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State of the Grid

A Service from Modern Grid Academy

Welcome to the 3rd quarter newsletter from Modern Grid Solutions. We have passed a major milestone with this newsletter – it is now going to an organically evolving subscriber list of more than 1800 people. It is a packed newsletter full of very interesting articles that I believe you would enjoy.

Don't miss the last segment which also includes information on our successes and other activities.

Sincerely yours
Mani Vadari, Modern Grid Solutions

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1. MGS news – Hot off the Press

- Existing and ongoing projects at Modern Grid Solutions:
 - Develop conceptual design for a grid innovation center in New York to support the REV mandate.
 - Develop an OpenADMS application development platform
 - Select modeling and simulation tool to support a statewide electricity system planning process that supports accurate representations of distributed energy resources.
 - EMS integration at a utility in Southwest US
 - Evaluate distribution operations
 - Evaluation of energy trading operations at a Canadian Crown Corporation
 - Evaluation of a utility's DERMS needs at a utility in Northeast US.
- Dr. Vadari has now been named an Affiliate Professor at the University of Washington, Dept. of Electrical Engineering.
- Dr. Vadari delivered a graduate student lecture on Distributed Energy Resources management at University of Washington.
- Subscriptions to "State of the Grid" briefing has now blown past 1800 and is on its way to reaching 1850.

MGS's experts (more than 20) are making a difference in the industry. Our mantra: if you have a problem, someone in our team has solved it at least 3 times. Call us to find out more.

2. Mergers & Acquisitions

ABB Buys GE Industrial Solutions

Power grids maker ABB is buying General Electric's Industrial Solutions business for \$2.6 billion. ABB sees the potential for annual cost benefits of \$200 million with the deal, which includes an agreement for long-term use of GE's brand and a strategic partnership. GE products include circuit breakers, switchgear, components for lighting control and power supply equipment for facilities including data centers. ABB's portfolio includes similar products. ABB is seeking to better penetrate the North American market and gain access to GE's larger installed base of electrical installations worldwide.

Itron to Acquire Silver Spring Networks

Itron, Inc. and Silver Spring Networks, Inc. signed a definitive agreement for Itron to acquire all outstanding shares of Silver Spring for \$16.25 per share in cash. The transaction is valued at approximately \$830 million. Itron anticipates approximately \$50 million in annualized cost synergies to be substantially realized within three years of completing the transaction by optimizing combined operations and expenses. Itron envisions it will converge the best complementary technologies of both companies to provide streamlined solutions on standards-based platforms, allowing the combined company to optimize industrial networks and deliver more solutions that increase value for customers.

Total Acquires Energy Efficiency Company GreenFlex

Total to acquire GreenFlex, a French company specialized in energy efficiency. GreenFlex is one of the European leaders in its sector, with more than 600 clients. It combines data intelligence, equipment management and financing to help clients manage their energy consumption efficiently.

The acquisition is expected to accelerate the expansion of Total's energy efficiency offering, over and above the growth of its affiliates BHC Energy in France and Tenag in Germany. Total intends to offer its customers integrated solutions, from optimization of energy needs and sources and finding financing solutions to energy management and emissions measurement and reduction.

3. Key Highlights

DOE Expands SunShot Program After Early Success

The U.S. Department of Energy announced plans to expand the SunShot program after hitting its 2020 goals to trim utility-scale

solar costs to \$0.06/kWh, or under \$1 per watt, three years early. Under the new goals, the popular program plans to cut utility-scale solar costs in half to \$0.03/kWh by 2030. The agency also plans to trim commercial solar costs to \$0.04/kWh and residential solar to \$0.05/kWh in the same timeframe. The Office of Energy Efficiency and Renewable Energy (EERE), which houses SunShot, also announced \$82 million in funding for early-stage research in concentrating solar power and power electronics.

As part of the SunShot expansion, DOE allocated \$62 million for concentrated solar power technologies and \$20 million for early-stage power electronic projects that would help grid operators better detect problems, while also shoring up against cyber and physical attacks.

California's Utilities Blocking Community Choice

San Diego Gas & Electric Co. and Pacific Gas & Electric Co. are working to thwart the expansion of government-owned electricity programs. They are seeking to impose a moratorium on community choice aggregation (CCA) programs operated by local governments as alternatives to existing power companies. The legislative effort, dubbed the Freeze Bill is proposing to put the choice program expansion on hold, until the state develops appropriate fees to be paid by customers who leave for government-run providers.

The CCA movement is the latest potential blow to IOUs, which have endured a dramatic shift in their industry with the proliferation of rooftop solar, improved energy efficiency, use of smart technology and the advent of battery storage that enables consumers to store electricity in their garages. Although the IOUs support consumer choice, they insist that the current regulatory framework creates inequities for those who want to stay with their existing power provider.

Hurricane Maria and the Destruction of Puerto Rico's Grid

The devastation that Maria exacted on Puerto Rico's electricity system when it slammed ashore as a Category 4 storm is unprecedented. Most parts of system are still offline. The territory is facing weeks, if not months, without service as utility workers repair power plants and lines that were already falling apart.



