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Management Survey
on Page 4

State of the Grid

A Service from Modern Grid Academy

Welcome to the 1st quarter newsletter from Modern Grid Solutions. Our subscriber list continues to grow organically and we have now passed 1650. This is the first newsletter for 2017 – Welcome. 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

- Dr. Vadari has been appointed by the University of Washington as an Affiliate Professor of Electrical Engineering.
- Subscriptions to “State of the Grid” was at 1425 at last release. It has now blown past 1650 and is on its way to reaching 1700.
- Dr. Vadari was a key presenter at the India Smart Grid Week held in Delhi on 7th – 10th March 2017.
- MGS has over 20 experts making a difference – each has between 25-40 years of experience in their respective fields. If you have a problem, someone in our team has solved it at least 3 times. Check out our web-site to find out more.

2. Mergers & Acquisitions

OVO acquires VCharge

VCharge will join OVO and continue its work on a proprietary technology platform that according to OVO will change the way electricity grids are controlled to allow for greater integration of storage and renewables.

The platform uses algorithms to balance grid requirements with those of individual users, and has so far been used to help control electric heaters in homes facing fuel poverty. Heating controls are installed and controlled via a smartphone which, when coupled with new tariffs, have been proven to help reduce consumer bills.

VCharge will build on OVO's successful trials with social housing landlords in London and Scotland, and offer free heating control upgrades with new OVO smart tariffs for about 1.5 MM homes.

EU Approves Merger of Siemens and Gamesa

Siemens and Gamesa have received unconditional approval from the EU for their planned merger. The deal, giving Siemens a 59% stake in Gamesa creating the world's largest wind turbine manufacturer with a market capitalization of \$10.7 B.

The move would combine the German company's strength in offshore wind power and the Spanish company's strong presence in emerging markets. The new company would be headquartered in Spain with offshore division in Germany and Denmark.

GE Acquires LM Wind Power

GE plans to purchase LM Wind Power, a Denmark-based manufacturer and supplier of rotor blades for wind developments, for \$1.65 B.

LM Wind Power is GE's largest blade supplier. Since 1978, LM Wind Power has produced more than 185,000 blades and contributed to 77 GW of wind power capacity. The deal would give GE's Renewable Energy segment an internal source for wind turbine blade design and manufacturing and improve its ability to increase energy output.

3. Key Highlights

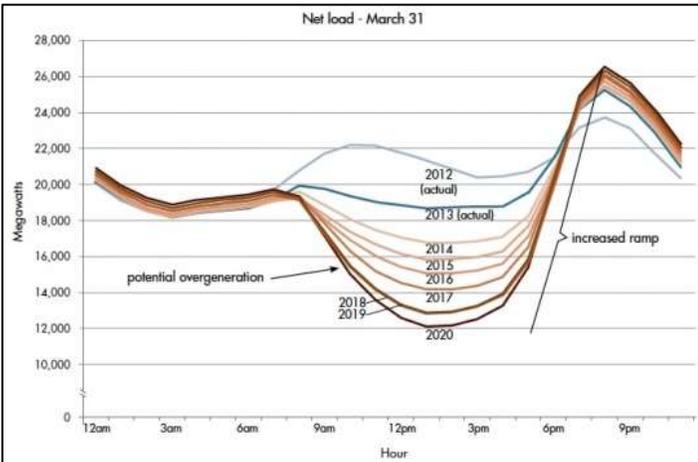
California's Duck Curve Worsening

California's sunshine helps produce lots of solar electricity during the day, when demand is typically low. Usually, demand for power peaks in the morning, when people are getting ready for work and school. Then they leave home for the office, causing power usage to drop off in the middle of the day. Later, when they return home, there's a peak between 7 and 9 p.m. as they cook dinner and watch TV or use computers. This use pattern typically creates a gentle wave-like dip, but because of the growing popularity of solar power, that demand trough during the day is getting deeper.

When plotted on a graph, this creates the sagging belly of the duck, hence 'Duck Curve'. Then, when the sun goes down, the demand for power from conventional power plants quickly ramps up.

