State of the Grid

3RD QUARTER 2020

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WELCOME TO OUR Q3 2020 NEWSLETTER!

As we approach the end of 2020, MGS would like to extend gratitude to our clients and the entire global energy community.

We are privileged to provide value during this unprecedented time with minimal business disruption and look forward to continuing our work in helping make the modern grid possible.

We sincerely hope that you and those around you remain safe and well as we look toward a more uneventful 2021.

Thank you for reading!
Dr. Mani Vadari, President

AT MODERN GRID SOLUTIONS, SMART GRIDS ARE BUSINESS AS USUAL

Differentiated services to utilities and their vendors focusing on Smart Grid and System Operations. Our team brings deep expertise in all aspects covering technology and management consulting.

IN THIS ISSUE

AVAILABLE PUBLICATIONS

Electric System Operations – Evolving to the Modern Grid, Second Edition
Dr. Vadari's book "Electric System Operations – Evolving to the Modern Grid, Second Edition" is available now. The key chapters covering EMS, OMS, ADMS, and DERMS now include industry case studies to move the discussion from theoretical to evidentiary with real-world, relatable content.

Smart Grid Redefined: Transformation of the Electric Utility 3.0
The book has been released and is now available in all leading bookstores and online. The Chinese edition is out now and available in China.

"Optimal Energy Dispatch of Distributed PVs for the Next Generation of Distribution Management Systems," in IEEE Open Access Journal of Power and Energy, vol. 7, pp. 287-295.

INDUSTRY EVENTS

CALL FOR TECHNICAL PAPERS ABSTRACTS: India Smart Utility Week (ISUW) 2021

Max 250-word abstract to be submitted with application by November 15, 2020. For all the details on ISUW 2021 program, please visit this link.

WEBINAR: How to Future-Proof Your Utility for Whatever Comes Next

November 17, 2020 2:00 PM EDT
In this webinar, we'll discuss how utilities can plan for the future by aligning all channels, knowing what to automate, providing expert advice, and supporting prosumers. Click through for more info and to register.

WEBINAR: Building A Modern Digital, Integrated, Utility of the Future with Madison Gas Electric, and Ernst & Young.

Wednesday, November 4, 2020 12:00 PM EDT
In this webinar, Madison Gas Electric and Ernst & Young give their stories on how improving efficiencies helps boost productivity and reduce costs today; yet, that is only the beginning of the realized value. Click through for more info and to register.

WEBINAR: PV Operations & Financial Strategies 2020 Virtual

Thursday, November 12, 2020 9:30 AM CST
Reuters Events: PV Operations and Financial Strategies 2020 Virtual tackles the key issues and the different ways to manage assets using the best proactive tools available for your portfolio. Click through for more information and to register.

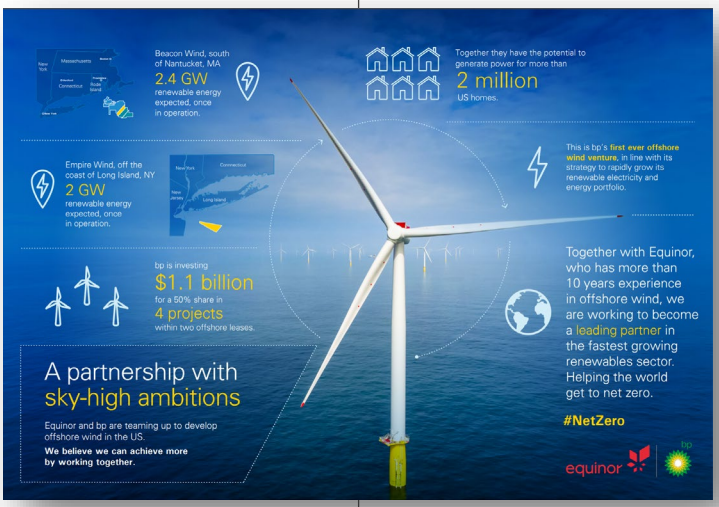
MERGERS AND ACQUISITIONS

Total acquires London's largest electric vehicle charge points network

In a recent press release, Total announced the acquisition of 'Blue Point London' from the Bolloré Group. With this transaction, Total is taking over the management and operation of Source London, the largest electric vehicle charging network citywide, which includes more than 1,600 on-street charge points. Launched in 2010, the current Source London network currently represents more than half of the charge points in operation in the capital city. Source London growth perspectives are supported by the City of London's ambition to be a zero-carbon city by 2050, notably with the aim of increasing tenfold the number of charge points within five years.

