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**WELCOME TO OUR
Q4 2021 NEWSLETTER!**

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.*



It's 2022. We made it!

Throughout 2021 we continued to confront the global pandemic. We saw lockdowns, a global recession and unprecedented upheaval. We also suffered through more catastrophic weather events around the world.

On the brighter side, we saw the fastest vaccine development in history. And the US re-joined the Paris Climate Accord.

Wherever you are, we hope the brighter side of life is at the forefront for you and your loved ones this new year!

Dr. Mani Vadari, President



IN THIS ISSUE

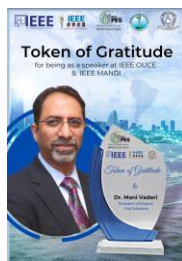
INDUSTRY EVENTS	1
MERGERS AND ACQUISITIONS	2
KEY HIGHLIGHTS	3-4
FEATURED ARTICLES	5-7
WHAT'S ON MANI'S MIND	8
MEET THE TEAM	8
MORE ABOUT MODERN GRID SOLUTIONS	9



INDUSTRY EVENTS

Q4 Presentations by Dr. Vadari:

- "Grid Modernization and the imperative for utility transformation" to IEEE IIT Mandi and IEEE Osmania College of Engineering
- "Storage, the ultimate disruptor. Is there anything storage cannot do?" at the 9th International Conference on Power Systems (ICPS 2021) at IIT Kharagpur
- Dr. Vadari was invited to serve on the Joint Expert Panel to review the US-India Collaborative for Smart Distribution System with Storage (US-ASSIST) project.



LIVE EVENT: DistribuTECH International Conference & Exhibition May 23-25, 2022, in Dallas, TX – **NEW DATES!**

The show has been postponed from its original January dates. "At this time many companies still have travel bans in place that are impacting their decision to travel to events. We respect those health and safety decisions being made and are confident delaying the event until May will deliver an environment where people feel safe to reconnect face-to-face and business can be done." [Get more info here.](#)

WEBINAR: Electric Vehicles: Navigating the road ahead February 1, 2022, @ 8:30am EST

This free webinar from Rystad Energy features speakers from Audi, Polestar and NIO who will examine the success of EVs, the wider implications for the energy industry, and what the future holds for the electrification of transport. [Find out more here.](#)



JUST IN!

New Mexico announces new grid modernization roadmap

The Energy, Minerals and Natural Resources Department's (EMNRD) Energy Conservation and Management Division (ECMD) announces the publication of the [New Mexico Grid Modernization Roadmap](#) (PDF).

MERCOT: 2021 sees big growth in funding

Battery storage, smart grid, and energy efficiency received \$19.5 billion in corporate funding. [Read more.](#)

S&C Electric introduces new self-resetting interrupter

New innovation brings fault-testing to the edge of the grid and mitigates unnecessary outages. [Read more.](#)



MERGERS AND ACQUISITIONS

Chameleon Technology acquires GenGame for home energy optimization

Chameleon Technology (U.K.) said the acquisition represents an acceleration of its roadmap, bringing together enhanced capability to deliver value to consumers through enabling low carbon technologies that are driven by real-time energy data insights. GenGame - a spin-out from a three-year government-funded project with [Northern PowerGrid](#) - focuses on enabling domestic flexibility using its app product suite. "The acquisition is the latest strategic move from Chameleon Technology to empower consumers on their personal journey to net-zero." Read more [here](#).

Meridian Energy sells to Shell

Meridian Energy said it agreed to sell its Australian energy business for A\$729 million (\$527.80 million) to a consortium of global energy giant Royal Dutch Shell and Australian investment manager Infrastructure Capital Group (ICG). Under the deal, the energy giant's unit Shell Energy Operations will get the control of Meridian's online energy retailer Powershop Australia, while ICG will become the owner of the electricity generator's hydropower and wind farm infrastructure assets in Australia. Read more [here](#).

Shell buys solar and energy storage developer Savion

Savion, based in Kansas City, Missouri, specializes in developing solar power and energy storage projects. It currently has more than 18 gigawatts of solar power and battery storage under development, including for utilities and major commercial and industrial organizations. The Savion purchase bolsters Shell's strategy to become a net-zero emissions energy business by 2050. Shell aims to sell more than 560 terawatt-hours of power globally per year by 2030; that's twice as much electricity as the company sells today. Read more [here](#).

Centrica acquires in HiiROC for a stake in green hydrogen tech

Centrica announced it is taking a minority stake in HiiROC, the hydrogen production technology company helping to combat climate change with affordable hydrogen produced at scale but without CO2 emissions. HiiROC's proprietary technology converts biomethane, flare gas or natural gas into clean hydrogen and carbon black, through an innovative electrolysis process using thermal plasma. This results in zero CO2 "turquoise hydrogen" at a comparable cost to steam methane reforming but without the emissions and using only one-fifth of the energy required by water electrolysis. Read more [here](#).

