



State of the Grid

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2ND QUARTER 2019



WELCOME TO OUR Q2 NEWSLETTER!

Now more than ever, we are all witnesses to the transformative changes in the way electricity is produced, transmitted, managed, transacted and used. It's an exciting time and essential for all of us to understand and evaluate the emerging trends that could transform the grid further.

My hope is that our newsletter highlights some of the trends - like decarbonization, digitalization and decentralization - and provides a bit of intellectual stimulation along the way.

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.*



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MGS NEWS

HOT OFF THE PRESS!

The second edition of Dr. Vadari's book, *Electric System Operations: Evolving to the Modern Grid* is in progress for a 1st quarter 2020 release. Stay tuned for more information as the publication dates gets closer.

The Chinese language edition of *Smart Grid Redefined: Transformation of the Electric Utility* is on target for a 4th quarter 2019 release.

Upcoming Events

- WEI's executive leadership summit, (the Annual Meeting) is being held in Carlsbad, CA on Sep 15-17. John (JD) Hammerly and Mani Vadari are attending.
- IEEE PES General Meeting, August 2019 in Atlanta, Georgia. The theme this time is "Expect Uncertainty – Prepare to Adapt."

You May be Interested in...

Opportunity to lead SFCC Smart and Microgrid Training Center

Santa Fe Community College is seeking a qualified, full-time faculty member to lead its Smart and Microgrid Training Center. SFCC is developing the Smart and Microgrid Training Center as part of the National Science Foundation funded New Mexico SMART Grid Center. The center is based upon a "nanogrid", currently under construction, that will power the school's training greenhouse and will include the entire campus microgrid in the near future. The school is in collaboration with the Distributed Energy Systems Technician-Education Network Initiative to establish a national credential for modern grid technicians. *Job description and application link can be found [here](#).*



KEY HIGHLIGHTS

British power grid experiences first week of coal-free operation

Britain's electricity grid has gone a full week without coal for the first time since the Industrial Revolution, the Press Association reported in early May. According to the National Grid Electricity System Operator (ESO), which runs the network in England, Scotland and Wales, the new record was set at 1.24pm May 8, 2019 – a week after the last coal generator came off the system. The milestone marks the first coal-free week since 1882, when a coal plant opened at Holborn in London and it comes only two years after Britain's first coal-free day.

Germany to close all its coal-fired power plants

Germany, one of the world's biggest consumers of coal, will shut down all 84 of its coal-fired power plants over the next 19 years to meet its international commitments in the fight against climate change. The announcement marked a significant shift for Europe's largest country. Coal plants account for 40 percent of Germany's electricity, itself a reduction from recent years when coal dominated power production. The decision to quit coal follows an earlier bold energy policy move by the German government, which decided to shut down all of its nuclear power plants by 2022 in the wake of Japan's Fukushima disaster in 2011. Twelve of the country's 19 nuclear plants have been shuttered so far.

Pacificorp proposes replacing coal with renewables and storage

PacificCorp is taking the first step toward considering early closure of some of its poorest-performing coal-fired power plants, and replacing them with hundreds of megawatts of less costly wind, solar and energy storage resources. In [preparation of filing its integrated resource plan](#) in August, the Berkshire Hathaway-owned utility revealed that its customers could save up to \$248 million over the next 20 years, under a plan to retire four of its least economically competitive coal units in Wyoming by 2022, several years ahead of schedule. In December, a PacificCorp analysis showed that 13 of its 23 operating coal units in Montana, Colorado and Wyoming were more expensive than their cleaner-energy alternatives across a range of scenarios, including one that could save customers up to \$317 million over 20 years by early retirement of five units generating 834 megawatts, currently set to close no earlier than 2029.