bp and Equinor form strategic partnership to develop offshore wind energy

British oil company bp and Equinor announced a new strategic partnership to develop offshore wind projects in the US. Equinor has agreed to sell a 50% stake in two offshore developments to bp for $1.1bn. This includes the development of existing offshore wind leases on the US East coast and jointly pursuing further offshore wind opportunities in the US. ***See related infographic to right.***



bp and Equinor form strategic partnership to develop offshore wind energy

NextEra to acquire GridLiance

NextEra Energy Transmission, LLC, a subsidiary of NextEra Energy, Inc. announced it has entered into definitive agreements with Blackstone's affiliates to acquire GridLiance Holdco, LP and GridLiance GP, LLC (GridLiance) for approximately $660 million, including the assumption of debt. GridLiance owns about 700 miles of high-voltage transmission lines and related equipment spanning three regional transmission organizations and six states.

Microchip acquires Tekron

Microchip Technology Inc. announced the acquisition of Tekron International Limited, a global leader in providing high-precision GPS and atomic clock time-keeping technologies and solutions for the smart grid and other industrial applications. Microchip has established a leading position in the synchronization and timing market for communications, enterprise, government, and military and aerospace applications. Tekron extends this focus to encompass the specific industry requirements for the power utilities and industrial markets. Founded in 2002 in Wellington, New Zealand, Tekron has solved key challenges including providing precision time stamping for advanced substation automation applications; ensuring Network Time Protocol (NTP) reliability and security over computer networks; maintaining continuous time sync operation for transmission and distribution system operators; and implementing IEEE® 1588V2 Precision Time Protocol (PTP) standards to modernize the traditional power grid.

Emerson completes purchase of OSI Inc. for $1.6b

Emerson recently announced it has completed the purchase of Open Systems International, Inc. (OSI Inc.) for $1.6 billion in an all cash transaction. OSI Inc. is a leading operations technology software provider. The acquisition adds to Emerson's existing $1 billion standalone software and associated engineering implementation services portfolio. OSI Inc. is headquartered in Minneapolis, MN and has approximately 1,000 employees globally.

Electriq Power enters definitive agreement with Lilypad Energy

US-based energy storage systems provider Electriq Power has agreed to acquire Lilypad Energy for an undisclosed sum. Lilypad Energy offers data analytics solutions for the energy industry, focusing on battery energy storage applications. Lilypad Energy's software enables system optimization planning before battery systems are installed at commercial and residential sites. Lilypad Energy will enhance the performance capabilities of Electriq Power's fleet of residential and small commercial battery systems that can be paired with or without solar.

VivoPower agrees to acquire 51% of Tembo e-LV

VivoPower International PLC, an international battery technology, electric vehicle, solar and critical power services company announced it has signed a definitive agreement to acquire a 51% shareholding in Tembo e-LV B.V. Tembo is a Netherlands-based specialist battery-electric and off-road vehicle company with global sales and distribution channels across four continents. VivoPower and Tembo have over 700 active customers combined, many of which are in the mining, infrastructure and utilities sectors.The purchase consideration will be USD$4.7 million, and VivoPower will have the option to acquire the remaining 49% of Tembo in the future.

AVEVA agrees to acquire OSIsoft

AVEVA, a British software firm working with oil rigs, ships, and nuclear power station design, has announced the acquisition of OSIsoft, a California-based data company, in a deal expected to increase Aveva's market value to more than £10bn and make it Britain's most valuable software company. The Cambridge-headquartered company was established in the 1960s, making it one of the oldest UK technology companies. In turn, OSIsoft specializes in collecting data from mines, factories, and other industrial sites using an array of sensors connected to the Internet of Things. It is known for catering to hundreds of the world's biggest companies, including most of the top oil and gas firms, providing software to 14,000 sites in 127 countries.

Siemens Energy joins partnership to launch green hydrogen project in China

Siemens Energy and China Power International, a unit of renewables giant State Power Investment Corp (SPIC), have partnered to create a green hydrogen production system on a megawatt scale for a H2 fueling station near Beijing. Yanqing District is due to host the Winter Olympics in 2022 and its green hydrogen production system will split water into H2, using renewable power to help guarantee the hydrogen supply for public transport during and after the event.

KEY HIGHLIGHTS

Powerlink to offer 'system strength as a service' model

Powerlink says it is about to become the first transmission company in Australia to deliver "system strength as a service" to address one of Australia's most significant issues facing transmission networks. Powerlink is set to install its own large synchronous condenser in north Queensland and then sell the "service" to wind and solar farms in the region. The first part of the deal was signed this week with Neoen, which is building the 157MW Kaban wind farm after landing a contract for the bulk of the output with the state-owned CleanCo. Powerlink will install a synchronous condenser large enough to support Neoen's project in Far North Queensland, as well as other new renewable generation projects. Synchronous condensers are large machines that provide system strength for asynchronous generators like solar and wind farms.