PRO TIP: If 'turquoise hydrogen' left you scratching your head, check out National Grid's explanation of the hydrogen color (ok, colour) spectrum [here](#).



Image Source: BEC

Capgemini joins E4S Alliance

Capgemini is joining the Edge for Smart Secondary Substations (E4S) Alliance, created to develop a standard, flexible, manageable and interoperable platform for next-generation Smart Grids. Having some of the largest distribution system operators in the world partnering with technology providers to co-develop an entirely new solution is intended to revolutionize the energy transition and help achieve a climate-neutral economy. The Edge for Smart Secondary Substations (E4S) Alliance is a technical working group formed by Ariadna Grid, Capgemini, Circutor, Enedis, Iberdrola, Intel, Landis+Gyr, Merytronic, Minsait, TTTech Industrial and ZIV Automation. Read more [here](#).

BEC, Burns & McDonnell partner to deliver energy analytics platform

Bandera Electric Cooperative (BEC) and Burns and McDonnell reached an agreement to distribute BEC's energy analytic solution, Apolloware, to electric utilities nationwide. Apolloware is a cloud-based platform that provides real-time energy information down to the appliance level. Utilities will be able to aggregate distributed energy resources throughout their system, individualize demand response programs, identify potential equipment failure, manage energy loads, and improve overall operations. Consumers will be able to view energy usage at the appliance level and can alter energy usage to save money and energy. Consumers with solar will be able to view energy generation and consumption to optimize system performance and view real-time market pricing to know when to sell and when to store energy. Apolloware was created in 2016 by BEC and currently serves three electric utilities and more than 800 residential and commercial customers. Read more [here](#).

G.E. Digital to acquire Opus One Solutions Energy

G.E. Digital has entered into an agreement to acquire Opus One Solutions Energy Corporation ("Opus One"), a software company that helps electric utilities optimize energy planning, operations, and market management. Opus One's renewable energy planning capabilities combined with G.E. Digital's network management and optimization portfolio will help utilities make decisions about how to integrate renewables and Distributed Energy Resources (DERs) at scale across the electric grid. Transmission, Distribution, and Market Operators will benefit from the combined software solutions, providing the ability to plan, onboard, manage, optimize, and trade renewables and DERs to enable a modern grid that is reliable, sustainable, and affordable for all. The terms of the deal were not disclosed. Read more [here](#).

ARENA invests \$100m in grid-scale energy storage and advanced inverters

The Australian Renewable Energy Agency (ARENA) announced a \$100 million competitive funding round for grid-scale batteries equipped with advanced inverters to support the grid. ARENA's [Large Scale Battery Storage Funding Round](#) will provide up to \$100 million in funding to new battery energy storage projects of 70 M.W. or larger operating in the National Electricity Market or Western Australia's Wholesale Electricity Market. In addition to supporting new build projects, funding will also be available to existing grid-scale batteries seeking to retrofit advanced inverter capability. Read more [here](#).



KEY HIGHLIGHTS

StoreDot receives battery regeneration tech patent

StoreDot, a pioneer of extreme fast charging (XFC) battery technology for electric vehicles, has revealed new patented technology that will allow battery cells to regenerate while they are in use, through a seamless background repair mechanism. The company has developed an innovative system that identifies underperforming cells, temporarily takes them out of service to fix them without an E.V. driver experiencing any vehicle interruption or loss of performance. Read more [here](#).

Construction starts on first large-scale U.S. offshore wind farm

Vineyard Wind, a joint venture between Avangrid Renewables, a subsidiary of AVANGRID, Inc., and Copenhagen Infrastructure Partners (CIP), today broke ground on Vineyard Wind 1, the nation's first commercial-scale offshore wind farm. The 800-megawatt (M.W.) project, located 15 miles off the coast of Martha's Vineyard, will generate electricity for more than 400,000 homes and businesses in the Commonwealth of Massachusetts, create 3,600 Full Time Equivalent (FTE) job years, save customers \$1.4 billion over the first 20 years of operation, and is expected to reduce carbon emissions by more than 1.6 million metric tons per year, the equivalent of taking 325,000 cars off the road annually. More info from Vineyard Wind [here](#).

Microgrid at Texas army base successfully islands from utility grid

Power management company Eaton, in partnership with the U.S. Army Engineer Research and Development Center (ERDC), Construction Engineering Research Laboratory (CERL), and the Department of Public Works at Fort Hood, Texas, demonstrated a microgrid's ability to operate Fort Hood's Robert Gray Army Airfield independently from the utility grid. The effort is the result of grants Eaton received from the U.S. Department of Defense. Eaton researchers demonstrated the microgrid's ability to seamlessly "island" itself from the grid and optimize the use of sustainable power and energy storage to minimize operation of the on-site backup generators. The generators never came on during the short demonstration. Read more [here](#).