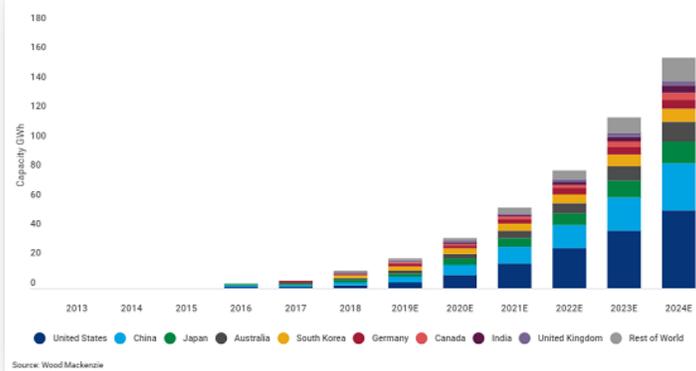
SEPA provides snapshot of the current EV industry

With estimates of over 20 million EVs expected on the road in the US by 2030, [a new report](#) from the Smart Electric Power Alliance (SEPA) highlights the important role of utilities in furthering the intelligent integration of EVs and the grid. EVs represent the most significant new electric load opportunity for utilities since the rise of air conditioning in the 1950s but if improperly integrated into today's dynamic grid, the rise in EVs could lead to grid constraints and increased T&D peaks, SEPA said. That in turn could prompt the construction of more "peaker" plants, unplanned grid upgrades, and other costly solutions.

GM and Bechtel plan to build thousands of electric car charging stations across the US

General Motors (GM) and Bechtel will partner to install thousands of electric vehicle fast charging stations across the United States, with construction on the first installations expected to begin later this year. GM officials say details on the partnership are sparse because the arrangement remains in a Memorandum of Understanding phase. The stations are expected to be located in dense urban environments rather than along major transportation corridors, [according to CNN](#). GM and Bechtel are planning to form a separate company to develop the charging network, and will seek investment from other entities. The plan could be a boon to GM, which expects to roll out 20 EV models by 2023.

Global cumulative deployment capacity, 2013-2024



The report predicts the U.S. and China will dominate the deployment of energy storage up to 2024. (Image credit: Woods Mackenzie)

Global energy storage market takes off

According to a [new report](#) from Woods Mackenzie Power & Renewables, 2018 was a record-breaking year for energy storage. Last year saw global energy storage expand to record levels, with 147 percent year-on-year growth in gigawatt-hour (GWh) terms. This pales in comparison to what is to come. By 2024, Woods and Macenzie forecast that the market will expand 13-fold (see chart on left). Rising demand for electric vehicles has driven new developments

in energy storage technology. In 2018, demand for nickel-manganese-cobalt (NMC) batteries, used in both EVs and energy storage, outstripped supply.

California ISO tests flow battery technology showcasing the economics of storage in wholesale markets

Given the nationwide increase in renewable energy targets, utilities and wholesale market operators have ample reason to experiment with different types of storage technologies in order to determine which of them will provide the most benefits to the grid and consumers. The California Independent System Operator (CAISO) [announced](#) it has become one of the first wholesale power markets in the United States to connect a new and innovative battery storage technology to its grid. The four-year pilot project is intended to test and evaluate the performance of flow batteries in the commercial wholesale market. San Diego Gas & Electric (SDGE), in coordination with Tokyo-based Sumitomo Electric, started testing a flow battery in 2015, according to CAISO, and the battery started participating in the ISO wholesale market in December. The vanadium redox battery storage pilot will provide 2 MW/8 MWh of energy storage, enough to power the equivalent of 1,000 homes for up to four hours.

Madison Gas & Electric aims for zero carbon by 2050

According to the [utility's news release](#), MGE already has been on a path to reduce carbon, having reduced carbon dioxide emissions 23 percent since 2005 and targeting carbon reductions of at least 80 percent by 2050 from 2005 levels. Key strategies for deep decarbonization include reducing the carbon intensity in electricity generation through adding significant new renewable energy resources and reducing the use of fossil fuels; continued work to help customers with energy efficiency; and electrification, including transportation.

