multiple[2] (2015→2022)	9.7x→12.3x (2.6x increase)	9.8x→11.0x (1.2x increase)	10.4x→11.8x (1.4x increase)
Average Market Cap[3] (as of Dec '22)	$33B	$15B	$22B
EPS growth ('15-22 CAGR)	8%	-1%	5%
Capex growth ('15-22 CAGR)	6%	5%	5%
ESG rating[4] (# of companies with average or above rating)	Nine out of 12	Four out of 12	24 out of 48
Regulatory environment[5] (on a scale of 1 to 9)	4.1	4.7	4.5

Table 1: Performance of the utility sector

Scale matters

The analysis points to a significant advantage of scale, with an average market capitalization of $33B for 1st TSR quartile performers, more than double that of the bottom quartile with an average market capitalization of $15Bn. Additionally, out of a total of 27 companies with market capitalization above $10Bn, 10 are in the top quartile, eight are in the 2nd quartile, with only five in the bottom quartile.

Scale provides the ability to invest in the growing requirements of the energy transition, including the systems and infrastructure needed to support changing customer needs, to participate in the growth of capital-intensive transmission, to modernize the grid and invest in growth areas like building needed EV infrastructure. Large market cap companies also tend to be more highly valued by investors since they provide better liquidity and often greater performance stability and predictability, in other words, lower risk. →

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[1] Average total shareholder return (TSR) of the group, from 31 Dec 2015 through 31 Dec 2022.

[2] Calculated based on total enterprise value (TEV) as of Dec 31 over NTM (next-twelve months) EBITDA.

[3] Average market capitalization of the group, as of Dec 31, 2022.

[4] Based on MSCI ESG ratings, measuring companies' long-term, financially relevant environmental, social and governance (ESG) risks.

[5] Based on S&P RRA rating measuring utility regulatory environment by state jurisdictions from investors' perspective, the rating is converted into a 9-point scale, with 1 being most favorable and 9 being least favorable.

Earnings growth is key

A notable characteristic differentiating the top and bottom performers is their earnings growth over the period. The top quartile performers have delivered an average annual EPS growth of 8%, whereas most of the bottom quartile performers exhibited less than 5% and, in some cases, negative growth.

Effective and disciplined cost management is certainly a key driver of earnings growth – operating expenses (O&M) of top quartile performers grew at an average of 5% CAGR over the past five years, vs. 7.6% for the average of the other three quartiles.

Foundational to delivering strong and steady earnings growth is the ability to drive top-line growth through consistent and focused capital spending.

Capital spending is a threshold requirement – investing in favorable trends is key

Active and focused capital deployment is a threshold requirement for leading performance in the utility sector. Having sufficient attractive investment opportunities in the core T&D infrastructure, in generation and in supporting evolving customer needs is the starting point, as these investments are essential to driving growth in rate base and earnings.

Year-on-year capex growth between top and bottom performers has been somewhat, but not materially, higher for top-tier performers over the past seven years. Leading performers generated 6% capex growth vs. 5% for the bottom quartile performers. However, most top performers augmented their growth by establishing meaningful growth platforms well aligned to favorable trends in the sector, sometimes quasi-regulated or non-regulated more competitive areas. Examples of such platforms include investments in renewables, competitive transmission, EV charging, as well as emerging technologies such as hydrogen and long-duration energy storage. Focused and targeted investments in such platforms help to drive earnings growth but typically require taking some measured risk.

The key challenge for utility executives is, therefore, to drive productive capital spending in the core regulated business without causing significant rate pressure, while investing behind selected platforms that can serve as sizable and sustainable growth drivers.

ESG is not just a buzzword

Another key characteristic of top performers is their superior ESG performance. Nine out of the twelve companies in the top TSR quartile have average or above ESG ratings vs. only four out of 12 in the bottom quartile. While social and governance issues are part of the ESG equation, environmental issues comprise more than 50% of the weighting for utility companies. The utility sector is evaluated on metrics such as carbon intensity, water intensity, environmental contaminations and their efforts to manage climate- and environment-related risks. It is not just about having ambitious ESG targets but delivering on specific programs and initiatives to drive sustainability.

Portfolio mix is key – electric-centric utilities have an edge

Most of the top-tier performers over the past seven years were combined electric and gas utilities typically with a significantly larger share of the assets and earnings in electric. Gas-only utilities were the weakest performers making up the majority of the fourth quartile while electric-only tended to be positioned in the second and third quartiles.

The weaker performance of gas utilities reflects in part the lack of meaningful demand growth, the relatively limited scope for capital investment when compared to electric and broader concerns over the longer-term role and value of natural gas in a decarbonized energy system. This is evidenced by the ongoing announcements by utilities of their plans to exit from their natural gas businesses.

Regulatory environment is not a deterministic factor

Lastly, and not surprisingly for the regulated utility sector, many of the top performers operate in jurisdictions with more favorable regulatory and policy environments. However, the regulatory environment is not a deterministic factor in TSR performance. Several companies in the top TSR quartile operate in states with "less favorable" regulatory environments.

If we measure the attractiveness of the regulatory environment on a 9-point scale, the average attractiveness of jurisdictions where companies in the 1st TSR quartile operate is somewhat better than those in the fourth quartile (4.1 vs. 4.7). Regulatory environment alone is not, therefore, sufficient to support leading performance. What is more important is how well utilities navigate within their jurisdictional regulatory construct, regardless of the "attractiveness" of the regulatory and policy environment.

What are the strategic implications?

Aligning strategy to be consistent with the characteristics of leading performers is the central challenge and opportunity for utility management. The extent and substance of the challenge are unique to individual utilities, as each has a very different starting point in terms of portfolio, regulatory environment, positioning vs. key trends and decarbonization pathways. No single characteristic is sufficient to drive leadership, and no lack of a single characteristic (*e.g.*, being a smaller-scale utility) is sufficient to drive below-par performance.