WPD files £6.7b grid modernization and decarbonization plan

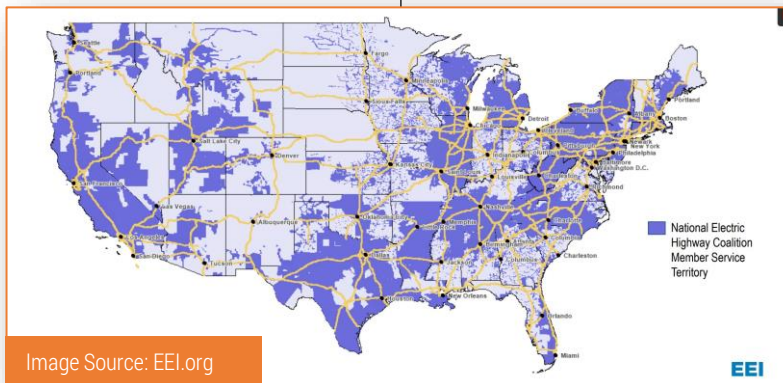
U.K. utility Western Power Distribution has announced a £6.7 billion (\$8.8 billion) grid modernization and decarbonization plan that will enable the energy firm to achieve net emissions 22 years ahead of the national target. The utility's 2023-2028 plan will prepare the grid for increased integration of distributed energy resources (DERs) and low carbon technologies without stressing it. Western Power Distribution says the plan will enable the provision of same-day DERs connections services and that the business is ready for rapidly changing customer expectations. In addition, the strategy aims to make sure the energy transition is just and inclusive and address energy affordability and poverty issues. Read more [here](#).

India's solar installations more than tripled in 2021, report says

India added 2,835 MW of solar in the third quarter of 2021, up 14% compared to 2,488 MW installed in the second quarter. Year-over-year installations rose 547%, according to a new report by Mercom India Research. In the first nine months of 2021, India added more than 7.4 GW of solar, a 335% increase compared to the 1.73 GW installed in the same period in 2020. Get the executive summary of the report [here](#).

Australia's biggest battery officially opened

The Victorian Big Battery, the biggest battery storage installation in Australia, and one of the biggest in the world, has been officially opened (December 8) and is now operating at full capacity, just 12 months after being awarded its landmark contract. The 300MW/450MWh facility, which will play a key role in keeping the lights on in Victoria, particularly in high demand periods in summer, was officially opened on December 8, 2021, by its owners Neoen and state energy minister Lily D'Ambrosio. Read more [here](#) (PDF).



New National Electric Highway Coalition formed

The Edison Electric Institute (EEI) announced the formation of the National Electric Highway Coalition, which merges the Electric Highway Coalition and the Midwest Electric Vehicle Charging Infrastructure Collaboration and now includes additional participating electric companies from across the country. Currently consisting of 51 investor-owned electric

companies, one electric cooperative, and the Tennessee Valley Authority, the coalition is committed to providing electric vehicle (E.V.) fast charging ports that will allow the public to drive E.V.s with confidence along major U.S. travel corridors by the end of 2023. Read more [here](#).

Genex strikes "world-first" revenue-sharing deal with Tesla

Renewable and storage developer Genex has struck a "world-first" revenue deal with Tesla for its Bouldercombe big battery in Queensland, which will feature Tesla Megapacks and Tesla's Autobidder technology. The deal acts as a sort of off-take deal for the battery, providing a minimum amount of contracted revenue that will enable Genex to lock in finance for the 50MW/100MWh battery project near Rockhampton. It is common for a battery storage developer to lease out its battery to a third party to operate. This is the business model for other Australian batteries. "This is the first case we know of where the arrangement is struck with the battery technology provider." Read more from Genex Power [here](#).

Vestas reports cybersecurity incident and stolen data

Danish wind turbine manufacturer Vestas has confirmed that data stolen in the November 19, 2021 cybersecurity incident which involved external attackers compromising and gaining unauthorized access to data stored on Vestas internal file share systems, has been leaked by the attackers and potentially offered to third parties. The investigation carried out by Vestas has confirmed that personal data has been compromised by the attackers. Read more [here](#).

How much energy does Bitcoin consume?

The short answer is, "more than you would think." We recently stumbled onto this [Bitcoin Energy Consumption Index](#), which provides the latest estimate of the total energy consumption of the Bitcoin network. The index is provided by Digiconomist, "a platform that is dedicated to exposing the unintended consequences of digital trends, typically from an economic perspective. Tech trends often open up a world of possibilities but also bring their own unique challenges. It's easy to get lost in the optimism that accompanies those new possibilities, but it's important to maintain a healthy dose of realism." Well, we thought it was interesting.