California ISO approves energy storage, DER enhancements

Per a press release, the California Independent System Operator (ISO) Board of Governors approved energy storage and distributed energy resource (DER) enhancements making it easier to integrate and operate these resources while maintaining grid reliability. The Board approval of Phase 4 of the Energy Storage and Distributed Energy Resources (ESDER 4) enhancements includes:

- An optional end-of-hour, state-of-charge parameter to give storage resource
- owners real-time management of future resource use commitments;
- Offering demand response resource owners the option of including a daily
- maximum run time constraint, and requiring a minimum of 1 MW
- curtailment to better manage demand response; and
- Streamlined participation by simplifying agreements for non-generator resources.

Battery and hybrid resources are fast-growing components of the resource mix, with more than 1,500 MW scheduled to connect to the grid by the end of 2021. They are an important component of a reliable and clean electricity grid. Excess solar generation in the middle of the day can be stored for use in the evening when solar production declines and the demand for energy increases.

Darwin Labs partners with Clevest for COVID-19 health checks

Clevest announced its partnership with Darwin Labs and the integration of its Clear360 solution with Clevest Mobile Workforce Management. Clear360 is an enterprise health management solution designed to protect utility workers and public members from the spread of viral infection. Clevest selected the technology to help safeguard employees when location monitoring and quick views of worker health are especially crucial. The integration of Clear360 with the Clevest Mobile Workforce Management (MWFM) platform will allow utilities to introduce a critical step in daily safety readiness procedures for front-line workers.

Small modular reactor with molten salt storage launched

TerraPower, the Bill Gates-backed nuclear innovation firm, has launched a new small modular reactor system paired with a molten salt storage unit.

The new concept, dubbed Natrium, is being developed in partnership with GE Hitachi Nuclear Energy. According to the pair, it could be used to boost a 345-megawatt small modular reactor (SMR) to around 500 megawatts for a period of up to five hours. This allows for a nuclear design that follows daily electric load changes and helps customers capitalize on peaking opportunities driven by renewable energy fluctuations, said the company.

North Carolina's Largest Battery System Now Operating at Duke Energy Substation

Duke Energy announced it began operating the largest battery system in the state. In the city of Asheville, a 9-megawatt (MW) lithium-ion Samsung battery system is operating next to a Duke Energy substation in the Shiloh community. With a total cost of less than $15 million, the project will primarily be used to help the electric system operate more efficiently. It will provide energy support to the electric system, including frequency regulation and other grid support services. Battery storage offers many benefits to customers. Duke Energy has plans to invest $600 million for 375 MW of energy storage across its regulated businesses. Duke Energy has more than a decade of experience with battery storage. At one time, the company's 36-MW battery system next to the company's Notrees Wind Facility in Texas was the largest battery operating in the United States. It remains one of the country's biggest.

GE to deliver UK's first DC-coupled Battery Energy Storage System

GE Renewable Energy announced that it has been selected by Wykes to deliver a 25MW multiple hour duration Energy Storage Systems, to be integrated with Wykes' Solar PV plant at the Chelveston Renewable Energy Park, in the United Kingdom. The site currently operates with 60 MW of solar energy and 26 MW of wind energy, featuring GE's 2.85 MW onshore wind turbines. Wykes will use GE's Reservoir Energy Storage technology to add another 60 MW of solar capacity, for a total of 120 MW of solar and 146MW from the park.

The Storage system will be the UK's first direct-DC-coupled solar deployment where the solar panels and the batteries will share a common set of power conversion equipment. This will help improve the solar-storage hybrid system's overall energy output while optimizing costs and increasing the overall system reliability and flexibility. It allows Wykes to optimize the energy it generates on site and gives it the flexibility to choose how and when the energy generated is used, GE said.

Mitsubishi Shipbuilding to pilot world's first marine carbon-capture system

In Japan, Mitsubishi Shipbuilding is partnering with transportation company Kawasaki Kisen Kaisha and non-profitable organization Nippon Kaiji Kyokai to pilot the world's first marine-based carbon-capture system. The three parties have gained the support of the Maritime Bureau of Japan's Ministry of Land, Infrastructure, Transport and Tourism to conduct the study. The pilot will be conducted in Tohoku Electric's K Line's coal carrier to identify potential risks and conduct operability and safety evaluations to determine ongoing specifications.

The "Carbon Capture on the Ocean" demonstration involves converting the design of an existing carbon capture system for onshore power plants to a marine environment and installing it on board an actual ship in service.