Some of the best solutions to the California Duck Curve problem may come from breakthroughs in energy-storage technology. The ability to efficiently store power during low-demand hours and withdraw it during high-demand hours would allow the curve to be flattened even further.

Software will play a big role. It would help monitor and coordinate the control of many distributed energy resources ranging from solar, wind, gas, to hydropower. Since many of these sources are



owned by third parties, they will need advances in communication, visualization and optimization software to get them working together.

Source: www.gereports.com

Utility Solution for DER Management

Siemens has introduced its Distributed Energy Resource Management System (DERMS) a solution for more flexible and scalable management of distributed energy resources.

The new solution includes tools that provide data and visibility across the energy system, from distribution grid planning to market forecasting, for more effective management of existing and adoption of DERs.

The solution also features customer-centric applications that allow utilities to better define, forecast and control customer-owned distributed energy resources across their territory, enabling customers to become energy “prosumers.”

DERMS features advanced distribution control center functionalities that provide insight into the entire power system state, operations planning to define how the system should be operated in the coming days and weeks, and customer oriented applications that define, aggregate, forecast, settle and control customer-owned distributed energy installations within a utility’s service territory. These applications improve system reliability and outage restoration and increase automation, communication and analytic capabilities across the system through advanced data management processes.

Source: www.usa.siemens.com

4. Cloud-Based Innovations in Power

The current electrical grid is built around the concept that a central control center manages a limited number of generation sites via telecommunication. This approach has worked well for many decades.



However, change is now afoot. It is expected that by 2025, more than 25 billion “smart” energy devices will (must) be simultaneously connected to the electrical grid and to the internet. This means that an estimated 44 trillion gigabytes of data (44,000 exabytes¹) coming in needs to be handled efficiently, extensively and in real-time.

Here are a few questions for electric utility C-Suite executives:

- Where is the bandwidth? and where is the storage?
- Who is going to invest to build and run all this?
- Who is going to pay? and who is making the money?

Our industry always reacts to these kinds of new challenges by running “a pilot project” and “testing” some new approaches to see if that solve the problems. Although this approach works well in most situations, in this case, the small number of sites tested in a pilot project do not have the size and scale to identify the “44 trillion gigabytes of data” problem let alone find a solution. Julius Caesar was told to “beware the Ides of March”. to this we would add to beware the words “it is a cloud based solution” or “it runs in the cloud”. It is your balance sheet that may be assassinated.

On the list of power sector transformational issues that merit a “cold eyes” review, this one should be near the top. The good news is that this is already happening through the emergence of utility and prosumer profit-friendly solutions.

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¹ In comparison, Google’s datacenter capacity is expected to be 0.0013 exabytes/second according to Computerworld (2015).

Concord, MA Builds a Fiber Network

The town of Concord, MA, has a history of triggering important initiatives in geopolitics, American literature, and now municipal fiber. In 2009, Concord voters authorized Concord Municipal Light Plant (CMLP), to build a \$3.9 MM smart grid which included a 100-mile fiber-optic network passing 95% of premises in town. In 2013, the town borrowed \$600K to fund startup of an Internet access business, Concord Light Broadband. The town began making fiber connections to subscribers’ premises in early 2015.

By the end of 2016 CMLP was serving about 750 customers with service of up to 200 Mbps upload and download. Today the town’s network has added reliability to elements of the town’s electricity grid, helped the town avoid \$108,000 in annual communications costs, and generated \$88,000 in annual leasing revenue. The town has recently begun a strategic planning process in part to help identify how the smart grid can best be used to reduce expensive peak-hour electricity demand, reduce operating costs, enhance revenue, and cut greenhouse gas emissions. One vendor estimates that CMLP could earn \$125,000 in revenue by allowing the regional transmission system to use the town’s smart grid to help balance regional electricity supply and demand. Although the financial paybacks on the town’s project are not yet fully covering debt service and operating costs, the long-term prospects are bright, especially given that the fiber will last 30 or more years, and debts on the smart grid will be paid off after 15 years.