NYPA deploys LiDAR tech from LineVision

The New York Power Authority (NYPA), the country's largest state-owned public power organization, announced it will deploy grid-enhancing technology to help unlock additional transmission capacity to enable more renewable energy to reach the grid. The non-contact LiDAR (light detection and ranging) sensors will be deployed to monitor NYPA's 230kV transmission lines in Franklin and Clinton counties in upstate New York. In addition to unlocking additional capacity, the sensor data will provide insight into conductor health and the real-time detection of anomalies and potential risks. The grid enhancing technology was developed by LineVision, a Boston-based firm that works with utilities to provide real-time, actionable data that optimizes the performance of transmission assets. Recent studies have shown grid-enhancing technologies can help double renewable energy integration, while dynamic line ratings have shown the ability to increase capacity on power lines by as much as 40%. Read more [here](#). Check out this video about LineVision's technology [here](#).

World's largest pumped storage to power Beijing Winter Olympics

The State Grid Corporation of China has announced the operation of the Fengning Pumped Storage Power Station, touted as the 'world's largest'. The plant is located in Fengning County, Chengde City, Hebei Province and will ensure the Beijing Winter Olympics is green, according to the statement. The project was started in 2013 and has 12 reversible pump-turbine generators, with each unit having a total generating capacity of 300,000KW. The project has a capacity of 3,600 000KW, generates 6.612 billion KWh of energy capacity per annum and has an annual pumped power of 8.716 billion KWh. The 12 units at Fengning have pumped capacity for 10.8 hours. The project has 190 caverns, the largest underground factory in the world, and is the world's first pumped-storage power station connected to the flexible D.C. grid, as a result of a connection made to the Zhangbeirou DC converter station. Watch video [here](#).

DTE Energy details \$7b investment in smarter, more reliable grid

DTE Energy announced its plans for a \$7billion, five-year investment in southeast Michigan's electric grid, preparing the state for the 21st-century demands posed by automobility/electrification, increasingly severe weather trends, and the fast-evolving needs of consumers and businesses. The investment was detailed in a filing with the Michigan Public Service Commission on September 30 and compliments DTE's vast, forwarding-looking plan to harden and upgrade the grid for the next 10 to 15 years. Read more [here](#).

Largest U.S. renewable energy project up and running

Pattern Energy Group announced it has completed construction and begun commercial operation of its suite of Western Spirit Wind power projects. Western Spirit Wind is comprised of wind power facilities totaling more than 1,050 megawatts (M.W.) located in Guadalupe, Lincoln, and Tarrant Counties in central New Mexico.



Image Source: Tractebel

The four wind power facilities that comprise Western Spirit Wind utilize a total of 377 GE wind turbines ranging from 2.3 to 2.8 MW in size. The G.E. turbines utilize various tower heights to optimize the wind capture at each facility. Read more [here](#).

World's first offshore hydrogen storage concept unveiled

Tractebel and partner companies have developed the world's first offshore infrastructure and processing facilities concept for hydrogen storage in offshore caverns. The design study, unveiled by Tractebel Overdick GmbH's offshore experts, outlines an innovative solution for large-scale hydrogen storage on the high seas: a scalable offshore platform for the compression and storage of up to 1.2 million m³ of hydrogen. Underground salt caverns will be used as storage and buffer for the hydrogen produced offshore before the gas is transported via the pipeline network to the onshore grid and finally to consumers and customers. Read more [here](#).

RWE and Audi create second life for E.V. batteries

A joint energy transition project between RWE and Audi is breaking new ground: In Herdecke, North Rhine-Westphalia, RWE has put an energy storage system consisting of used lithium-ion batteries from Audi EVs into operation. Using 60 such battery systems, this novel storage technology will be able to provide temporary storage for about 4.5 megawatt-hours of electricity at the site of the RWE pumped-storage power plant at the Hengsteysee reservoir. The decommissioned batteries supplied for the project come from Audi e-tron development vehicles. At the end of their first life in the cars, they still have a residual capacity of more than 80 percent. That means these "second-life batteries" are ideally suited for use in stationary electricity storage systems. Depending on how they are used, the batteries could still have a remaining service life of one to ten years. And they're much cheaper than new cells. That's where "second life" comes in: The carbon emissions generated when the batteries were produced are spread sustainably across two service lives – one in the car and one in the storage system. Read more [here](#).

