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State of the Grid

A Service from Modern Grid Academy

Welcome to the 3rd quarter newsletter from Modern Grid Solutions. This is a packed newsletter full of very interesting articles that I believe you would enjoy. We also have two articles here that will be sure to tickle your interest and attention (1) Intelligent Streetlights and (2) Utility transformation.

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

Sincerely yours

Mani Vadari, Modern Grid Solutions

Table of Contents

1. MGS news – Hot off the Press	1
2. Key Highlights	1
CA Approves Climate Change Law	1
New Energy Storage Material Could Speed up Charging.....	2
Solar + Storage may get cheaper than grid in 2017	2
National Grid to Add 14 MW of Solar Test Batteries.....	2
Emerging Relationship between DERs and Transmission System	3
Costca Rica Two Straight Months on 100% Renewable Energy	3
Bold Renewable Energy Targets for India.....	4
3. Intelligent Streetlights – the Smart App for the Smart City	1
4. Utility of the Future – the beginning of transformation	2
5. Mergers & Acquisitions	3
Utility Investment at the Grid Edge	3
S&C Acquires Intelligent Power & Energy Research Corporation ...	3
Innogy to Acquire BELECTRIC Solar & Battery Holding	3
Xylem to Buy Sensus	3
6. Smart Grid venture capital (VC) funding	4
7. News from Modern Grid Solutions	4

1. MGS news – Hot off the Press

- The city of Ajmer was selected in the latest round of winners in the Smart City India Challenge grant. Congratulations to the City of Ajmer. Such a proud moment.
- Dr. Vadari is part of several USTDA initiatives – India (Ajmer and Allahabad), Jamaica (Intelligent Streetlights) and Turkey.
- Subscriptions to “State of the Grid” briefing is approaching 1400
- MGS and its extended team of experts 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. Key Highlights

CA Approves Climate Change Law

A controversial measure to extend California’s target for reducing greenhouse gas emissions was approved by the Assembly, clearing a major hurdle in a battle over the future of the state’s environmental programs. The legislation would require slashing greenhouse gas emissions to 40% below 1990 levels by 2030 which is a tougher target than the current goal of hitting 1990 levels by 2020. It is the sequel to Assembly Bill 32, a landmark 2006 law that laid the groundwork for California’s extensive array of environmental initiatives, including the cap-and-trade program, which provides a financial incentive to reduce emissions by forcing companies to buy permits to pollute. The measure, Senate Bill 32,

must receive a final vote in the Senate before it can go to Gov. Jerry Brown for his signature.

3. Intelligent Streetlights – the Smart App for the Smart City

The streetlight is something no one thinks off until it doesn’t work and even when that happens, most people either ignore it or complain about it. It is just not that important – Right??

Wrong!!!

Streetlights are one of the most ubiquitous pieces of equipment in any city – modern or otherwise. Most of them are either powered by fluorescent bulbs or the more recent ones have high-pressure sodium bulbs.

Worldwide, there is a movement to replace these bulbs with LED bulbs because they generally result in seriously reduced energy consumption of the order of 50 - 70% dependent on where the starting point. E.g., a study at a US city municipal utility, the conversion to LED would have moved the streetlight account from #3 to #29. The savings are quite amazing. This should be enough right???

Wrong!!!

Let us walk through a scenario – Let us take a typical city anywhere in the world and focus on their streetlights.

1. Converting the existing lights to LED – energy savings of about 50-60%
2. Adding some level of local controls to them such as (1) reducing their intensity in the middle of the night (2) turning every other light off at night (3) having some kind of motion detection such that if motion is detected would turn all lights in an area to their full intensity – additional savings of 10-15%
3. Adding a communications infrastructure would allow for the streetlights to be monitored and controlled remotely – one could detect if the streetlight is not working and even have a better understanding of their energy consumption.
4. With power and communications available at each streetlight could turn each streetlight into a Wi-Fi hotspot thereby offering ubiquitous Wi-Fi to every citizen.
5. With power and Wi-Fi available at each streetlight – one could easily visualize other services such as
 - a. Putting a camera at some of the locations and providing services such as (1) surveillance (2) support to traffic monitoring and control (3) and others
 - b. Putting other sensors at the streetlight such as (1) mosquito detection (2) pollution detection or others.