World's largest solar project goes operational in the UAE

The Emirates Water and Electricity Company announced the 8 square kilometer, 3.2 million solar panel Noor Abu Dhabi power plant as the world's single largest solar project. It is part of the country's initiative toward better energy security and is expected to produce approximately 1.2 GW of electricity that can cover the demand of 90,000 people. By contrast, the Solar Star power plant in Rosamond, California, commissioned in 2015 is the United States' biggest solar project spread over an area of 13 km square that uses 1.7 million solar panels to generate 579 megawatts of electricity, equivalent to powering 255,000 homes. The \$871 million project is a joint venture between the Abu Dhabi Government and a consortium of Japan's Marubeni Corp and China's Jinko Solar Holding.



The Noor Abu Dhabi single-site solar plant is claimed to be the largest in the world with a production capacity of nearly 1.2 GW (Photo credit: EWAC)

Canada's first utility-scale microgrid is debuted

S&C Electric Company and North Bay Hydro Services announced the completion of North Bay's Community Energy Park project with the successful installation of the first utility-scale advanced microgrid in Canada. Developed largely in response to a 2013 ice storm that hit the province of Ontario and left hundreds of thousands of residents without power for days, the 789kW microgrid will supply enough energy to heat buildings in the town's Community Energy Park, allowing thousands of local residents a safe haven from the elements during prolonged outages. The microgrid is powered by two 265-kW natural gas generators and a 9-kW of solar, 7kW of rooftop panels and a 2kW solar flower. The project now allows for North Bay Hydro Services to provide 87 percent of the electricity requirements for the Community Energy Park's buildings from on-site generation along with more than half of the park's electrical heating needs.

Green Mountain Power looks toward the grid of the future

A first-of-its-kind program pioneered by Green Mountain Power (GMP) in Vermont is replacing residential energy meters with batteries that would also keep the lights on during power outages. Using Tesla Powerwall batteries, they not only store energy, they also track a home's energy use, making traditional – or even smart – energy meters obsolete. GMP's CEO, Mary Powell said, "Even the smartest meter of the smart meters can't keep your home powered when the lines go down." Customers who join GMP's "[Resilient Home](#)" pilot program will pay \$30 per month for two Powerwall batteries that act as a meter and backup power for the home. GMP is filing a patent to protect the technology they've developed.

World Economic Forum releases Smart Grid Risk Snapshot

Mass deployment of smart technologies is transforming the traditional electricity grid system into a Smart Grid. But, this smart tech spending boom in the utility and energy industry has introduced new risks with high costs leaving the sector vulnerable to cyberattacks and significant financial losses. So says the recently released [Smart Grid Risk Snapshot](#). Industry experts point to three main ways to mitigate the risk: balancing innovation and cyber resiliency, developing proactive safeguards and creating a culture of organizational awareness to mitigate cyber risk. They estimate that an attack on the connected US grid could cost \$1 trillion, or eight times as much as the Fukushima nuclear disaster clean up.

Inslee signs mandate for carbon-free electricity by 2045

Washington Gov. Jay Inslee, who is seeking a path to the White House on the message of climate change, signed a measure in early May that makes Washington the fourth state in the nation to establish a mandate to provide carbon-free electricity by a targeted date. The signing of the new state law comes less than a week after Inslee unveiled his first major policy proposal of his presidential campaign, in which he called

for the nation's entire electrical grid and all new vehicles and buildings to be carbon pollution free by 2030. Washington now joins California, Hawaii, and New Mexico, which have all established either renewable energy mandates or clean energy mandates with the 2045 target. Washington, D.C., passed a bill last year establishing 2032 date for a 100 percent renewable energy mandate, and Puerto Rico this year established a 100 percent renewable energy mandate by 2050. Washington, which relies heavily on hydroelectric power, already generates more than 75 percent of its electricity from carbon-free sources, including renewable energy. Existing hydroelectric

power would count toward the goal, giving the state about 25 years to find carbon-free sources for the remaining 25 percent of its electricity needs. The penalty for noncompliance would be \$100 for each megawatt-hour, but it could go higher depending on the type of source, with coal penalties the highest.