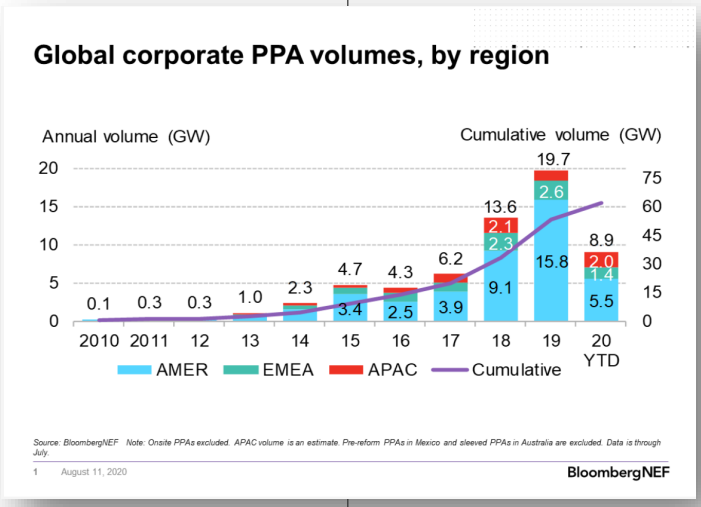
First green hydrogen 'standard package' projects in US

Three projects in the US are to implement the first green hydrogen standard packages for power balancing and energy storage. The three projects are for the Danskammer Energy upgrade initiative in Newburgh, New York, with a capacity of 600 MW; for Balico in Virginia; and for EmberClear for its fully permitted 1,084 MW Harrison Power Project in Cadiz, Ohio.

These projects are the world's first to use standard packages for green hydrogen integration. The combined investment is over $3 billion. Read more here.

COVID-19 causing drop in US corporate clean energy purchases

Global corporate PPA volumes reached 8.9GW in 2020 through July. Though activity is currently marching ahead of 2019, a big second half will be required in order for the market to hit record volumes by year-end, according to this report by BloombergNEF. Corporate power purchase agreement activity slumped to just 4.3 gigawatts in the U.S. during the first half of 2020. In Texas alone, which saw 5.5GW of PPAs in 2019, PPA volumes stand at just 940MW so far. This is partially due to the pandemic, which is having a significant impact in a number of markets around the world. Despite the nearly 30% decline in activity, BloombergNEF reports that demand for renewable energy now exceeds supply by a wide margin.



COVID-19 causing drop in US corporate clean energy purchases

Tesla secures funding for Australia's largest virtual power plant

The Australian Renewable Energy Agency (ARENA) has issued AUS$8.2 million in funding for the development of what is claimed to be the largest virtual power plant in the country. ARENA announced the funding will be used by Tesla Motors Australia to install battery energy storage and rooftop solar systems for 3,000 residential consumers in South Australia. The pilot will also leverage $10 million in funding from the South Australian Government's Grid Scale Storage Fund, $30 million debt finance from the Clean Energy Finance Corporation and an $18 million equity contribution from Tesla. Tesla will install 5kW of rooftop solar and a 13.5kWh Powerwall battery system at each property, at no cost to the tenant.

Utility-scale fuel cell technology to power South Korea's historic cities

Bloom Energy is partnering with SK Engineering and Construction to deploy two new clean energy facilities with fuel cell technology in Gyeonggi Province. The power plants will be located in Hwasung and Paju and will leverage Bloom Energy's non-combustion, electrochemical process to produce low-carbon electricity with lower and predictable energy costs and enhanced reliability. The Hwasung power plant will comprise a 19.8MW fuel cell deployment and will be Bloom Energy's largest South Korea project and its second largest in the world. This deployment marks the first-ever solid oxide fuel cell project financed in Korea, with over 141 billion KRW ($118.7 million) of debt and equity financing. The solid oxide fuel cell installment provides a new source of electricity to meet growing energy demand. This facility alone is designed to generate enough electricity to power approximately 43,000 homes in the area. This follows the government releasing a Hydrogen Economy Roadmap in 2019 calling for 15,000MW of stationary fuel cells by 2040.

Ørsted to pioneer Netherlands green ammonia project powered by hydrogen and wind

Norwegian chemical company Yara and Danish energy giant Ørsted have joined forces to develop a 100MW wind-powered electrolyser plant for renewable hydrogen production. The project has the potential to abate more than 100,000 tons of CO2 per year, equivalent to taking 50,000 conventional cars off the road. If the required public co-funding is secured and the right regulatory framework is in place, the project could be operational in 2024/2025, said Ørsted. The renewable hydrogen would generate around 75,000 tons of green ammonia per year - approximately 10% of the capacity of one of the ammonia plants in Sluiskil - based on dedicated renewable energy supply from Ørsted's offshore wind farms. Ørsted is about to inaugurate its Borssele 1&2 offshore wind farm, the second biggest globally, located off the coast of Zeeland close to the Sluiskil plant. The green ammonia is intended to be used to produce carbon neutral fertilizer products, decarbonize the food value chain, and has potential as a future climate-neutral shipping fuel.