Voltage Optimization Pilot at Ameren Illinois

Ameren Illinois is implementing a world-class energy infrastructure modernization program to improve service reliability in central and southern Illinois. Volt/VAR optimization has the potential to deliver significant energy efficiency savings for

our customers. Ameren Illinois is working with Utilidata to implement their innovative technology.

Utilidata's AdaptiVolt™ technology leverages real-time information from the distribution system to optimize the delivery of electric power and has been proven to help utility companies reduce their overall energy consumption without any required changes to consumer behavior. The technology helps to reduce losses and save energy by optimizing how a utility's electric distribution system voltage control devices operate as electricity travels from substations, through the electric distribution system, and ultimately to homes and businesses.

5. Utility Generation – Hunkering down to create value

"I believe the IPP model is now obsolete and unable to create value over the long term."

These are the stern words NRG CEO Mauricio Gutierrez used in the last earnings call. Almost uniformly, North America Utility companies are feeling the pain of prolonged price depression and customers load is slowly disappearing.

How can Gencos and regulated generators have been forced to respond a plethora on business drivers such as new markets (i.e. the Energy Imbalance Market), low prices, rate caps from intense regulatory pressure, new rules on safety and higher expectations of environmental stewardship. To respond requires a strategic re-think and a top-down shaping of the operating model. Generators are finding they may have no choice but to strive to first quartile performance on operations and flexibility just to make any profit.

Recent work with one generator has yielded some systematic change to core capabilities. It resulted in several initiatives to update the operating model and include:

- Fleet Planning and scheduling - Centralize and standardize all work planning and scheduling across the fleet, not by plant fiefdoms;
- Outage Optimization - Optimize the planned outage schedule to minimize costs and maximize availability for market opportunities;
- Work Dispatch and Execution - Weekly maintenance work packages developed in advance with all pre-requisites addressed to increase wrench time by up to 50%;
- Workforce Flexibility - Trades and engineers team up and are mobile to work across the fleet while specialty crews increase quality and productivity and contracting provides the expansion and contraction based on revenue.

New technologies provide greater leverage for operations but reframing the business activities create the new value equation. Such measures will create needed headroom for both regulated and non-regulated generators.

*Charles Filewych
CEO, SGiCTech*

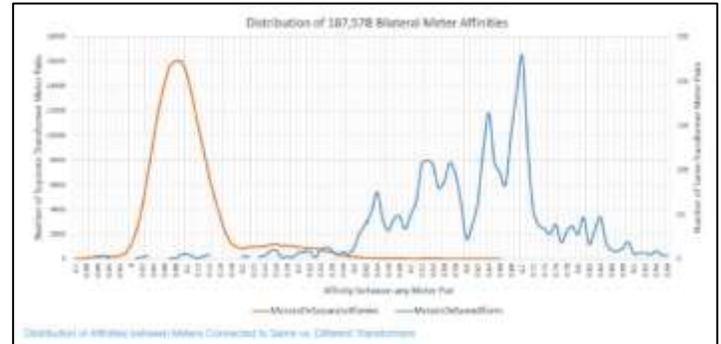
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Algorithm to Identify Poorly Connected Meters

Accurate Meter-to-Transformer connectivity is essential to enable a smart grid. A dynamic grid connectivity modeling service from Itron called Grid Connectivity is now commercially available.

The service uses an innovative algorithm for validating and correcting the utility's meter-to-transformer connectivity. It uses normally occurring voltage fluctuations at each meter as a signal to identify the meter.

The meter-to-transformer connectivity method relies on correlating five-minute time series of voltage changes between any two meters within a user-settable limit, typically 1,000 to 3,000 feet. The algorithm exploits the fact that a voltage change caused by switching a load at a premise is "felt" by most meters that are connected to the same transformer. Therefore, by correlating each meter's voltage changes to those of all other meters that are within



a reasonable radius (e.g. 1,000 feet), one can distinguish meters on the same transformer.

Source: www.itron.com

Mobile Apps Increase Customer Satisfaction

As utility companies increasingly offer mobile apps, customers are finding that the digital experience with those apps is more satisfying on a smartphone than with other mobile options such as responsive design or dedicated mobile sites, according to the J.D. Power 2017 Utility Website Evaluation Study.