The U.S. consumed a record amount of renewable energy in 2020

According to the [Renewables 2021 – Analysis and forecasts to 2026 report](#) (PDF) from the International Energy Agency (IEA), additions of renewable power capacity are on track to set yet another annual record in 2021, driven by solar P.V. Almost 290 gigawatts (G.W.) of new renewable power will be commissioned in 2021, which is 3% higher than 2020's already exceptional growth. Solar P.V. alone accounts for more than half of all renewable power expansion in 2021, followed by wind and hydropower. The growth of renewable capacity is forecast to accelerate in the next five years, accounting for almost 95% of the increase in global power capacity through 2026. Globally, renewable electricity capacity is forecast to increase by over 60% between 2020 and 2026, reaching more than 4 800 GW. This is equivalent to the current global power capacity of fossil fuels and nuclear combined. Overall, China remains the leader over the next five years, accounting for 43% of global renewable capacity growth, followed by Europe, the United States and India. Read more [here](#).



FEATURED ARTICLE



Electricity Storage: A Look Ahead

By [John \(J.D.\) Hammerly, CEO, The Glarus Group](#)

The last article in this five-part energy storage series addresses rapid marketplace change. In 15 months since this series started, the stationary electricity storage landscape dramatically evolved. Today, there is a de facto definition of storage durations. Short-duration is 8 or fewer hours, mid-duration, 8 to 72 hours, and long-duration, more than 72 hours. Of course, pigeonholing marketplace solutions into these categories remain messy as emerging long-duration technologies can store for minutes.

The first article focused on short-term storage only and a subsequent one on battery chemistries, particularly lithium. The lithium-based battery market shows incredible dynamism. Although lithium prices rose six-fold this year, battery prices are half the Q3 2020 prices because global factory capacity has grown eight-fold since 2019 to meet the demand for transportation electrification and stationary storage benefits.

Flow batteries continue to attract interest and pilots in both short-and mid-duration applications. Over the last year, major corporations became flow battery suppliers bringing scalability and R&D investment legitimizing this technology. Innovation in flow battery fluids continues to improve the quality and reliability of the batteries.

Although short-duration storage marketplace evolved rapidly, long-duration storage progressed from concepts to pilot projects over the same period. Further, two long-duration technologies emerged as early leaders, thermal (TES) and gravity-based (GES). TES uses electricity to heat sand and discharges by running heated air through turbines. TES begins production shipments in 2022 of packaged solutions. GES appears primarily in two forms, vertical and rail. Vertical GES lifts large weights to charge, stacking them to increase storage and discharging by lowering again. Implementations vary from mine shafts to cranes to complete buildings filled with weights. Rail GES charges by moving large railcars, 330 tons each, up inclined rails and discharges as the railcars descend again. Each railcar stores about 250kWh when raised a thousand feet in elevation. The number of railcars storage at the top and bottom equals the storage capacity.



Long-duration thermal and gravity electricity storage have advantages. First, none require major technological breakthroughs to achieve marketplace success because they rely on well understood, existing technologies combined uniquely. Secondly, these technologies consume and produce alternating current, avoiding inverter losses and complexity. Lastly, although these technologies target long-duration electricity storage market space, their flexibility allows storage durations as short as 15 minutes. Their fundamental advantages being, efficiency and extremely low cost per kWh stored, claiming less than \$0.02 at scale. Gravity storage requires scale to reach the cost claims, but thermal scales down to a single megawatt-hour.

Another encouraging long-duration storage is iron/air-based. This technology charges as iron "rusts" and discharges when it returns to its original state. Companies developing this technology have received massive investment and will reach commercial-scale quickly. Again, this technology offers scalability, efficiency, flexibility, unlimited duration, and exceptionally low cost.

What is next? Marketplace competition will drive energy storage costs down while capabilities and flexibility rise. Those technologies unable to remain competitive will disappear, while others will achieve greater market penetration. A consideration in the coming shakeout will be the customer's financial evaluation.

Investor/developer-driven projects prefer to exit the asset's useful life earlier to enable capital redeployment. Utility investments focus on long-lived, low-maintenance assets residing in the rate base for decades. Now, as large fossil assets retire, expect utilities to replace those with long-lived storage and technology-related assets such as communications. This outlook difference will enable certain

technologies to succeed because utility and investor/developer economic evaluations are not identical.

Hydrogen-based storage made the largest impact because it offers a carbon-free, energy agnostic future. Electricity produces hydrogen for water or methane, stored as a gas or liquid. Blending hydrogen with natural gas enables burning the blended fuel in existing combined-cycle gas turbines. Burning pure hydrogen in modified generators creates steam to drive traditional turbines, or a fuel cell can convert hydrogen into electricity. Of course, pure hydrogen can replace natural gas for industrial and residential heating applications and produces no emissions. Lastly, it offers promise as a transportation fuel because its energy density is more than one hundred times that of a lithium-based battery.

A year from now brings additional rapid evolution and technology maturation as the marketplace votes with its investments. It will be a fun ride.