Port of Rotterdam testing blockchain and AI for renewables trading

The Port of Rotterdam's blockchain subsidiary, Blocklab, has been trialing a decentralized electricity trading system to help lower costs and optimize renewables use on its microgrid. The system, called Distro, has been jointly developed by Blocklab and S&P Global Platts and has been operational as a trial since August. Distro uses blockchain technology, smart contracts and artificial intelligence to support the decentralized, high-frequency trading of renewable energy by commercial consumers looking to optimize and manage their energy use. It matches demand with the intermittent power generated from different sources, specifically solar and battery storage. The trial involved 20 million blockchain-validated, cleared and settled transactions, which cumulatively lowered the cost for commercial users by 11% and improved local renewables producers' revenues by 14%. Read more here.

LS Power energizes world's biggest battery

In August, LS Power unveiled the largest battery energy storage project in the world – Gateway Energy Storage. The 250 MW Gateway project, located in the East Otay Mesa community in San Diego County, California, enhances grid reliability and reduces customer energy costs. In doing so, Gateway provides a valuable resource for energy consumers, utilities and other load servers across California. Gateway Energy Storage follows another LS Power battery project, Vista Energy Storage in Vista, California, which has been operating since 2018 and was previously the largest battery storage project in the United States at 40 MW. LS Power has additional projects in development or construction in both California and New York, including Diablo Energy Storage (200 MW) in Pittsburg, California; LeConte Energy Storage (125 MW) in Calexico, California; and Ravenswood Energy Storage (316 MW) in Queens, New York.

FEATURED ARTICLE

Pedagogical considerations of grid resiliency

By John Camilleri, Principle Architect, PSC North America
Original article on PSC web site. Included here with permission.

What does the North Atlantic Ocean's peak hurricane season have in common with kids heading back to school? The obvious answer is timing since the season's climatological peak of activity occurs around September 10 each season, right around the same time we're sharing our back to school photos on social media.

A more esoteric answer may be in the way utilities are adapting to restoring power after outages due to hurricanes using some of the same tools and techniques schoolteachers are incorporating into their remote classrooms.

Challenges of remote utility operations

Between 2002-2019, the US suffered over 2,500 major power outages. Nearly half of them were caused by weather conditions like storms and hurricanes for an average of 65 weather-related outages per year. During this pandemic, however, the face-to-face communications and physical meetings to coordinate between utility operations centers and support teams have gone virtual so utilities are working to bridge the last mile of restoration work with web conferencing and specific procedures.

Whether it's scrambling to get the lights back on or teaching our kids geometry, adopting new technology in a short timeframe and using it to achieve critical tasks is a challenge in the best of times. Add a global health crisis to the mix and both the difficulty and the consequences of failure become more severe.

The unique issues that arise from remote communications are the same whether you're a utility IT support manager meeting with your distributed team to address key system operational issues during a crisis or a teacher engaging with students who are now de facto homeschooling. Some of the big questions are:

- How do you tell if you have the full attention of the participants?
- How do you tell if a participant is showing signs of uneasiness or concern that you would normally pick up from in-person visual cues?
- How do you organize the workflow to minimize talk over and ensure that everything is heard and not lost because the connection was lost for 10 secs?
- How do you gauge the participants' energy level, given they may have been in a seat for the last six hours ("Zoom fatigue")?
- How do you assess the risk of fatigue-related errors?

Back to the classroom

For utilities, increasing the relevance of remote communication capabilities and tools creates the infrastructure to address the above issues, including sharing documents and collaborating on checklists. The process and culture for remotely ensuring everyone has a specific assignment, leveraging peer validation for critical tasks, utilizing fieldwork communication styles that require acknowledgment via repeating the statement, and other methods are a work in progress.

Some tactics teachers have incorporated may also work well in the new environment for utilities:

- Mix things up – use screen sharing, whiteboarding and annotations to help ease the analysis of information.
- Try incorporating polling to solicit fast feedback, even if it's just to ask how people are doing.
- In large groups, use a 'thumbs up/thumbs down' to make sure you're being understood.
- Figure out what doesn't need to be done together online and handle it separately.
- Consider recording sessions for less critical information.
- Use the 'raise hand' feature on Zoom, Teams or other collaborative products to keep track of questions and comments and avoid talk-over.
- Use chat features to ask questions as they come up and ask team members to enter responses and ideas in the chat.