Management will have to make some difficult choices about where and how to focus their capital and resources along several dimensions, including whether to participate in more competitive businesses, whether and how much to invest in emerging technologies such as hydrogen and renewable natural gas (RNG) and the degree to which to invest behind the delivery of solutions to meet customers' changing needs. These choices also rest on each company's willingness and ability to take on risk. While it is certain that making these choices will be difficult at times, maintaining a clear focus on the requirements for success offers an opportunity to drive substantial shareholder value while supporting the achievement of broader stakeholder goals.
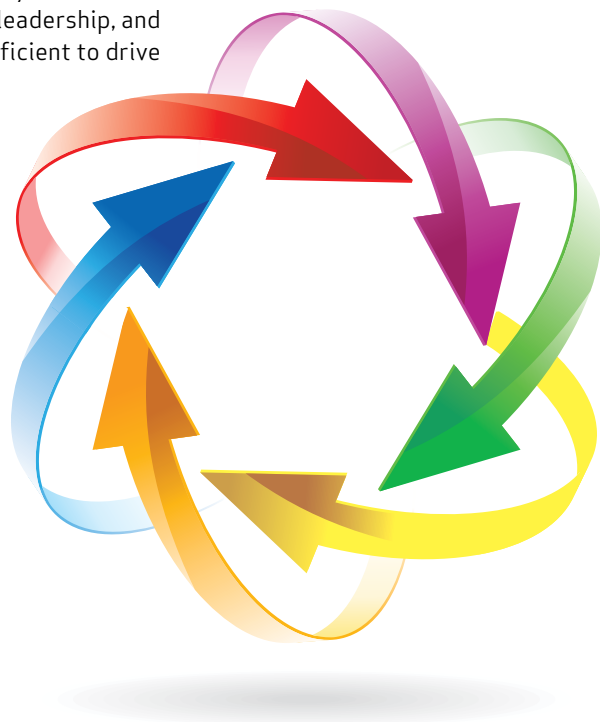
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HOW AI, EDGE COMPUTING, IOT AND THE CLOUD

ARE DRASTICALLY RESHAPING ELECTRIC ENERGY FLEET VEHICLE MANAGEMENT

SUMIT CHAUHAN

As electric energy companies look to modernize their vehicles, the benefits of connected vehicles could make these technologies the new standard for fleet management. In fact, 86% of connected fleet operators already surveyed have reported a solid return on their investment in connected fleet technology within one year through reduced operational costs[1].

Furthermore, connected fleets with advanced telematics technology today offer additional benefits in terms of managing and maintaining vehicles. Another study[2] illustrated a 13% reduction in fuel costs for surveyed businesses, along with improvements to preventive maintenance. It also showed a 40% reduction in harsh braking, showing modifications to driving habits that could both contribute to parts' longevity and improve driver safety.

Large amounts of data are difficult to process

This means electric energy vehicle fleets, their insurance providers, maintenance and aftermarket companies are all looking to harness more of this intelligent telematics data. However, the amount of data produced every day keeps growing. As a result, these businesses have more data than ever at their disposal to help make informed business decisions. But, this vast amount of data brings in plenty of new challenges in capturing, digesting and analyzing the entirety of the data cost-effectively.

To truly be effective and useful, data must be tracked, managed, cleansed, secured and enriched throughout its journey to generate the right insights. Companies with electric energy fleets are turning to new processing capabilities to manage and make sense of this data. →

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[1] https://www.globenewswire.com/news-release/2021/12/07/2347114/0/en/Survey-Highlights-Powerful-Results-Obtained-By-Using-Fleet-Technology.html

[2] https://www.greencarcongress.com/2022/08/20220822-motive.html

Embedded systems technology has been the norm

Traditional telematics systems have relied upon embedded systems, which are devices designed to access, collect, analyze (in-vehicle) and control data in electronic equipment, to solve a set of problems. These embedded systems have been widely used, especially in household appliances and today the technology is growing in the use of analyzing vehicle data.

Why current solutions are not very efficient

The existing solution in the market is to use the low latency of 5G. Using AI and GPU acceleration on AWS Wavelength or Azure Edge Zone, vehicle OEMs can offload onboard vehicle processors to the cloud when feasible. This approach allows traffic between 5G devices and content or application servers hosted in Wavelength zones to bypass the internet, resulting in reduced variability and content loss.

To ensure optimum accuracy and richness of datasets, and to maximize usability, sensors embedded within the vehicles are used to collect the data and transmit it wirelessly, between vehicles and a central cloud authority, in near real-time. Depending on the use cases that are increasingly becoming real-time oriented such as roadside assistance, ADAS and active driver score and vehicle score reporting, the need for lower latency and high throughput have become much larger in focus for fleets, insurers and other companies leveraging the data.

However, while 5G solves this to a large extent, the cost incurred for the volume of this data being collected and transmitted to the cloud remains cost prohibitive. This makes it imperative to identify advanced embedded compute capability inside the car for edge processing to happen as efficiently as possible.

The rise of vehicle-to-cloud communication

To increase bandwidth efficiency and mitigate latency issues, it's better to conduct critical data processing at the edge within the vehicle and only share event-related information to the cloud. In-vehicle edge computing has become critical to ensure that connected vehicles can function at scale, due to the applications and data being closer to the source, providing a quicker turnaround and drastically improving the system's performance.

Technological advancements have made it possible for automotive embedded systems to communicate with sensors, within the vehicle as well as the cloud server, effectively and efficiently. Leveraging a distributed computing environment that optimizes data exchange as well as data storage, automotive IoT improves response times and saves bandwidth for a swift data experience. Integrating this architecture with a cloud-based

platform further helps to create a robust, end-to-end communications system for cost-effective business decisions and efficient operations. Collectively, the edge cloud and embedded intelligence duo connect the edge devices (sensors embedded within the vehicle) to the IT infrastructure to make way for a new range of user-centric applications based on real-world environments.

This has a wide range of applications across verticals where resulting insights can be consumed and monetized by the OEMs. The most obvious use case is for aftermarket and vehicle maintenance where effective algorithms can analyze the health of the vehicle in near real-time to suggest remedies for impending vehicle failures across vehicle assets like engine, oil, battery, tires and so on. Fleets leveraging this data can have maintenance teams ready to perform service on a vehicle that returns in a far more efficient manner since much of the diagnostic work has been performed in real time.

Additionally, insurance and extended warranties can benefit by providing active driver behavior analysis so that training modules can be drawn up specifically to meet individual driver needs based on actual driving behavior history and analysis. For fleets, the active monitoring of both the vehicle and driver scores can enable reduced TCO (total cost of ownership) for fleet operators to reduce losses owing to pilferage, theft and negligence while again providing active training to the drivers.

Strong benefits in improving safety

One of the primary benefits of AI in connected cars is its ability to improve safety. By analyzing data from various sources, including traffic patterns, weather conditions and the behavior of other drivers, AI can help drivers make better decisions on the road, reducing the risk of accidents. AI can also be used to monitor drivers' behavior and alert them to potential risks, such as drowsiness or distracted driving. Unexpected things happening inside today's vehicles can lead to accidents. Drivers can see something disturbing – a car accident, or an animal injured by a car – or do something distracting, such as spilling coffee or dropping a mobile phone. Emotion and

activity detection can detect when this happens and take safety-related actions, such as going into autonomous mode briefly and slowing down until the driver can recover. If an emergency arises, even with an unconscious or incapacitated driver, cars should be able to call 911 or even drive them autonomously to the hospital. Driver inattention is critical since the vast majority of car accidents are due to human error. Understanding the driver's cognitive state is crucial.