FEATURED ARTICLE



Collaboration is critical for a 21st century DSO

Authors: Przemek Tomczak, Dr. Mani Vadari, Steve Ridley, and Colette Honorable

Last quarter's newsletter included a feature article titled, "Dominant DER Considerations Following FERC Order 2222." Building on that theme, some of the same authors collaborated on this article which contemplates the emerging role of the DSO.

With the introduction of Order No. 2222, FERC promised to "help usher in the electric grid of the future." In many ways, it was already here, fueled by changing market dynamics, growing consumer demands and greater digitization. While Order 2222 removed certain barriers (specifically those surrounding distributed energy resources or DERs), the energy and utility sectors were already undergoing a massive transformation.

How the industry responds to this evolution – and, more importantly, how it maintains service continuity and operational efficiency amid its acceleration – is still to be seen.

Consider, for example, the distribution utility. To meet this moment, the distribution utility must adapt and adopt the role of a distribution system operator (DSO). This would require them to assume the responsibilities of a distribution network service provider (DNSP), with a greater duty toward ensuring grid resilience and reliability while also meeting new consumer and societal objectives.

Best Practices for Progressive Digitalization

A DSO is typically charged with the maintenance and management (i.e., reliable operation) of the electric distribution system, interfacing with the bulk power system operators as well as new grid assets (including DERs).

In the emerging energy architecture, its role – and the many new technologies, customer-owned generation sources, and data resources within its territory – will demand more. The landscape will transition from the one-way flow of power to the power flowing both ways and require a new approach to grid modernization that drives decarbonization and democratization of energy through the network.

To properly enhance the grid and support the system in this way, a progressive DSO must address:

- The need to decarbonize against grid resiliency and reliability goals – Distribution model accuracy and coordination with the TSO (or transmission system operator) will be key as we contemplate new energy resources. Another consideration, of course, is cost. This will require the sector to consider whether the money being spent will provide the right

level of benefits (and rate) to the customer and to dial up or dial down its plans appropriately.

- State and federal levels requirements for a 21st century DSO – The recent passing of the Infrastructure Bill in the United States House of Representatives represents a strong signal of regulatory support for this transformative grid effort. As we move forward, DSOs must work with state and federal entities to ensure progress and innovation through greater visibility and understanding of existing processes and rules and manuals.
- Advanced data modeling capabilities and information sharing – Utilities must deal with a more dynamic grid than ever before and require the visibility and exchange of information securely. Aligning data models to time-series optimized data platforms will ensure data is high quality (for market settlements and reconciliation, for example) and performing analytics "in context" (i.e., blending data together from different siloes) will enable better planning and detection.
- An approach to digital transformation and automation – To support this kind of overall transformation and really drive change, a DSO must have an effective data strategy in place. This will require it to analyze its data readiness and establish a technology roadmap in order to properly execute its strategy. Together, these pillars will enable better planning and detection of events and anomalies.

A Blueprint Moving Forward

The electricity industry is journeying down a path, and strategic engagement involving stakeholders will be crucial to its success. FERC is not in the business of picking winners and losers, and it left many wondering, "Well, how are we going to do this? And how will interoperability be affected?"

It's a brave new world and it shouldn't be assumed that anyone player has all the answers – instead, the focus of any blueprint for the sector must be one of radical collaboration. As a first step, it is incumbent on regulators, DSOs, TSOs, generators, and end-customers to work together to define the 'why' of any approach. Are we trying to make a decision much faster? Or are we trying to improve the accuracy of our decision or planning, etc.?

What we are collectively working toward is complex and relies on the integration of multiple new technologies and resources to be successful. Only by examining existing strategies, readiness and roadmaps and refining them – together, constructively – will we realize a better energy future.

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FEATURED ARTICLE



The Road to V2G

By [Kevin Cheung, PSC](#), North America Managing Director
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The main focus of the energy transition for utilities is to harness renewable energy sources instead of using fossil fuels for electricity production. However, without a way to store energy on a large scale, the delicate balance of instantly meeting demand and consistently ensuring grid stability during this transformative time is a complex undertaking. But what if there was an existing electrical reserve utilities could draw from when needed?

V2G

That's where vehicle-to-grid (V2G) comes in. V2G is an interactive technology system utilizing bi-directional communications between the grid and battery storage. In this case, E.V.s are not only a load on the grid but also a distributed energy resource in the form of storage systems.

V2G technology generally involves an inverter interface between the E.V. and the grid, allowing for a bidirectional energy flow. Since the average vehicle is used less than five percent of the time, the idea is that E.V.s' high-capacity batteries can serve a dual purpose: to power E.V.s and act as backup storage cells for the electrical grid.

However, even as we know the 'smart grid' allows for two-way communication between the utility and its customers, we still have some steps to take until we reach that point for E.V.s. Until E.V.s are equipped with the capability to allow bidirectional flows of electricity and E.V. owners are assured they can still use their car when needed, V2G isn't ready for prime time. When E.V. users are also compensated for allowing their utility to use their E.V. for grid services, and the utility can get enough benefit from V2G to offset the cost of it, V2G will be ready for the next step.