In a professional environment, the standard operating procedures of these collaborative meetings should be more formalized. Some considerations include the following:

- Use a team to drive the meeting, i.e., someone to monitor chat/raised hands, someone to pause meeting in case of talk-over or dropped communications, someone to capture notes or collaboratively allow everyone to create notes.
- Capture voting on issues online and verbally for key decisions.
- Use status notifications, such as "brb" (be right back), "b" (back).
- Be sure to consider company policies related to recordings.
- Always have a safety message at the beginning of the meeting. This may include issues of individual awareness of the environment, like weather, organizational matters, safety issues outside of work, and so on.
- Leverage cameras when possible to see people's faces, better interpret their reactions and have a clearer understanding of the meaning behind their words, something difficult to do while social distancing with masks.

Learning from each other

COVID has changed the landscape and as we try to settle into a 'new normal' we're all looking for solutions to adapt quickly and efficiently. We can learn from each other and incorporate best practices across domains. Utilities can take a page from today's teachers' handbook when it comes to working remotely to coordinate between operations centers and their support teams. And all of us can learn from each other as we deploy new tools to improve day-to-day operations, allowing for remote support where it was previously not considered without physical presence.

John Camilleri is a Principle Architect with PSC in North America. View his LinkedIn profile here.

FEATURED ARTICLE

Enabling the distribution system of the future

By Mani Vadari and Tim Wolf

Original article in T&D World. Edited here with permission.

A few years back, a group of experienced distribution system operators and engineers from leading utilities across the United States gathered in a conference room at CenterPoint Energy in Houston for a Department of Energy sponsored 'Voices of Experience' discussion on how they could apply new technologies to improve distribution operations.

Energized by their recent experience implementing and evaluating new grid technologies funded by the American Recovery and Reinvestment Act (ARRA) Smart Grid Investment Grants, they shared perspectives on how they could better integrate their systems and data to transform their distribution operations. Specifically, several of the utilities that had begun to procure and deploy Advanced Distribution Management Systems (ADMS) shared their experiences and lessons learned. The common theme that emerged in this discussion was that implementing advanced distribution functionality is a complex, time-consuming and expensive endeavor, especially the integration of disparate systems and data sources.

Fast forward five years to today and the drivers for advanced distribution functionality are accelerating. At a time when customer expectations of quality service are higher than ever, electric utilities are facing an array of challenges to delivering a safe, reliable and affordable power supply. Increasing penetration of distributed energy resources — such as rooftop solar and electric vehicles — is creating new operational and planning headaches for distribution system operators. Grid operators must maintain a continual balance between electricity supply and demand, ensure power quality and protect expensive equipment amid two-way power flows, increased load volatility and a rapidly changing ecosystem at the edge of the grid. Adding to this complexity, grid operators are managing more and more intelligent, connected devices on the grid and the data they generate.

Succeeding amid this new normal requires ubiquitous sensing and communications to monitor grid conditions across the domains of transmission and distribution systems all the way to the customer premise (a.k.a. Behind the Meter – BTM). Operators also need to manage those domains through a combined architecture of systems, analytics and algorithms based on where intelligence and control are needed to best support the use case requirements. Much of this cannot be done using conventional approaches and mechanisms used today. As an industry, we need to exploit newer techniques such as Internet of Things (IoT), cloud and Artificial Intelligence/Machine Learning (AI/ML) while still maintaining the security and integrity of the systems and protecting the privacy of the customer. In short, it requires intelligent and coordinated control at scale.

A shift of this magnitude requires rethinking the distribution planning and operations paradigm. The new paradigm should include a constantly maintained and accurate physical power system network model (as-built and as-operated), standardized Application Programming Interfaces (APIs) to exchange data and a set of advanced applications that can capitalize on the richness of data and the fidelity of today's models. It also calls for new control paradigms based on the best architectures (centralized, decentralized or distributed) to solve specific problems through an integrated architecture. Examples of such value-added applications include demand forecasting, Volt-VAR Optimization (VVO), threat/intrusion detection, damage assessment and improved situational awareness at the grid-edge.