And so on

What does this really mean??

Having a combination of power and communications at one of the most common pieces of equipment in a city can create a situation with endless possibilities.

This means that as cities consider the move towards LED conversion, thinking through the end-game is equally critical – otherwise it could be a squandered opportunity. As cities consider this move, it is important to consider –

- Control needs – what kinds of control needs will be there in the future?
- Communication needs – when levels of bandwidth and latency requirements are needed now and into the future? All of it does not need to be implemented right away but the implementation should be scalable into the future.

These considerations allow the city to take one of the first steps towards becoming a Smart City and should be managed very carefully so as to take full advantage of the possibilities that technology can offer.

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New Energy Storage Material Could Speed up Charging

A new material developed by William Dichtel and his research team from Northwestern University could one day speed up the charging process of electric cars and also help increase their driving range. An electric car currently relies on a complex interplay of both batteries and supercapacitors to provide the energy it needs to go places, but that could change.

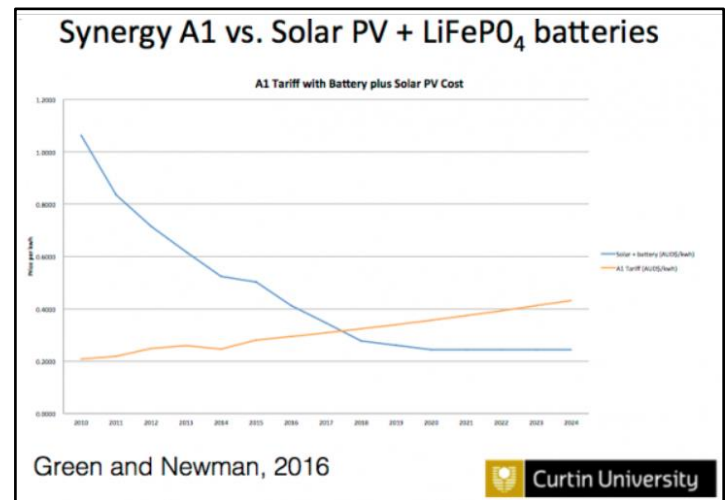
The material combines the ability to store large amounts of electrical energy or charge, like a battery, and the ability to charge and discharge rapidly, like a supercapacitor. Dichtel and his research team have combined a strong, stiff polymer with an abundance of tiny pores suitable for storing energy, with a very conductive material that closes the gap with other older porous carbon-based electrodes. To demonstrate the new material's capabilities, the researchers built a coin-cell battery prototype device capable of powering a light-emitting diode for 30 seconds. The material has outstanding stability, capable of 10,000 charge/discharge cycles.

Solar + Storage may get cheaper than grid in 2017

New research from an Australian university suggests that the cross-over point between the value of solar + storage and grid prices for Australian households may occur within one year. The study shows that the standard tariff offered to households by state owned retailer Synergy in West Australia will become more expensive than the combined value of rooftop solar and battery storage some time in 2017.

This does not mean that people were going to “leap off the grid”. They still believe that there are “intangible benefits” of being connected to the network, and it would cost a lot more to install enough batteries to deal with the consumer's demand peaks, or days of cloudy weather. However, it does pose a big problem for utilities that make their money from supplying power to households, because a lot of that demand will now disappear from view, and go “behind the meter”.

This brings up the need for completely new ways of thinking about network use, and of sharing solar energy and battery storage, a shared solar model that allows those with solar and storage to share their power with those who don't have it and allows better utilization of the grid.



Source: reneweconomy.com.au

National Grid to Add 14 MW of Solar Test Batteries

National Grid, submitted a proposal to add 14 MW of solar generation to its existing 21 MW portfolio and test emerging, advanced solar technologies to better understand the potential benefits for customers and the environment. The company plans to install an innovative battery storage project at its solar generation facilities in Everett and Shirley, making it the first investor-owned utility in the region to add energy storage to its renewables program. National Grid anticipates that implementations such as these have the potential to save hundreds of millions of dollars, lessen the impacts of peak demand on the state's energy infrastructure, and reduce carbon emissions by better integrating renewable resources into Massachusetts' energy infrastructure.