AI can also be used to improve health and well-being in connected vehicles. For example, AI-powered systems can monitor drivers' vital signs, such as heart rate and blood pressure, and alert them to potential health issues. AI can also be used to provide drivers with personalized recommendations for exercise and nutrition, helping them maintain a healthy lifestyle while on the road.

Overall improvements for health purposes
Another area where AI is having an impact on health, safety and well-being in connected cars is in the area of accessibility. AI-powered systems can be used to assist drivers with disabilities, providing them with information on accessible routes and parking spaces, as well as providing them with assistance in operating the vehicle.

Overall, the use of AI and data in connected cars is transforming the driving experience, improving safety and promoting health and well-being on the road. As AI technology continues to evolve, it is likely that we will see even more innovation in this space, making the connected car a safer and more enjoyable place to be.

Powering the future of fleet management
AI-powered analytics leveraging IoT, edge computing and the cloud are rapidly changing how fleet management is performed, making it more efficient and effective than ever. The ability of AI to analyze large amounts of information from telematics devices provides managers with valuable information to improve fleet efficiency, reduce costs and optimize productivity. From real-time analytics to driver safety management, AI is already changing the way fleets are managed.

The more datasets AI collects with OEM processing via the cloud, the better predictions it can make. This means safer, more intuitive automated vehicles in the future with more accurate routes and better real-time vehicle diagnostics.

ABOUT THE AUTHOR:

Sumit Chauhan is co-founder and chief operating officer of Cerebrum X and has more than 24 years of experience in automotive, IoT, telecoms and healthcare. Chauhan has always played the leadership role that allowed him to manage a P&L of close to US $ 0.5B across various organizations, such as Aricent, Nokia and Harman, enriching their domestic as well as international business verticals. As co-founder of CerebrumX, he has applied his experience in the connected vehicle data domain to deliver the automotive industry with an AI-powered augmented deep learning platform (ADLP). Chuhan is also passionate about mentoring and guiding the next generation of entrepreneurs.

CONNECTING MOBILE DEVICE VESSELS TO SHORESIDE ELECTRICITY

An innovative, cost-effective Mobile CPD is facilitating shore power connections.

MIKE WATTS

One of the keys to reaching the cruise line industry's target of net-zero carbon cruising globally by 2050 is switching from diesel-burning engines to shoreside electricity while in port. Although the technology can significantly reduce emissions to address climate change and improve air quality, one impediment to adoption has been the challenge of efficiently connecting ships of various sizes and shapes to shore power with cabling and equipment on piers.

While fixed systems exist for vessels to connect to shoreside electricity in port, the options are complex, expensive and occupy valuable pier real estate. Repositioning a fixed system to accommodate vessels of different sizes and configurations can take several days.

Now innovative, cost-effective mobile cable positioning devices (CPD) are facilitating shore power connections by moving the cabling strategically to the ideal location. The first such device has already been delivered for use at the Port of San Diego, California.

A mobile CPD is a mobile manlift on a turret that rotates 360 degrees retrofitted from a Genie lift into an electrified cable positioning device. The new mobile design simplifies moving the system to accommodate docked vessels of all sizes and configurations. The mobile cable positioning devices can be used with any shoreside electric power system. →

A mobile device can be strategically positioned where the ship is docked and can then be moved to support another ship, say, 60 feet away. With a fixed system that is not possible, and it can take days to move it if that is required.

These mobile units are designed to allow the operator to strategically position the mobile CPD, then plug it into shore power cables on the back side, while extending the cables from the end of the boom. The vessel's crew can then reach out, pull the power cables in and plug them into their connection box.

A hydraulic power unit (HPU) is used to power a battery instead of a diesel engine, which is more eco-friendly. The lift, boom and winch movements are all powered by electricity – just like the ships in port while shore power is connected.

The development of mobile CPD units could be what the marine industry needs today to ramp up its efforts to decarbonize operations with the ability to connect more ships each year. These systems are game changers for ports and will facilitate the connection to shoreside electrical power for a variety of ships.

Once the connection has been made using a mobile CPD or a fixed system, the shore-side operator then selects the ship to be connected from the database in an automation system, which determines the proper operating parameters. Protection relays and redundant safety systems ensure the safety of the ship and shore electrical systems.
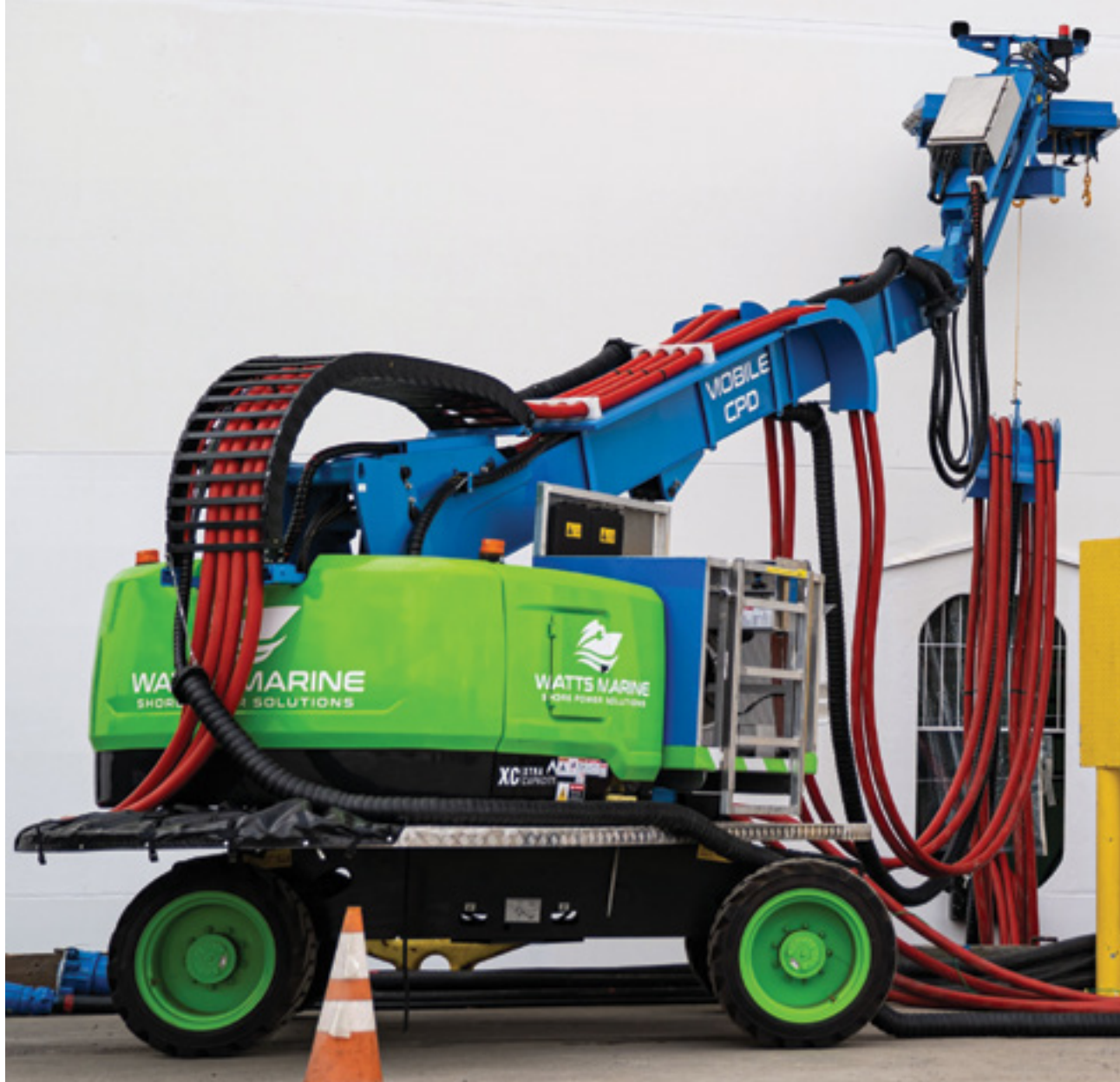
The Mobile CPD is a mobile manlift on a turret that rotates 360 degrees that we retrofitted from a Genie lift into an electrified cable positioning device.