Microsoft says datacenters will use 60% renewable energy by 2020

Microsoft, headquartered in Washington State, is doubling down on its commitment to cut operational carbon emissions by 75 percent in the next 11 years. On the datacenter side of things, in 2016 Microsoft announced a goal to use 50 percent renewable energy in all of its facilities by the end of last year, and the company now says it's ahead of schedule and on track to reach 60 percent by the end of this year. It will seek to surpass 70 percent by 2023, in part with a new "data-driven" cloud initiative that will employ internet of things (IoT) devices, blockchain technology, and AI to monitor performance and "streamline" the reuse, resale, and recycling of datacenter hardware.

Study: Bitcoin's carbon footprint rivals Las Vegas

A study by researchers at the Technical University of Munich and the Massachusetts Institute of Technology examined how much power is consumed by computers used to generate bitcoins and process transactions. Researchers calculate that the electricity required for the virtual currency bitcoin generates as much carbon dioxide as cities like Las Vegas or Hamburg. Last year the bitcoin network processed about 81 million transactions, compared to 500 billion transactions handled by the regular global banking system. The researchers said about 68 percent of the computing power used to generate, or mine, bitcoins is in Asia, 17 percent is in Europe and 15 percent is in North America. In a recent story about the carbon footprint of bitcoin, The Associated Press reported that the electricity required for a bitcoin transaction results in hundreds of thousands of times as much CO2 emitted as a credit card payment!



FEATURED ARTICLE



Where do EV batteries go when they die?

By now, it must be obvious to most people that EVs are the direction of the automotive industry's future. This is evident through a large number of industry signals.

The success of Tesla (the carmaker) who has managed to create a global brand despite being in business a very short time when compared to the rest of the automobile industry. Following this success, every carmaker in the world has announced a dramatic move toward EVs. For example, Volvo announced that every car built from 2019 onward will be solely electrified. Lexus recently announced that by 2025 all their models will have an electrified version. Similar announcements have come from carmakers such as Ford, General Motors, Mercedes Benz, BMW and others.

Additionally, the pressure is being applied by several countries too. A couple of years ago, the Indian Power Minister announced that by 2030, not a single petrol or diesel car should be sold in the country. Following this, several EU countries also announced a ban on cars with internal combustion engines (ICEs) ranging from as early as 2030 to 2040. Norway, Sweden, Germany, France, Belgium, Switzerland and the Netherlands are all considering the ban.

We can argue about the merits and demerits of EVs, range anxiety, whether the energy used to power them is coming from clean sources of power or not, and so on. In the end, however, there is one indisputable fact: The central source of power in a car, the battery mechanism, has a finite lifespan. Currently, most EV manufacturers are offering 8-year/100,000-mile warranties for their batteries.

Automobile makers prefer lithium-ion (Li-ON) batteries because they deliver superior performance in both power and energy density, allowing them to achieve a high weight-to-performance ratio. However, EV batteries are mostly made of some derivative of Li-ON technology which is not easy to dispose of since the materials are quite harmful to the environment. In addition, over the next 5-10 years, ALL the batteries in EVs on the road now will need to be disposed of in some form as they'll no longer be suitable for EV's. Finding ways to reuse the technology is

becoming more urgent as the global stockpile of EV batteries is forecast to exceed the equivalent of about 3.4 million packs by 2025.

While today's typical EV batteries may not have any more use for mobile applications once they've run their course, they still have a good amount of ability to charge and discharge. Just as EVs have disrupted the automotive value chain, it's on the verge of disrupting the energy-storage value chain as well. Utilities are looking at options to take old batteries off EV's and use them for stationary applications such as in substations to provide backup power. Several pilot projects are in play to test out this hypothesis. Other examples of reusing EV batteries include:

- Batteries from [Nissan's Leaf](#) will soon help illuminate streets in the Japanese coastal town of Namie, which is recovering from the 2011 disaster at the nearby Fukushima nuclear plant.
- [Toyota](#) will install retired batteries outside 7-Eleven stores in Japan next year. The hybrid batteries will store power from solar panels, and then use the energy when needed to help run the drink coolers and other equipment inside the stores.
- [Volkswagen](#) has a new mobile charger that uses old batteries to juice up new ones. The charger has been designed to use the same battery packs as Volkswagen's MEB electric vehicle chassis, so that when those packs reach the end of their useful life, they can have a second career as a recharge station. The first of these Volkswagen Group portable quick chargers is anticipated to be installed in Germany next year, and Volkswagen Group expects to begin full production in 2020.