4. Utility of the Future – the beginning of transformation

Let's look at a few options that assess areas where utilities are working on and what is needed to be in place for it to become real.

- 1. Direct communication from the utility:** A smartphone app can get us an exact status of an outage, update on the charging status of an electric car and other specific billing information.
The key – All the information is in one place for the customer
- 2. Command of severe weather implications:** Whether an outage is planned or unplanned, the utility can take advantage of automation to derive specific outage times.
The key – the customer can depend on information from utility.
- 3. Reducing outage times and restore on time:** Customer trusts the information provided by the utility.
The key – the customer is now part of equation and can plan their schedule around utility plans.
- 4. Monitor and control energy usage:** If the utility has a full featured AMI system in place with net metering capability, it can determine exactly how much energy is being consumed and how much energy is being delivered back into the grid.

The key - the customer can use the energy tools available.

5. Personal acquisition of renewable energy: Utility customers can install solar cells and possibly other (storage) on their own and the utility may be able to take advantage of it.

The key – The customer and the utility worked together

6. Customer choice: Net metering, unbundling of the retail rate can allow a customer to purchase their power from a third-party retailer.

The key – the utility can provide options to the customer.

7. Rewards for reducing consumption: Depending on the circumstances, the customer can reduce consumption under utility peak times, and possibly use only the renewables and other equipment installed in their house

The key – The customer can help utility solve their issues.

In the next ten years, utilities need to get their automation (and other) systems in place to deliver on this expectation. The utility front-office, back-office and mid-office systems all need to be integrated and most importantly around the customer. If the architecture is not in place, then the utility will need to implement them on a piecemeal basis leading to increased cost to the customer and inefficient operations at the utility.

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Previously published by Intel Energy Insights - viewable in full at <http://blogs.intel.com/energy/utility-future-beginning-transformation/>

Emerging Relationship between DERs and Transmission System

Today, much of the DER-related policy conversation has focused on their potential to contribute to utility business model reform and related distribution-level regulations. But the impacts of DERs on the electric system don't stop at utility service territory or even state borders. Whether connected to your thermostat, on your roof, in your garage, or in your community, DERs, added together, have significant potential to impact and enhance transmission system operations.

The relationship between DERs and the federally-regulated transmission grid has become increasingly important in the quest to fight climate change while providing affordable and reliable electric service. In order to unleash DERs' full potential on the transmission side, the policies that impact these resources' interactions with the transmission system must be considered, reformed and in some cases invented to recognize the realities and potential of a modern grid.

Some of the considerations of the DER-transmission system interaction are:

- Regional load forecasting
- Transmission system planning
- Wholesale markets
- Transmission system and utility business model reform

Utility Investment at the Grid Edge

Investment at the grid edge is becoming a new trend. The most popular submarket for the utility investments is distributed energy resources, accounting for just over one-third. O&M technology and software and analytics account for a little over 15% each, and energy efficiency, energy storage, the connected home and electric

vehicles all have received between 5% and 10% of the investments. The most active utility investor is E.ON Venture Partners, with 15 investments listed to its name on its website. Others in the top 5 utility investors are in order Exelon and Edison International in the US and Engie and Iberdrola in Europe. Energy software developer AutoGrid leads the pack with five utility investors.

These investments give utilities a voice in and ready access to new technologies they can make available to customers, while the companies can gain access to the utility expertise and to large new customer bases and markets. As utilities look to differentiate in a competitive and service oriented energy system, where customer retention and new revenue opportunities will be crucial to driving their business, more such investments are expected.

5. Mergers & Acquisitions

S&C Acquires Intelligent Power & Energy Research Corporation

S&C Electric Company and IPERC today announced a definitive agreement under which S&C would acquire all outstanding common shares of IPERC. Terms of the transaction were not disclosed. IPERC is an industry leader in cybersecure, intelligent microgrid control systems. The acquisition of IPERC is part of S&C's strategic plan to enhance its technical portfolio. IPERC has highly skilled team members and technology that will complement S&C's current product offerings and advance its presence in the military market. IPERC also brings industry expertise in the area of microgrid controls and cyber security.