Custom software allows specialists in a dedicated control center to oversee every connection. All the ship's systems then run on shore electricity instead of its diesel engines, virtually eliminating fuel emissions while in port.

While meeting the industry's decarbonization initiatives can seem daunting, the availability of mobile cable positioning devices can cost-effectively facilitate the use of shoreside electricity for a wide range of ships in port. This combination is an important step in achieving the organization's goals and addressing climate change for ports and the marine industry.

ABOUT THE AUTHOR:

Mike Watts is the president of Seattle-based, Watts Marine, delivering the company's patented shore power solutions to the maritime industry worldwide since 2005 to eliminate millions of tons of air pollutants each year.

TRUE COMPETITION FOR EV ADOPTION IS POWER COMPANIES, NOT GAS STATIONS
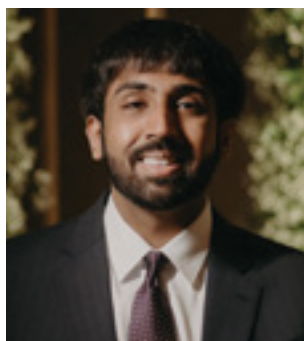
AATISH PATEL

From 2011 to 2021, the number of electric vehicles (EVs) registered rose from 20K to over two million, and entering 2023, more than 130,000 EV charging stations are currently being utilized. Notably, according to Edison Electric Institute, EV driving is predicted to continue growing year-over-year, with upwards of 18 million to 26 million EV drivers expected by 2030. In tandem, the Biden administration established a 500,000+ new public charger goal by 2030 to support the predicted rise in EV drivers. However, domestic EV adoption is sluggish compared to other international markets, primarily due to limited charging accessibility for drivers.

Without the proper electrical grid and infrastructure innovations to meet the rising demand for accessible charging, growth will stagnate. The lack of charging accessibility, in turn, increases the reluctance of drivers to adopt electric vehicles. Increasing charging station accessibility, particularly installing chargers in consumer-friendly locations, will accelerate consumer adoption and reduce the need for further government-established initiatives to meet the determined U.S. sustainability benchmarks and goals. However, introducing new charging isn't a quick fix to increasing EV technology usage, as solutions depend on the power available, especially in environments – like rural regions – with limited grid accessibility. →

Hurdles to adoption and electrical transportation implementation

EV charging limitations exist because the North American electrical grid is outdated, especially compared to the European and Asian infrastructure, and is a key restrictor to installing new chargers. The U.S. electrical grid needs grid innovation and superior infrastructure to make deployments possible.

This isn't the first time, nor will it be the last, that the U.S. utility industry had to rise to the impending challenge of the increased potential of electrical grid strain and usage. For instance, in the 1960s and 70s, air conditioning wasn't a common household amenity but a luxury. As we've progressed, air conditioning is now considered commonplace, but the electricity industry had to innovate to meet the sharp rise in demand. Successful adoption relied on deliberate thought into how and where the electricity could be distributed effectively and efficiently to support improved accessibility.

The same electricity challenges and concerns of the 60s and 70s are currently being identified for EV drivers and charging adoption – how will our electrical grid handle the new pressure? Effective and efficient storage and distribution of generated electricity will be essential, but so will unifying all dispersed and usable generating nodes. Ensuring that EV technology is uniform and specifically built to maximize U.S. electrical grid energy transfer efficiency is necessary to increase accessibility and certify no consequential demand from expanded grid use. Furthermore, superior EV solutions can save and restore energy back into the grid, as necessary, to intelligently improve grid resiliency.

A bigger hurdle to relying primarily on EV transportation is charging access, specifically fast chargers which are defined as providing more than 22kW of voltage and serving power ratings up to 350kW. These chargers significantly reduce the idle charge time for drivers to approximately 35-45 mins, compared to the 90+ mins from Level-2 chargers. As of 2021, the US has approximately 22K fast chargers publicly available, but that's less than half of Europe's (approx. 49K chargers) and one-tenth of China's (470K).

Updating charging perception

EV charging station availability is vastly narrower compared to gas stations, as EV drivers are forced to be more conscious and intentional when seeking to charge, or "fill up" their vehicles. Currently, most EV drivers rely on a home charging station for most of their charging needs. But these equipment stations are costly to implement and practically impossible for drivers that live in an apartment complex. Some homes are beginning to offer "charger-ready" homes – but this introduction isn't a feasible or realistic way to increase charging for everyone across all economic backgrounds.

EV charging could be much more accessible with proper investment, as charging stations don't need to be limited to specialized areas. Theoretically, charging can be done anywhere. But this concept relies on the EV industry overcoming the pre-established electrical grid determined by the power industry, which will require intensive updates to North America's current electrical grid to make charging availability not limited to just 'stations.'

A key obstacle to making charging locations more widely available is the lack of standardization and interoperability within the nation's EV charging industry. Most EV automakers are designing and implementing their own solutions since there are no governmental standardization requirements for solutions, as noted by Tesla's business model. Additionally, even the cost of charging isn't uniform, with some providers charging based on time while others charge based on kilowatt hours (KwH).