Each utility much approach this journey in its own way but there are common challenges and considerations that shape strategy:

- Type of utility: IOUs, municipals and co-ops all have different levels of resources as well as capabilities of their personnel (IT and power system). Many are also working to solve different problems. For example, an IOU with multiple geographic footprints and large customer base may seek to solve broad challenges first. Munis and co-ops (especially the smaller ones), on the other hand, may have more specific problems that require point-solutions.
- Microgrids: Still an uncommon asset, some microgrids are owned by the utility and some are owned by third parties. However, in the continental United States, most of them are still connected to the grid most of the time. Therefore, they must be managed for two different operational scenarios — one for grid connected and one for disconnected.
- Multi-dimensional problems: Taking the example of VVO, the solution will depend both on the grid conditions that are causing the Volt-VAR issues and require fixing, but also on the set of controls available to alleviate the root problem when it has been identified. As a result, one algorithmic solution may not solve every VVO problem or capitalize on every opportunity.
- Networked or radial configuration: Solutions will need to consider the type of grid they are managing because the networked configuration has multiple paths and hence multiple options to solve the same problem. However, the radial configuration has limited options available because of fewer (or none) cross-connects between the feeders.
- DER penetration: In some utility territories, a significant percentage of the load volatility and resulting variability is driven by increasing inverter-based resources. Thus, drivers for a utility with high DER penetration can be significantly different from those at a utility with low DER penetration.

While every utility will have a unique combination of ADMS drivers, the idea that each utility will deploy a customized solution to integrate hundreds of thousands or even millions of grid edge devices is not sustainable from a time, cost and resources standpoint. As an industry, we need to leverage standardization, where it makes sense, to enable cost-effective integration of the growing diversity of DER, edge devices and data streams, as is common in other industries.

References for additional reading:

Voices of Experience: Insights into Advanced Distribution Management Systems, whitepaper by the National Renewable Energy Laboratory for the US Department of Energy, February 2015.

Electric System Operations – Evolving to the Modern Grid (2nd edition), author Dr. Mani Vadari, published by Artech House, used as a textbook by several universities.

WHAT's on MANI's MIND?

If you didn't celebrate National Hydrogen and Fuel Cell Day on October 8, don't worry, you weren't alone. Only in its sixth year, the day – much like the objects of its celebration – is just starting to gain momentum. As it was created by and for scientists and engineers, the date is a nod to hydrogen's atomic weight, which is about 1.008.

Even though we recently started celebrating it, hydrogen was used to power the first internal combustion engines over 200 years ago. And because of its versatility, it's making a comeback in the transportation and power generation sectors, just in time to help tackle environmental concerns and enhance energy security.

Benefits

The benefits of hydrogen are that its light, storable, energy-dense and produces no direct emissions or greenhouse gases. It can be produced locally from various sources or centrally and then distributed.

For transportation, once the hydrogen is generated through the process of electrolysis (hopefully using renewable energy to create 'green hydrogen'), it can then be turned back into useful energy through a fuel cell, or even by burning it.

For electricity, hydrogen can be used to replace natural gas as fuel burned to create heat and generate steam. There is also potential to reuse existing coal and natural gas-fired generators and turbines for hydrogen-fueled generation. Hydrogen can be generated with excess renewable electricity and converted to a commodity that provides a sustainable form of dispatchable generation.

No matter how hydrogen is used, the byproducts of electrolysis are water and oxygen: Water when hydrogen is used as fuel, and oxygen when water is converted to hydrogen. This makes it especially beneficial for the environment.

Hurdles

The main challenge of hydrogen is cost. Massive investment is needed and compared to other commodities, there isn't much of a market for it. Trade is localized with little chance for price discovery.

Growing support

Support for hydrogen is growing. Fuel cells are improving, and the cost is coming down. There's increased interest in carbon capture utilization and storage facilities for hydrogen production. And hydrogen is currently enjoying a revived momentum in various projects around the world.

One such project in the Pacific Northwest is with Douglas County PUD who is proposing producing hydrogen with surplus hydropower. The excess hydropower would be sent to an electrolyzer to separate the hydrogen and oxygen in the water. The hydrogen can then be used to store energy, compressed for transportation fuel or transported in pipelines for industrial purposes.

Join me in marking our calendars for October 8, 2021. After this year, we need to take advantage of every reason to celebrate!

MEET THE EXPERTS

Denee Hayes, Principal Consultant
Bijih Resource Consulting LLC

Throughout her career, Denee Hayes has focused on the efficiencies and connection of the value chain from the perspective of the customer, planning, operations, leadership and functional teams. Her passion is empowering individuals and teams to drive the highest value for the total system through identifying value levers and loss at transfer points achieving positive outcomes through creating total system metrics and defining decision rights. Denee is experienced in delivering large programs of work including digital transformations, agile platform development, and cultural transformations by creating organizational agility utilizing industry tested change management techniques. She empowers front line workers by identifying pain points and roadblocks to deliver results in the mining value chain as well as energy efficiency and utility industries. She has integrated mining value chains to increase free cash flow and built frameworks and guidance for global teams to integrate product groups from mine to market. Her areas of expertise are in Program/Project Management, Process Improvement & Integration, Journey Management & Organizational Agility, Stakeholder Management, Strategic Planning, Complex Business & Digital Transformation, Design Thinking, System Optimization, and Risk Management.