Source: wired.com

Puerto Rico's power plants are clustered along the island's south coast, a hard-to-reach region that was left completely exposed to

Maria. Even before the storm, Puerto Rico's grid was in disrepair, outages were common, and the median plant age was 44 years, more than twice the industry average. Government-owned PREPA, the island's utility provider, operating under court protection from creditors, has more than \$8 billion in debt. Rebuilding the island's grid into something more robust will cost billions of dollars.

Extreme Weather Events Drive Battery Microgrids

As frequency of extreme storms, like the ones that recently devastated Puerto Rico and Houston, grows, battery-connected microgrids are emerging as a potentially crucial technology. Such systems could help hospitals, shelters and retail outlets become more resilient against surging waters and torrential winds compared to backup diesel generators or relying on the power grid to remain operational.

Puerto Rico has emerged as a potential market for batteries following Hurricane Maria. Recently, Tesla CEO Elon Musk suggested that his company could rebuild Puerto Rico's power grid with solar and batteries in the wake of the devastating storm. However, Musk isn't the only one interested in selling and delivering batteries to the region.

The recent attention focused on distributed energy storage for storm resilience coincides with broader market trends that have battery technologies poised for takeoff in the years ahead.

FERC Proposes DER aggregation in wholesale Markets

In late 2016, the FERC issued a Notice of Proposed Rulemaking (NOPR) that would require regional transmission organizations (RTOs) and independent system operators (ISOs) to modify or create rules to enable energy storage and aggregated DER participation in wholesale markets.

Integrating DERs into the wholesale markets could shake up the system and require changes to the way the bulk power system works to ensure that electric distribution companies can continue to provide reliable power to customers and operate the grid effectively.

FERC has completed the notice and comment period for the rule, and now, with the confirmations of commissioners Chatterjee and Powelson, the Commission has regained a quorum and can now move forward with the rule. The Commission's proposed energy storage and DER aggregators rule would reduce existing market barriers and better facilitate inclusion of electric storage resources and distributed energy resource aggregators into wholesale electric markets. Solar energy providers support the Commission in proceeding with this rulemaking.

Hydrogen in Microgrids

Microgrids typically rely on local sources of power generation such as solar PV, wind, and other renewables. In recent times, with hydrogen-based technologies getting cheaper, hydrogen is gradually making its way into microgrids.

Emerging business models are setting the stage for hydrogen to play multiple and significant roles in microgrids. Some examples include:

- Remote Microgrids: Hydrogen Displacing Diesel

While batteries are generally too expensive for multiday storage durations, hydrogen tanks can be easily scaled, independent of the peak power demand. This type of model is quickly becoming commercially viable. Some reasons include capital and operating cost declines, tighter emissions regulations across the globe, and an eagerness to bypass the diesel value chain across hazardous terrain in remote areas.

- **Microgrids Exporting Hydrogen**

A bank of onsite electrolyzers can turn excess electricity into hydrogen, which can then fuel onsite fuel cell vehicles and can also feed the microgrid's fuel cell bank to generate power.

- **Islands: Hydrogen as Local Energy Commodity**

In places like Hawaii, the appeal of hydrogen is growing, thanks to concern over climate change and a growing need to store the high output of intermittent renewables—often using power-to-gas schemes. In addition, the captive nature of the vehicles helps alleviate the infrastructure problem since relatively few stations are needed.

Hydrogen's outlook is slowly improving, owing to cheap renewables and improving electrolysis technology. Hydrogen development is expected to be focused in small geographic areas through 2020.

Virtual Transmission Lines - A 'Non-Wires' Alternative

More states around the country are investing in non-wires alternatives, distributed energy projects that can substitute for expensive upgrades to distribution infrastructure. The concept, called "virtual transmission lines," centers on using DERs like rooftop solar or battery storage, stepping in when power is needed -- and getting paid for it. Though distributed energy can't shuttle electrons through a system in the same way traditional transmission lines can, it can help shore up the grid in certain areas so that electricity doesn't need to be dispatched from elsewhere.

Two FERC orders – 890 and 1000 were meant to make transmission planning more transparent and competitive. They require utilities to regionally compare different solutions for transmission load issues and pick the most economically viable.

With technology and prices improving for behind-the-meter installs, the partnership hopes to bring clarity to the process, and boost the profile of DERs competing against traditional transmission investments.

U.S. Senators Introduce the Advancing Grid Storage Act

The U.S. Senate Energy Committee, introduced the Advancing Grid Storage Act to accelerate investments in the deployment of energy storage systems. The Act promotes research, development, demonstration, and deployment of energy storage systems by:

- **Advancing energy storage research and development**
Authorizing \$50 million per year of dedicated funding for energy storage systems within ARPA-E.
- **Establishing a technical assistance program for energy storage systems**
Establishing a 5-year, \$500 million program to help identify opportunities, assess feasibility, overcome interconnection and permitting challenges, conduct financial assessments, and perform required engineering.