Smart charging and V1G

Although we have a way to go to reap all the benefits of V2G, smart charging – sometimes called V1G, although they aren't exactly the same – is within our grasp today. Smart charging is one-way E.V. charging with the ability to set the time of the charge. Many E.V. owners are already doing this to take advantage of lower electricity prices by setting their cars to charge at night. V1G adds on the ability of the utility to regulate the charge rate dynamically. V1G is simply a type of demand-side management – like smart thermostats – that utilities can use to compensate their customers for participation. When an E.V. owner agrees to shift their charging to off-peak, when electricity is less in demand, they pay less. And, in theory, the utility can integrate E.V.s as controllable loads and potentially lower grid operational costs by reducing peak demand or shifting load to off-peak times. As E.V.s become more commonplace, their collective demand could present a greater ability to peak shift and shave to optimize electricity delivery.

V2G E.V. owner benefits

Full V2G technology can benefit E.V. owners when their cars are not in use. This may include E.V.s listed as PEV or Plugin Electric Vehicles, Plugin Hybrid Electric Vehicles or PHEV, BEV or Battery Electrical Vehicles, and some Fuel Cell Electric Vehicles requiring plugging into the grid for charging.

The integration of V2G technology can be used to control vehicle charging during off-peak hours. It can also increase the ability to return excess power to the grid during peak hours when needed. This provides additional benefits in the form of potential income for the E.V. owners. The idea is that E.V. owners could become actual electricity market participants with the ability to earn money by selling their stored energy back to the utility.

Of course, the ability of the E.V. owner to save and/or earn money depends on the local utility and regulations around interconnection requirements and demand response schemes. The amount of money will vary depending on the variations in the cost of electricity, generally based on Time of Use (ToU) structures.

V2G electric utility benefits

As mentioned, the main benefit of V1G for utilities is to absorb a peak in consumption through peak shaving or load shifting. For example, [a study \(PDF\)](#) that assessed the impact of introducing 2.5 million E.V.s in Turkey, reaching a penetration level of 10% in the total stock, concluded that this would increase the peak load by 12.5% with uncontrolled charging. However, the peak load would increase only by 3.5% with smart charging.

Where V2G really shines is by allowing utilities to aggregate energy from many E.V.s or fleets to create a potential VPP, or virtual power plant. Then, theoretically, utilities and E.V. owners could collaborate to charge E.V. batteries when electricity is readily available and cheaper.

Grid stability has become more challenging because of the fluctuating nature of renewable energy sources. Utilities could help balance the grid by using E.V.s for voltage support and arbitrage energy between periods of low demand (low prices) and high demand (high prices). So V2G has the potential to smooth out fluctuations using energy storage, helping utilities reach their sustainability targets.

Current V2G efforts

The IEA projects that E.V.s registered around the world may increase from about 10 million today to 145 million in 2030, per their "[Global E.V. Outlook 2021](#)." With the rapid increase in E.V.s across the globe, there is an increasing market for V2G technology.

Automakers have also seen the writing on the wall and are gearing up to make it possible for their E.V. batteries to be used as flexible, mobile energy storage units. One example is [Volkswagen's 'ID.' branded cars](#) which are headed toward bidirectional charging with a Home Energy Management System. This will be able to manage the power supplied to the charger to take advantage of the lowest electricity rates possible and make it easier for consumers to charge their vehicles using electricity generated by their own rooftop solar system.

According to a [2018 report \(PDF\)](#) by [Everoze and EVConsult](#) there are an estimated fifty V2G projects currently underway. Commercialization is already happening in [Denmark](#) and the Netherlands, where cooperation across sectors has shown some success.

There are also undoubtedly other obstacles to a more widespread V2G rollout, such as the perception that V2G operation degrades E.V. battery life. And even though V2G may not be fully economically feasible everywhere today, prices will reduce accordingly as this technology becomes more common.

With pilot projects and the ongoing coordination between utilities, regulators, E.V. OEMs, charging suppliers, and others, V2G has the potential to become a reality creating benefits for E.V. owners and grid operators alike... Not to mention the upside for our environment.



WHAT'S ON MANI'S MIND?

Are we heading towards an energy agnostic future?

The energy industry is moving towards an unusual future. For the most part, over the last decade, electricity consumption was declining, mainly spurred by aggressive energy efficiency actions. In the U.S., overall electricity consumption has either been flat or declining despite

- (1) increased population,
- (2) increased appliances in residence, and
- (3) companies expanding (pre-COVID) their real-estate needs.

One silver lining of this unusual time is the advent of electric vehicles. Consumer, light commercial vehicles, and large interstate transport vehicles are expected to change the consumption trajectory by bringing a new electric load into the system – and why many electric utilities are eagerly embracing this change.