The study finds that among the three types of mobile channels utilities offer, satisfaction is highest for mobile apps, which score 415 points on a 500-point scale. By comparison, responsive websites—those where the web content adjusts to various screen sizes—score 409 points, and dedicated mobile websites score 403 points. Overall satisfaction with the mobile experience continues to lag the desktop experience, which averages 422.

While use of mobile apps from utility companies is still relatively low, usage is on the rise.

Electrification: Emerging Opportunities for Utility Growth

A Brattle whitepaper provides a counter-narrative to the utility "death-spiral," a vicious cycle of declining utility sales and rising electricity rates. Under this paradigm, weak utility sales growth is exacerbated by increasing distributed generation (DG) penetration.

Under the Brattle scenario, utility sales could nearly double by 2050 while energy sector carbon emissions would decrease by 70 percent. In this scenario, even partial electrification of heating and transportation could present a large opportunity for utilities to increase sales and be a major catalyst for reducing GHG emissions.

However, challenging questions remain. Who will bear the costs of this transition? How do those costs compare to alternative options for decarbonizing the economy? How will power grid operations be impacted by new, significant sources of load?

Several initiatives could be pursued by utilities to nudge future industry developments towards electrification. Such activities include retail rate reform, effective engagement with regulators and policymakers, enhanced planning activities, facilitating the deployment of vehicle charging infrastructure, and developing new

programs to leverage the grid flexibility benefits that could be provided by more electricity-intensive end uses.

Asian Energy Ring: A Reality?

The draft of the Asian Energy Ring (AER) that was first brought forward by Russia has been in existence for many years, yet it hasn't been implemented. However, there's a chance that the latest developments in the Asian-Pacific region may assist Moscow in bringing its vision to life, since it promises benefits to all parties.

The AER project involves the creation of a single electrical network that would transmit electricity across countries. Such a network would effectively distribute electricity surplus, which occurs when production in a certain country exceeds consumption. It is noteworthy that Russia has always had such surpluses in the Amur region, which shares a common border with the north-eastern provinces of China. If AER is to be implemented, Russia could export excess electricity it has to China, and then – to other Asia Pacific countries, where the rapidly growing population is pushing the economy forward, thereby creating a constant increase in energy consumption.

In January 2017, Bangkok hosted a series of forums, all of which were attended by Russian delegations. The project attracted a lot of interest from Southeast Asian players, and first shipments of Russia's electricity could begin as early as 2025.

6. Smart Cities: Opportunity for the Next Big Wireless Upgrade

With the advent of smart cities, the next wave of wireless deployment is here. The new technology called "small cells", could supplement and supplant the giant cell towers that the current network is mostly carried on. But outdated regulatory regimes are hindering deployment and, according to the wireless industry, inhibiting jobs and economic opportunities in cities ripe for infrastructure development.

Small cells promise more than just increased wireless reliability on every street corner. Industry advocates say that integration with city services could lead to everything from improved power efficiency to more responsive emergency services to better smart-car performance.

Telecom operators are expected to invest approximately \$275 billion in infrastructure, which could create up to 3 million jobs and boost GDP by \$500 billion.

There's two main hurdles in the way of smart cities and small cells. The first is backhaul infrastructure. Each small cell needs a wire running to it that can provide backhaul to the greater internet.

The other big hurdle is spectrum - along the coasts and in major urban centers, there's a spectrum shortage. Freeing up more spectrum, as the Federal Communications Commission has slowly been doing, would allow small cells to communicate with each other and with consumers with less infrastructure.



Regulatory reforms such as streamlined permitting, improved right-of-way application process, and updated fee structures would open the markets to small cell deployment. *Source: en.wikipedia.org*

7. Smart Grid venture capital (VC) funding

Top VC Funded Companies in 2016

Company	\$M	Investors
Vivint.Smart Home	100	Peter Thiel, Solamere Capital
ChargePoint	50	Linse Capital, Braemar Energy Ventures, Constellation Energy, etc.
AutoGrid	20	Energy Impact Partners, Envision Ventures, Envision Energy, E.ON
mPrest	20	GE Ventures, OurCrowd
Powerhive	20	Prelude Ventures, Caterpillar Ventures, etc.
SmartWires	20	Undisclosed

Source: Mercom Capital Group, llc

2016 VC funding of was \$389 MM in 42 deals, compared to \$425 MM in 57 deals in 2015. Total corporate funding, including debt and public market financing, was \$613 MM compared to \$527 MM in 2015.