EV markets poised to accelerate – will utilities lead, follow or get out of the way?

A uniquely MGS POV by Michael Harrison

As reported by *The Guardian*, recent research by investment bank UBS, predicts that the cost to produce electric vehicles (EVs) will match internal combustion engine (ICE) cars by 2024, driven largely by expected battery cost reductions below $100/kWh by 2022. This progress eliminates the price advantage of traditional ICE cars, and several major automakers are expected to substantially shift production to EVs. Not mentioned by UBS - but treated at length by several Wall Street Journal articles recently – is the pivotal role charging station coverage will play in EV market development. Regulators are weighing alternative roles for utilities in charge spot network development over the next decade, trading off concerns of thwarted competition vs. utilities ideal network extension position, master plan/POLR capabilities, and relatively low cost of capital relative to other entities. The demand and infrastructure stakes are quite high and the die will be cast in the next few years as to whether utilities can define/model complementary functional role(s) as a market catalyst or be relegated to reactive connection/delivery duties.

Michael Harrison
Managing Director, Realize Visions LLC
Principal, Modern Grid Solutions

MORE ABOUT MODERN GRID SOLUTIONS

Modern Grid Solutions

Modern Grid Solutions (MGS) is a cost-effective, global, supplier of deep expertise and board-experienced domestic resources. Our team members have been industry colleagues for over 25 years. Our approach focuses on delivering actionable guidance, direction and value, based on the depth of our team's expertise in North America, and around the world.

MGS has assembled a team of leading experts all having between 25 – 45 years of experience delivering complex, innovative technology, business, regulatory and finance solutions to electric utilities, corporate clients and policymakers. Our experts bring expansive breadth and tremendous depth in engineering, technology, economics, operations, and commercial areas directly applicable to utilities, suppliers, regulators and policymakers.

BUSINESS EXPERTISE AREAS	TECHNICAL EXPERTISE AREAS
For Utilities and Policy Makers • Strategy, tactics, and process redesign • Business, technical and enterprise architecture • Transmission and distribution roadmaps • Grid modernization plans • Project and program management • Strategic change management • RPS Support **For Suppliers and Corporate Clients** • Business model design and analysis • Electricity market entry and go-to-market • Market analysis, volumes, and trends • Competitive landscape analysis • Alliances, divestitures, and acquisitions • M&A, Project finance, structured products	**For Utilities and Policy Makers** • T&D system operations – EMS, DMS, OMS • Generation operations • Energy markets – design and deployment • Energy and REC tracking system • T&D Automation and smart grid solutions • GIS and asset management solutions • Generation planning and renewables integration • Big data management and analytics • Solution and vendor selection **For Suppliers and Corporate Clients** • Solutions design and implementation • Portfolio review and analysis • Adjacency analysis and technology management • Energy, REC and emissions trading

Ongoing Projects

- Assisting a major Northwest utility with transforming their planning capabilities to address the influx of Distributed Energy Renewables, Non-Wires Alternative solutions and to address the newly signed Washington State Clean Energy Act (SB 5116) to transition the state's electricity supply to 100 percent carbon-neutral by 2030, and 100 percent carbon-free by 2045.
- Assisting the Pacific Northwest National Laboratory on a DOE project - development of an OpenADMS application development platform (GridAPPS-D).
- Assisting with a major multi-OpCo distribution operations transformation – Control center consolidation, ADMS specification and procurement, and operations standardization.
- Assisting a major multi-Opco utility with identifying improvements to their Outage Customer Experience – People, Process and Technology.
- Assisting a major multi-Opco utility with defining a strategy for dispatching the DERs in their footprint by focusing on – People, Process and Technology aspects of the full implementation.
- Assisting multiple startup companies in the areas of IoT, Blockchain, and Voltage regulator.

Electric System Operations – Evolving to the Modern Grid, Second Edition

Dr. Vadari's book "Electric System Operations – Evolving to the Modern Grid, Second Edition" is available now. The key chapters covering EMS, OMS, ADMS, and DERMS now include industry case studies to move the discussion from theoretical to evidentiary with real-world, relatable content.

Smart Grid Redefined: Transformation of the Electric Utility 3.0

The book has been released and is now available in all leading bookstores and online. The Chinese edition is out now and available in China.

This book is also being used as a textbook for a UMass course given by Prof. Kishore Nudurupati on Smart Grids for undergraduate and graduate students. (ECE 687/597 SG, Smart Grids)

ABOUT THIS NEWSLETTER

This quarterly newsletter is a production of Modern Grid Academy under the auspices of Modern Grid Solutions.
Please send all comments and inquiries to info@moderngridsolutions.com.