- **Supporting demonstration and deployment of energy storage systems**

Establishing a 5-year, \$500 million program to help overcome high upfront capital costs of energy storage systems.

Artificial Intelligence for Energy?

Artificial intelligence (AI) is expected to play a significant role in managing, optimizing, and maintaining the grid and power plants. Analysts at Navigant predict that power companies will turn to AI for increased reliability, safety, cyber security, efficiency and better customer experiences.

Examples such as Nest's thermostat lowers the temperature of a home and reduces energy consumption after using AI to learn its occupants' habits. Startup Comfy delivers a similar service for office buildings, but by using a combination of AI and an app for office workers.

Developing AI tools for energy companies could be a major opportunity for startups and traditional tech vendors alike. New players are expected to emerge with brand-new, focused applications, and existing AI players like Google, GE and IBM are expected to use data tools from the web and consumer internet for energy services. AI could fundamentally change the way energy systems are built and operated.

Battery Storage Uptake by Australians as Grid Costs Soar

Battery storage system installations in Australia are expected to treble in 2017, compared to last year, driven by a growing uptake of home battery systems.



PHOTO: More Australians are investing in battery storage for their homes as the technology gets cheaper.
(ABC News: Alex Mann)

Source: www.abc.net.au

Home battery storage installations, are mostly being sold in combination with a rooftop solar system, is being driven mainly by major power price hikes, as homes and small businesses seek to maximize the consumption of their rooftop solar. As solar costs continue to fall, the payback time for customers buying PV and battery storage system is narrowing in most parts of the country due to much bigger savings on bloated power bills.

Australia remains a key market for battery players globally, largely owing to its world-leading uptake of rooftop solar, high electricity tariffs and low solar feed-in tariffs.

Lessons Learned from Performance-Based Regulation in the U.K.

Performance-based regulation has emerged as a promising potential solution to the many challenges faced by public utility commissions. But regulators interested in performance-based regulation are searching for real-life examples where it has worked well.

The United Kingdom began moving in this direction a few years ago. Its new regulatory structure called RIIO (Revenue set to deliver strong Incentives, Innovation, and Outputs; or Revenue = Incentives + Innovation + Outputs), went into effect just over four years ago, and contains several important lessons relevant to U.S. regulators

- Invest time upfront, to define outcome-based performance measures clearly and quantitatively.
- Create programs that last less than 8 years, or set predefined points for review and adjustment for less than eight years.
- Explore whether revenue caps, outcome-based performance incentives are right. Ensure the combined financial impact of incentives is crafted to capture utility management attention.
- Focus on important normalization factors (GDP, inflation, population changes or electrification rates) and build off-ramps and correction factors from the beginning. Look for ways to share value fairly between utilities and customers.

Kaspersky Labs Security Software

The Senate Intelligence Committee asked six top intelligence officials, if they would be comfortable with Kaspersky Lab software on their agencies' computers. Each answered with an unequivocal no.

Founder, Eugene Kaspersky, dismisses concerns that his company assists Russia's intelligence agencies with cyberespionage. He states that his antivirus software does not contain a "backdoor": code that deliberately allows access to vulnerable information.

Installation of Kaspersky Lab software, allows the company an all-access pass to all applications, files and emails. And because Kaspersky's servers are in Russia, sensitive United States data is constantly cycled through that country. Russian law requires telecommunications service providers such as Kaspersky Lab to install communications interception equipment that allows the F.S.B. to monitor the company's data transmissions. All of which are serious concerns for the U.S.

4. Smart Grid venture capital (VC) funding

VC funding for Smart Grid companies in Q2 2017 came to \$139 MM in eight deals compared to \$164 MM in 14 deals in Q1 2017. In a year-to-year comparison, \$222 MM was raised from 15 deals in Q2 2016. \$304 MM was raised in 22 deals in 1H 2017 compared to \$331 MM raised in 29 deals in 1H 2016.

Top VC Funded Companies in H1 2017

Company	\$ M	Investors
Microvast Power View	400	CITIC Securities, CDH Investment, National Venture Capital
Chargepoint	100	TIAA Investments
Actility	82	Daimler, BMW i Ventures, Linse Capital, Rho Capital Partners, Braemar Energy Ventures
Kinestral	75	Credev, Bosch, Inmarsat, Idinvest, Bpifrance, Ginko Ventures, etc.
	65	Undisclosed

Source: Mercom Capital Group, llc

5. News from Modern Grid Solutions

MGS team grows its team of experts

MGS has built a portfolio of experts with 25-40 yrs. 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.

Smart Grid Redefined – Transformation of the Electric Utility (to be released at Distributed 2018)

Please stay tuned for Book #2 from Dr. Vadari. This book to be published by Artech House focuses on different aspects of the Smart Grid that are now becoming mainstream at utilities worldwide are its impacts on how utilities are transforming themselves.

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



At Modern Grid Solutions, *Smart Grids Are Business as Usual*
We deliver 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.