> **Theoretically, charging can be done anywhere.**

Through the creation of EV charging standards, designing and upgrading domestic EV infrastructure can be much more efficient and effective, resulting in fewer rip-and-replace stations. Introducing regulations will establish unified networks that are easier for local businesses and companies to invest in as an additional revenue-generating opportunity. This can only be made possible through collaboration amongst EV technology manufacturers, automakers, policy regulators and the power utility industry, resulting in a more favorable EV ecosystem and cost-effective marketplace. →

Municipal and consumer benefits of increasing EV technology

Unsurprisingly, a leading contributor to U.S. carbon emissions is transportation; with one-third of America's greenhouse gas emissions coming from cars, buses, flights, etc. Electrifying public transportation is a key accelerator for a more sustainable future, particularly for metro metropolitan areas. Right now, the primary location for EV charging is in homes with workplace environments growing. Successful EV transportation adoption requires public charging to be widely available in consumer-friendly locations, such as fast-food locations, coffee shops and malls.

Introducing chargers in these locations creates a mutually beneficial scenario, where drivers can charge in locations they naturally gravitate towards while these local locations generate a new source of income. While initial installation can be slightly higher compared to alternative chargers, deploying an intelligent DC fast charger presents the best ROI for businesses, in addition to consumer benefit. These chargers will not only enhance the overall municipal experience but increase local property value for businesses that have charging available.

Furthermore, a well-considered EV infrastructure is a key component of a functioning smart city, as this technology has a vital role in ensuring sustainability in both rural and metro regions. To track location demand, establishing an EV-per-charger ratio will identify the gaps in a city's infrastructure to better understand where development will be most impactful. Additionally, an upgraded electrical grid that supports intelligent EV solutions supports superior grid stability, as these solutions can serve as power reserves, as needed.

Companies are pledging to support EV transportation development to help meet domestic greenhouse and carbon emission reduction goals. For instance, General Motors aims to only sell zero-emission vehicles by 2035, while other automakers – including Telsa, Ford and Volkswagen – announced dozens of new EV solutions to be released in the upcoming years. In parallel, Walmart and 7-Eleven recently announced investment in EV charging stations at their facilities, but charging accessibility won't be effective or successful without proper network grid infrastructure and intelligent EV station investment.

For gas-powered vehicles, drivers have ample dedicated areas to refuel their vehicles, which most drivers take advantage of daily. While filling a battery currently takes longer than filling a tank, there's an opportunity to create advantages of idle time, like running needed errands or grabbing a snack. If consumers are already stopping to grab groceries or lunch, head to the gym, or even run errands at the mall, why not take advantage of the time by having their EV idle charge?

EV adoption's biggest competition isn't gas stations, rather it's the power companies' ability to upgrade their transmission networks. To ensure sustainability for the current and growing demand for EV transportation is developing a proper charging infrastructure that's affordable and easily available in public locations.

ABOUT THE AUTHOR:

Aatish Patel is the president and co-founder of XCharge North America. Before Patel became a founding member of XCharge North America, he was an XCharge customer. He previously worked in hospitality, where he installed an EV charging station at one of the hotels he oversaw. Patel united with XCharge and utilized his engineering and product development expertise to redesign their EV chargers in accordance with the North American grid infrastructure. Before leading XCharge North America, Patel received a B.S. in mechanical engineering from New York University and an M.A. in management from Harvard.

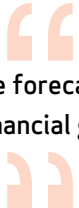# ARTIFICIAL INTELLIGENCE APPLICATIONS IN THE POWER AND UTILITIES SECTOR

JOHN VILLALI

The electric energy industry, like many, is on a learning curve when it comes to applying artificial intelligence (AI) to their businesses. That said, extensive research, pilot programs and commercially operational use cases for AI applications are on the rise in the power and utility sector. As the adoption of AI within the sector increases, it is anticipated that power and utility companies will leverage it and see improvements in overall asset, employee and financial performance.

In recent years, the utility industry has seen an uptick in AI adoption and use cases. However, many are still evaluating AI and trying to fully comprehend the technology's capabilities and decide which areas within their organizations are best suited to deploy AI technology and models. Whether applied in operations, at the enterprise level or in the back-office, power and utility companies using AI applications are beginning to realize positive results. With a foundational AI strategy in place, organizations in the sector are expected to produce positive business, operational and financial outcomes. →

> **Increasing the accuracy of electric demand and price forecasting provides power and utility companies with the potential to experience sizeable financial gains through the use of AI models.**

The following are key areas within the power and utility sector that are implementing AI with expectations for a return on investment.

Asset performance

A solid use case for AI in the power and utility sector is in the critical area of asset performance. Assets and their operational performance are the backbones of the electric power industry sector. AI models are being deployed to increase the operational and financial performance of their asset portfolios. Whether in generation, transmission or distribution, the assets in core areas of the power and utility sector's value chain can improve asset availability, optimization and life cycles when leveraging AI.

For example, in its 2023 Worldwide Utility MarketScape, one global provider of market intelligence and advisory services predicts that by the end of 2023, 60% of competitive power generators and traders will have AI-powered forecasting capabilities in production to help improve day ahead demand and wholesale price forecasting accuracy by more than 15%. Increasing the accuracy of electric demand and price forecasting provides power and utility companies with the potential to experience sizeable financial gains through the use of AI models. Utilities and competitive power producers have been using neural networks for years to better predict demand forecasts. Building, running and continuously training even more sophisticated AI models to increase the accuracy of electric demand forecasting models by analyzing years of historical data – supported by several variables such as time of year, time of day, similar heating and cooling degree days and more – can vastly improve their ability to meet demand obligations in the most economical manner.

Integrated resource planning

Many regulated utilities are required to submit integrated resource planning data to public utility commissions (PUCs) to prepare for the expected demand growth and generation sources that will be needed in future years to reliability serve their customers. AI can be used to create forward-looking model simulations to better predict load growth and energy supply which provides utilities with better forecasts of not only power supply and demand but can accurately forecast capital and operational expenditures as well. Historical and forecasted data on supply and demand fundamentals is essential when producing accurate capital and operational spending forecasts.

For example, many utilities are beginning to build out digital twin models, which are digital replicas of their utility networks and assets. These digital twins that are being deployed are leveraging AI capabilities to better understand both traditional utilities connected in front of the meter and emerging behind-the-meter forecasts of energy resources available in their footprints for years to come. With the expected accelerated growth of distributed energy resources (DERs) such as electric vehicles, rooftop solar and energy storage, it is becoming more difficult for utilities to have a clear and confident view of what capital and operational investments are needed to effectively manage their power grids.

The use of AI in both short- and long-term power market forecasts and scenario simulations will help utilities be ahead of the curve, when it comes to effectively managing the power grid in areas expecting a high penetration of DER assets. A key goal for AI-driven long-term power market simulations is for utilities to grasp a better understanding of customer energy consumption behavior over time and the likelihood of customers investing in a behind-the-meter generation. Without advanced, data-driven AI models that can accurately predict long-term supply and demand fundamentals, utilities could be at risk of having mediocre or subpar long-term power market forecasts which could lead to substantial negative financial consequences.