The one key approach that has the most attention of this author is the potential to re-energize the Li-ON to make it ready for the same set of applications in the mobile EV space. This approach has a couple of key benefits.

- It gives recycling a new name completely. If the batteries are capable of being renewed for the same set of uses – just as today's lead-acid automotive batteries are widely recycled – it creates a significant opportunity to reduce wastage and, in addition, creates an entirely new industry focused on this area.
- The core material used to make Li-ON batteries comes from several rare-earth materials which also come from countries with somewhat unstable political structures. Reenergizing the materials to create new batteries will reduce our dependence on the sources of this material from those countries.

Let's see what the future has in store for us (pun intended).

[Mani Vadari](#), President & Founder, Modern Grid Solutions



MEET THE EXPERTS

Gary is passionate about efficient, reliable and sustainable power systems operations and energy markets. For over 25 years, he has served as a core technical and business expert in generation, transmission, distribution and energy markets. In his early career, Gary developed engineering software to optimize the use of generation and transmission assets. With a solid software background and experience working in an operations environment, he now specializes in distilling stakeholder objectives and defining high-value and low-risk solution requirements.

Gary was on the front lines in designing and developing electricity market systems at MISO, SPP, ISO-NE, and Transpower and has made noteworthy contributions to the market clearing and settlements capabilities of leading markets around the world generation mix.



Dr. Gary Rosenwald

He currently works with market operators and utilities on pressing new issues such as distributed resources, energy storage, and the evolving.

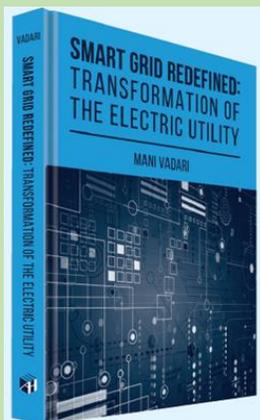
Successful change in the energy industry satisfies complex business and technical requirements and must be based on solid engineering principles. Gary's approach breaks through the roadblocks, empowers others, and helps teams achieve these goals on schedule.



NEWS FROM MODERN GRID SOLUTIONS

Ongoing Projects at Modern Grid Solutions

- 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 international storage company with their North American expansion plans and strategies
- Assisting multiple startup companies in the areas of IoT, Blockchain, and Voltage regulator



ARTECH HOUSE PRACTICAL BOOKS FOR ENGINEERING PROFESSIONALS

Smart Grid Redefined: Transformation of the Electric Utility Mani Vadari

- Guides professionals in the evolution of the Smart Grid and offers insight into distribution automation, storage, and microgrid;
- Highlights the journey to a transformed electric utility, provides solid examples, and includes real-world case studies;
- Presents new energy storage solutions and electric value chain disruptors;
- Learn how to overcome challenges related to integrating supply and demand diversity;
- Discusses how new technologies impact the day-to-day operations of a utility and how these technologies can transform the normal functioning of the utility;
- Provides discussions about how a transformed utility can be a springboard to a smart city;
- Demonstrates how to apply the strategies of technologies in this resource to guide them to success in the field;
- Defines the roadmap to the utility of the future and provides a vision for how utilities can thrive in their new environment.

MGS team grows its team of experts

MGS has built a portfolio of experts with 25-40 years of experience in fields ranging from Grid Modernization, T&D Operations, Generation operations, Utility regulatory & economics, Energy Efficiency and Demand Response and T&D Planning. **Check us out!**

Electric System Operations: Evolving to the Modern Grid

Dr. Vadari's book "[Electric System Operations – Evolving to the Modern Grid](#)" continues to receive rave reviews from readers. Buy them soon at a leading retailer. The second edition of this book will come out at the end of this year.

Smart Grid Redefined: Transformation of the Electric Utility 3.0

The book has been released and is now available in all leading bookstores and [an online store](#) near you. A Chinese edition will be available soon.



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.