The top VC funded companies were Vivint SmartHome, which brought in \$100 MM, ChargePoint with \$50 MM, followed by AutoGrid, mPrest, Powerhive and Smart Wires each with \$20 MM.

Asset Investment Planning Survey

We ask your help shaping the industries understanding by taking a five-minute survey.

While the pace of electricity industry change continues to increase, so has customers' reliability expectations. In fact, while some customers rely less on the utilities' energy, they now demand even more reliability. For the utilities to meet their customers' reliability demands at a time when the utility control over the grid is challenged by distributed energy resources and ever-changing load patterns, utilities' focus is shifting more to asset management and asset optimization.

This newsletter reaches the thought leaders in the industry, and we wish to validate some fundamental characteristics of the emerging asset solutions space.

Please select the URL to respond to the survey: <http://www.surveygizmo.com/s3/3532846/New-Survey>

8. News from Modern Grid Solutions



Dr. Vadari has been appointed by the University of Washington as an Affiliate Professor in Electrical Engineering.



MGS team grows its team of experts

MGS's portfolio of experts bring 25-40 yrs of experience in fields ranging from Grid Modernization, T&D Operations, Wholesale and Retail Markets, Generation operations, Utility regulatory & economics, Energy Efficiency and Demand Response and T&D Planning. [Check us out!](#)

Books – By Author Dr. Mani Vadari

Electric System Operations – Evolving to the Modern Grid. Published by Artech House. Several universities such as University of Wisconsin, Pennsylvania State University, Stonybrook and others use it as a textbook. Also, trending to 5 stars on Amazon and continues to get rave reviews from readers. Buy them at a leading retailer.

Next Book – on Grid Modernization (tentative title “Utility 3.0 – The Journey to a Smarter and Distributed Grid”). To be published by Artech House in 1Qtr2018. Stay tuned right here for more information on the book.

Key Publications

- Mani Vadari, “[Distributed Energy Resources: The Challenge of Integrating Supply/Demand Diversity](#)”, Reference Article doi: 10.1049/etr.2016.0034, ISSN 2056-4007, Jan, 2017, Engineering and Technology Reference, www.ietdl.org.

Training news -

Courses offered by IEEE and edX.

- Module 1 of the IEEE certificate course titled “**Smart Grids: Electricity for the Future**” was extremely successful with over 8300 registrants from across 167 countries. You can still register for the course at: “<https://www.edx.org/course/smart-grids-electricity-future-ieee-smartgrid-x>”. Please pass the course and registration information to all the people in your contact lists.
- Module 2 of the IEEE certificate course titled “**Distributed Energy – Smart Grid Resources for the Future**” is now live and has over 4000 registrants. You can register for this course at: “<https://www.edx.org/course/distributed-energy-smart-grid-resources-ieee-smartgrid02-x>”, Please pass the course and registration information to people in your contact lists.
- Stay tuned for Module 3.

Instructor-Led Courses and Tutorials

- Leading the Transition to a Smart City – A 360° perspective on planning for the future**, Dr. Vadari delivered the tutorial at the India Smart Grid Week, 2017 in Delhi, India. March 2017
- Grid Modernization Masterclass – Roadmap to fast evolving New Energy Eco-System**, Dr. Vadari delivered the masterclass to senior personnel at the Jamaica Public Service. March 2017

Events and News – Dr. Vadari in the news

- Dr. Vadari has been appointed as Affiliate Professor at the University of Washington, Department of Electrical engineering
- Dr. Vadari presented at a panel session at Distributech 2017 in San Diego. The title of the panel session was “The Next Generation Distribution Grid: Grid 3.0”

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



*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.*