Meter to cash

There are many sub-segments in utility meter to cash efforts that can leverage AI, whether it is in areas such as debt collection, billing and metering or through customer interaction services. AI, if deployed properly in these areas, can be of major use and provide many benefits to utilities. Having AI models accurately predict customer payment behavior can help utilities address unpaid balances before they become a major issue. AI models designed to detect anomalies in customer payment or energy consumption behavior can ensure that billing and energy usage data are accurate before being shared with customers. Additionally, AI being deployed in customer interaction activities can help improve customer satisfaction and automate customer service functions when AI models can predict and address specific customer complaints or customer preferences in utility-run programs.

There is a wealth of data that can feed AI models from customer information systems (CISs). AI predictive models can be deployed in the meter to cash function within a utility and can provide accurate, actionable insights across finance, customer acquisition and retention, credit collections, while also predicting increased participation in utility programs such as demand side management and solar and electric vehicle offerings. Understanding and accurately forecasting utility customers' interest and participation in clean energy programs will help utilities in reducing CO_2 emissions in their net-zero carbon emission initiatives.

Field services

In the areas of field services utility technicians can also benefit greatly from the use of AI. Predictive and prescriptive maintenance models can ensure utilities address asset issues and failures before they occur. AI models leveraging data from work order history can provide utility technicians with a wealth of insight on prior asset issues, equipment inventory and resolutions which in turn can support quicker and more efficient asset outage restoration times. The use of AI in asset maintenance and field work can reduce operational costs, improve asset downtime, increase technician productivity and also limit utility truck rolls on unnecessary regularly scheduled inspection rounds. →

Fieldwork productivity gains and operational cost savings can be achieved by analyzing and understanding historical data on specific equipment and assets which have had operational, performance issues or mechanical problems in the past. AI models can provide utilities a path to a condition-based maintenance approach to operations as opposed to a traditional reactive or time-scheduled approach to operational maintenance which is less efficient and more expensive in the long run. Arming utility crews with condition-based actionable intelligence derived from AI models built off of historical asset, equipment and maintenance data can lower overall operational costs and also provide utilities with increased safety and productivity in the field which can also lead to longer asset and equipment life cycles.

Advice for power and utility companies investing in AI

- Before investing in AI, thoroughly research utility industry use cases that have proved to be successful and ones that provided positive business, financial and operational outcomes. Having a clear understanding of the outcomes and improvements desired, along with concrete target metrics to be achieved from the use of AI applications, will help secure funding and build support for key stakeholder buy-in.

- To avoid pitfalls when deploying AI, ensure there is access to all of the data needed to build robust AI models and make certain the data has been cleansed. AI models will only be as good as the data that is fed into them. Large volumes of data can be used in AI models, that being said, knowing where the data resides, the governance structure for the data to be used, and a thorough review of the accuracy of the data will be key in achieving positive results when using AI models.

- Be sure to not get stuck in endless pilot programs. When deploying AI models consider working with third-party AI vendors with strong power and utility industry domain expertise that can fill in skill gaps and assist your organization's employees in building out AI tools. Create a definitive end date for pilot programs to get AI models to operate and provide results as soon as possible, in a live production environment. Taking the leap from pilot programs, to having AI tools in commercial production, will be a critical step in paving the way to reaping long-term benefits when putting a solid AI foundation and strategy in place.

AI applications in the power and utility sector are expected to grow and as use cases start to produce tangible results and demonstrate high returns on investment. AI technology and applications are not expected to replace human functions immediately in the power and utility sector. However, AI will certainly increase efficiencies and automation in many functions throughout power and utility organizations. AI applications, when implemented correctly, can provide the power and utilities sector with a wide range of benefits including increased efficiencies, productivity gains and ultimately better financial performance, which can impact power and utility companies' bottom lines.

ABOUT THE AUTHOR:

John Villali is a research director for IDC Energy Insights, primarily responsible for thought leadership in the area of utility digital transformation and smart operations in the energy and utility sector. Villali's research helps utility and energy IT and business management understand the disruptions that are transforming the energy and utility value chains and develop strategies and programs to capitalize on the evolving opportunities.

SECURING CRITICAL INFRASTRUCTURE
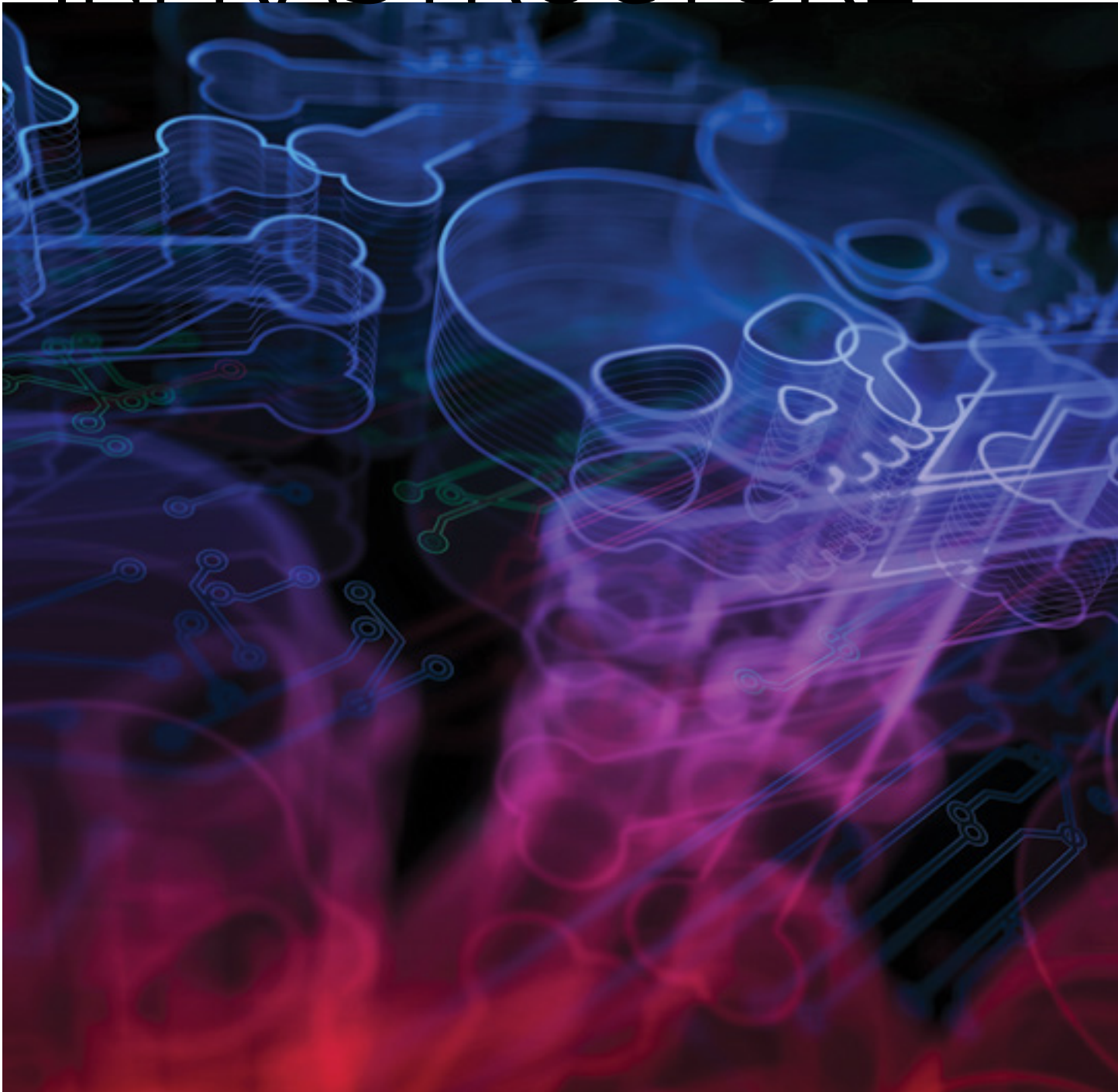
ROBERT NAWY