Another major change on the horizon is an assault on natural gas. A growing number of U.S. cities are taking a stand against gas stoves, long billed as a more convenient way to cook, because of their contribution to climate change. Since June 2019, a dozen cities have banned natural gas equipment in new buildings. Berkeley, California, was the first, followed in the state by San Jose, Mountain View, Santa Rosa and Brisbane. In addition, a half-dozen other cities have passed laws to encourage all-electric construction without outright banning fossil fuels. On the East Coast in November, Brookline, Massachusetts, became the first city in the state to ban new gas hookups. From Cambridge and Newton in Massachusetts to Seattle, dozens of other cities are considering similar bans.

The last change on my mind in this area is the nascent advent of hydrogen as an alternative fuel in all of its various colors (white, grey, brown, green, blue, yellow, pink, or turquoise), used to identify the source of electricity to create hydrogen.

The question to me is not whether natural gas is good or bad. Nor is it about whether natural gas should be banned. These are topics for people much smarter than me. However, if one identified themselves, I would love to pick their brains on this.

At its core, **a utility's business – indeed, its purpose - is delivering energy to its customers.** Regardless of form (electricity or gas) or method (central or distributed generation), the utility of the future must have an open mind when considering options to achieve its mission-critical role. Just as renewable resources have become a viable alternative to fossil fuels, new technologies like dual fuel solutions, hydrogen delivery, fuel cells and others are being considered for a diverse energy future.

Signing off,
Mani Vadari



MEET THE TEAM



Kerry Donk

Kerry Donk is an accomplished professional with a proven track record of successful sales and marketing initiatives for large global industrial companies as well utilities. Kerry spent much of her time working in the sales and marketing group at Alstom Grid and brings over 30 years of experience in the energy industry where her primary focus was on utilities covering both North America and the world.

Kerry is a strategic consultant with a strong background in market research activities related to smart grids, system operations, and related enabling technologies. She is also proficient in assisting RFP response materials to reflect business expectations and goals.

Kerry has a solid reputation for business acumen and as a trusted C-suite advisor. She's known for influencing various audiences with her flexible approach to problem-solving and has spent time assisting with developing communication programs (mission, goals, culture) to encourage employee engagement and a better understanding of market-driven effects on both the business and the industry.

Originally from Billings, Montana, she now lives in Missoula. Modern Grid Solutions has come to depend on Kerry for her electric utility expertise and general project management skillset.



MORE ABOUT MODERN GRID SOLUTIONS

Modern Grid Solutions

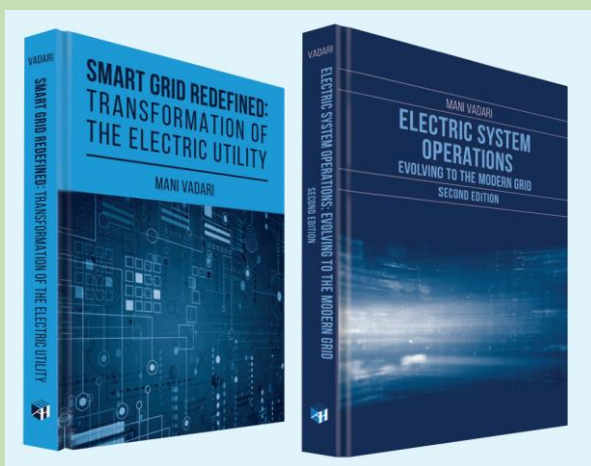
Modern Grid Solutions (MGS) is a cost-effective, global, supplier of deep expertise and board-experienced domestic resources. Our team members have been industry colleagues for over 25 years. Our approach focuses on delivering actionable guidance, direction, and value based on the depth of our team's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

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.

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-jurisdictional 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 a major multi-jurisdictional utility with assessing their ADMS implementation and helping define their long-range planning efforts.
- Assisting multiple startup companies in the areas of IoT, Blockchain, and Voltage regulator.

BUSINESS EXPERTISE AREAS	TECHNICAL EXPERTISE AREAS
For Utilities and Policy Makers <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> Solutions design and implementation Portfolio review and analysis Adjacency analysis and technology management Energy, REC and emissions trading



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. This book has been used in a semester-long course at Shri Vishnu Engineering College for Women in Bhimavaram and at BV Raju Institute of Technology in Narsapur, taught by Dr. Anil Jampala, Dr. NDR Sarma and Dr. Mani Vadari, author.

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)

Recorded Webinar: "To DER or not to DER – is that a valid question?"

Hosted by K.X. and CGI, this [roundtable of industry experts](#), including Dr. Vadari, explored the recent FERC 2222 ruling and the next steps affecting the North American Energy Markets.



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.