In today's highly interconnected world, the electric grid is rapidly evolving to accommodate the growing demand for cleaner and more sustainable energy sources. As demand increases, arguably the most critical component of modern infrastructure – our electric grid is becoming a top target of cyberattacks. Addressing key vulnerabilities and potential threats is paramount to ensure a secure and reliable energy supply.

We come into contact with multiple devices and multiple electrical networks every day. What many do not realize is the devices we spend so much time interacting with provide hackers windows to slip in and access critical personal data. According to DataProt, nearly 60% of Americans say they have experienced cybercrime or somehow fell victim to a hacker. As we become more connected and reliant on technology, those numbers are sure to rise as bad actors seek to take advantage of vulnerabilities. →

Cyberattacks impact everyone, from citizens to organizations. If you use the internet, you're at risk. Businesses make very inviting targets, more so than they may know. They can suffer from large-scale attacks as cybercriminals target them for their assets along with sensitive information.

Some of these at-risk industries are woefully behind where they need to be in terms of cybersecurity infrastructure. For example, the supply chain and transportation industries are already struggling due to limited resources as a result of the pandemic.

Reports also indicate that 70% of small businesses are unprepared for a cyberattack, and almost 90% of professional hackers can penetrate a company within 12 hours. It is no surprise that the Federal Bureau of Investigation has officially ranked cybercrime as one of its agency's most important interests.

Ensuring the security of critical infrastructure is vital to maintaining user safety, protecting data and ensuring the reliability of the electric grids. When it comes to cybersecurity awareness, the same principle of closing and locking a door applies to your employees' online activity. Not taking the proper precautions could result in stolen and potentially sold information. To avoid this, it is critical to institute "cyber hygiene" best practices such as turning on 2-factor or multi-factor authentication, using strong passwords that are unique for each account and utilizing a password protection vault to contain online credentials.

Should you or your organization be the victim of the cyberattack – a key thing to remember is to preserve evidence for law enforcement. The first instinct may be for victims to delete everything after a data breach occurs, but preserving evidence for law enforcement is vital to determining the perpetrator and how they gained access. Verify which servers experienced the breach and contain them quickly to keep others protected.

The sudden surge in electricity demand puts added strain on the grid infrastructure, increasing the possibility of power outages or brownouts. In these high-pressure situations, the focus on maintaining grid stability could inadvertently lead to a reduced emphasis on cybersecurity measures, creating the perfect conditions for cybercriminals to exploit vulnerabilities and gain control. Even as charger installation ramps up to level the energy demand, it is critical to acknowledge that the expansion - as needed as it is - increases the number of entry points for malicious entities.

Identifying cybersecurity blind spots

Implementing proper cybersecurity measures is a high-stakes task for any organization, and it is only that much more critical for professionals in the energy sector. With the rapid evolution of modern smart grids, knowing where to begin may become challenging. The need for increased cybersecurity intel and training in the critical infrastructure sector is fundamental to aligning with comprehensive cybersecurity programs and protocols.

In collaboration with cybersecurity experts that know exactly what threats require actionable solutions to safeguard operational technology, stakeholders can rest assured that all potential security weaknesses are addressed. Regularly assessing blind spots through security audits and penetration testing helps in the development of threat response. Collaboration between EV charging station operators, utility companies, manufacturers and cybersecurity experts is critical to facilitating industry-wide security standards and sharing threat intelligence. By working together, stakeholders can better understand emerging risks, develop best practices and ensure that the entire EV ecosystem remains secure.

Proper cybersecurity measures play a major role in halting threats before disaster strikes. However, energy infrastructure professionals must always be prepared for incidents. Having a well-defined incident response plan that includes clear roles and responsibilities for the response team can help minimize the impact of an attack and ensure timely recovery.

### Safeguarding energy infrastructure

Your home's locked front door provides a physical safeguard for your valuables and yourself. In the context of a connected grid, locking digital doors must be a priority. In partnering with a cloud-based managed security service designed specifically for organizations, those locks are monitored at all times and provide managers with comprehensive remediation guidance. Advanced technology locates vulnerabilities, deciphers the threat and provides real-time alerts if a security breach is imminent. Additionally, managers gain invaluable access to thorough assessments of control systems, servers, smartphones, laptops and any other vulnerable device connected to a network.

As we increasingly rely on interconnected digital technology, vigilant cybersecurity measures must become second nature – just as engrained as locking a door or putting on a seatbelt. It cannot be thought of as optional, especially in the context of safeguarding the assets of others. Cyber safety is now a mission-critical function to ensure information is protected. Cybercriminals act fast when given the opportunity to exploit network weaknesses, and they will capitalize on any chink in the digital armor, no matter how small. To prevent this, the implementation of an end-to-end solution can protect the entire organization while also having a keen eye on any vulnerabilities within all applications and operating systems.

ABOUT THE AUTHOR:

Robert Nawy is CEO of IPKeys Cyber Partners for a range of dynamic OT/IT environments. He has served in these roles since the inception of the company in 2005 and oversees the development and delivery of Municipal and Smart Grid products and services. He currently serves on the boards of directors of the Open Automated Demand Response (OpenADR) Alliance and the Advanced Energy Management Alliance (AEMA). Nawy also served as CFO & VP Business Development of Exenet and as CFO of Maden Technologies, a DoD focused high technology services provider.

MARY BROWN
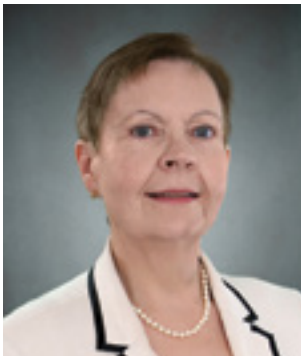
BY ELISABETH MONAGHAN

For this issue, EET&D is pleased to profile Mary Brown, senior executive vice president and chief legal officer for OATI.

EET&D: Describe your role and how you came to work in the industry.

MB: As the senior executive vice president and chief legal officer, I oversee the Enterprise Services of OATI, which includes administrative support, proposals, finance, compliance, communications and human resources. If you think of OATI as a table, I consider my divisions as the legs – we support the areas of the company that support customers – the things our customers see and experience. Underneath, though, there needs to be a very solid foundation so those teams can do their work. It's important to me that we're a strong base for the organization – like sturdy legs for a table.

I began working in this industry in 1995. when I started with the company. I helped early on when the organization was just getting off the ground, and I did all kinds of things, including procuring office furniture. Eventually, they needed a receptionist. Then, there was recruiting, payroll and onboarding. My role grew and changed as the company did. As I learned more about the energy industry, I understood why the mission was so important.

One of the things I brought to the company early on is that I'm not an engineer. I'm not a computer scientist. Obviously, those skills were fundamental to our business, but we also needed people who could see things differently and manage the other parts of the business.

EET&D: What was one of your greatest challenges early in your career?

MB: I had two big challenges. The first was trying to balance the demands of working while raising a family. When the business started, I had three young children. This was a growing business – it was difficult. My kids needed time and attention, as did OATI. I had to keep several balls in the air all at once. While there has been some progress, nearly 30 later, women are, unfortunately, still having to navigate this.

The other challenge was positioning the company for success. About three years in, we knew we were going to be successful. Most businesses fail, so once we understood the organization was going to be successful, we had to prepare for growth at a rate that most companies never experience. Our growth rate was very high. It was a challenge to know exactly how to grow efficiently and effectively, always keeping in mind our customers.

At the root of assessing whether or not we were going to be successful was the fact that OATI was doing things in new ways that had never been done before. We were doing cloud hosting before anyone knew what the cloud was. We challenged the status quo in terms

of infrastructure, responsiveness and customer service. Many of our services were so novel and so ahead of the industry that it took those three years for people to even understand what we were doing and that it was needed.

EET&D: What do you consider to be the most significant industry trends?

MB: More than any time in the past 30 years, and certainly even since electricity was understood, I think people are just beginning to appreciate how important electricity is in our lives.

We've all been turning light switches on, and nobody thinks about it. We just assume electricity will be there when we need and want it. But so much of our lives depend on electricity now, in ways they never have before. Imagine how we'd get through our days without power. We wouldn't last long.

Now, there's an even greater demand on the horizon – the electrification of transportation. Soon, for many of us, the car we get around in will also demand electric energy. People really don't understand what that's going to require of the grid and the generation of power. There is a huge gap in understanding how much more electricity we're all going to need and where that energy is going to come from.

Awareness is increasing in part because of recent natural events. For example, the big freeze down in Texas a couple of years ago, when people did not have electricity for days. Or, in California, with all of the recent wildfires. People notice when they don't have power. Without massive change, we're going to see more events like those affecting more people. I think people are beginning to understand it. I think that natural catastrophes and the momentum of EVs have changed people's perspectives dramatically. It's going to require a shift in public perception to truly move the needle. I think we're getting there.

EET&D: What are you currently working on that interests or excites you?

MB: Today, I'm interested in how to solve resource problems. These problems are probably some of the largest issues that restrict any industry from really moving forward with innovation. The United States is no longer a leader in producing power systems engineers. It's very hard to find power system engineers. It's even harder to find people with PH.D.'s in power systems engineering. The problems faced by utilities and the problems on the grid are very, very difficult to understand. You need people with advanced education to help solve the problems. And you also need people who are passionate about energy to become engaged in the business of energy.

EET&D: What technology has had the greatest impact on the electric grid?

MB: I would say electric vehicles and the impact of having to charge them. Utilities and organizations are beginning to understand how they can use the batteries in cars to help solve problems on the grid – V2G. So, I think those technologies are really important.

Security at the distribution level involving distributed energy resources also needs to be addressed. At the wholesale level, things are very, very secure. We have a lot of requirements that everyone understands and abides by. But, when you get down to the distributed resource level, we have different states, each with different requirements because, within the state, it's the public utilities group that sets the standards. So, if you have all 50 states saying something different, you have potentially a nightmare.

At some point, we need a set of commonalities. Each state could have particular nuances, but we all have to agree that there is a minimum condition of what cyber security looks like across the board. It doesn't matter where you are or who you are; this is what we have to do – which is to protect the integrity of the nation.

EET&D: Do you see the industry becoming more or less accepting of women in leadership positions?

MB: I think that the opportunity for women in the industry has never been better. Anecdotally, I see this every year at our annual energy conference, and it used to be predominantly male, like 90%. Today, our energy conference is 50% male and female. I anticipate that soon it's going to increase to 60% female, and then, 75% female.

And the industry has become much more open to women in leadership positions. One only has to look at where women are at the top of the industry - like Caroline Winn, head of San Diego Gas & Electric, which is a critically important utility. Another example is Southwest Power Pool, a large energy market, which is led by Barbara Sugg. There are many more examples as well. These are knowledgeable, highly experienced women, who have been in the industry for they're powerful and they make very sound decisions.

There has never been a more interesting or important time to pay attention to energy. Electricity has powered our lives for the past century, and will even power more of our lives as we move forward. The choices we make about how that electricity is going to be generated will impact how we as individuals, how you and I, are impacted in our daily lives.

ABOUT MARY BROWN:

Mary Brown is the senior executive vice president and chief legal officer for OATI. She has been with the company since 1995 and has nearly 30 years of experience in the North American energy industry. She currently directs OATI Enterprise Support Services that span various departments, including Compliance, Finance, Legal, Communications and Administrative Services. Before her work at OATI, Brown held the position of associate professor of business law for the Minnesota State University System. She holds an LL.M. from William Mitchell College of Law and a J.D. from the University of Missouri-Columbia.

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The RTDS® Simulator is the world standard for real-time digital simulation, used worldwide for the closed-loop testing of protection and control systems. It allows power system professionals to de-risk the integration of novel systems, anticipate and mitigate negative interactions, and optimize performance by connecting real devices to a simulated network.

Manufacturers use the Simulator to perform Factory System Testing of their HVDC and FACTS projects. Leading utilities use it for pre-commissioning testing, grid integration risk analysis, AC system interaction studies, and more. Closed-loop testing with a real-time simulator prevents project delays and increases safety, reliability, and performance.

In the hands of innovators, the RTDS Simulator is changing the grid as we know it.

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