Innogy to Acquire BELECTRIC Solar & Battery Holding

Innogy SE, the renewable energy subsidiary of German utility RWE, has signed a share purchase agreement to takeover the solar and energy storage business of Belectric. The takeover of Belectric's utility-scale PV plants and batteries is an important contribution to the expansion of the decentralized, renewable energy system of RWE's future. The acquisition means significant growth for RWE, as Belectric has built more than 280 utility-scale PV plants and rooftop solar systems with a total installed capacity of more than 1.5 gigawatts peak (GWp).

Costa Rica Two Straight Months on 100% Renewable Energy

Costa Rica ran on 100 % renewable energy for 76 straight days between June and August this year. This is the second time in two years that it has run for more than two months straight on renewables alone, and it brings the 2016 total to 150 days and counting. The country has been powered on a mix of hydro, geothermal, wind, and solar energy, with hydro power providing about 80.27 percent of the total electricity in the month of August.

Geothermal plants contributed roughly 12.62 percent of electricity generation in August, while wind turbines provided 7.1 percent, and solar 0.01 percent. Three major factors contributing to its success are heavy rainfalls at the country's four hydroelectric power facilities its smaller size and that hydro is considered a renewable energy resource.

Xylem to Buy Sensus

Xylem Inc., has signed a definitive agreement to acquire Sensus for approximately \$1.7 billion in cash. The acquisition will

accelerate Xylem’s ability to bring systems intelligence solutions to customers across the water and energy industries, establish a foundation for future growth and create significant shareholder value. The combination of Xylem’s world-class brands and products with Sensus’ leading-edge smart technologies will create a differentiated offering that is expected to meet customers’ evolving needs, including greater energy efficiency, water conservation, and improved life-cycle costs.

Bold Renewable Energy Targets for India

The Government of India has issued new norms for Renewable Energy (RE) in India, via guidelines for states to buy RE, through updated renewable purchase obligations (RPOs). These are central government guidelines, but ultimately RPOs will have to come from State Electricity Regulatory Commissions (SERCs). Historically, states have had weaker RPOs, and limited enforcement or penalties for not meeting targets. The RPO guidelines are ambitious. On the other hand, if one uses 175 GW of RE capacity by 2021-22 as a baseline, the RPO purchase guidelines could even overshoot the requirements, depending on growth of overall demand.

This is poised to become more pronounced if RE grows as targeted. India’s RE targets for 2022 imply a capacity growth rate of roughly 25 per cent per annum. In contrast, much-heralded plans like by

California for 50 per cent by 2030 only require an annual growth of share of about 4 per cent per annum. Even compared with the EU or China, India’s targets require a much higher growth rate.

Source: www.brookings.in

6. Smart Grid venture capital (VC) funding

Venture capital (VC) funding for Smart Grid companies doubled with \$222 MM in 15 deals compared to \$110 MM in 14 deals in Q1 2016. Year-over-year (YoY), funding also doubled compared to Q2 2015 when \$104 MM was raised in 18 deals.

Top 5 VC Funded Smart Grid Companies in Q2 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
Origami Energy	19.5	Cambridge Innovation Capital, Octopus Ventures, Fred.Olsen
Comfy	12	Emergence Capital, CBRE Group, Microsoft Ventures, Claremont Creek Ventures, Westly Group

Source: Mercom Capital Group, llc

7. News from Modern Grid Solutions

MGS team grows its team of experts

MGS’s portfolio of experts, have 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 and Construction.

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. It is now being used at several universities as course materials. SUNY Buffalo, UW-Wisconsin, LeHigh, Pennsylvania State University, Drexel and Stony Brook.

Training news

- 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.

These courses are based on materials from MGS is offered by IEEE and edX.

Events and News – Dr. Vadari in the news

- “[Distribution Automation: The Path to a Self-Healing Grid](#)”, is now ready. It follows an earlier article “[Smart Grid Redefined](#)” and looks at how Distribution Automation is changing the utility landscape allowing for greater sensing and control of the grid.
- “[Utility Transformation: Automation – All about sensing, analysis and control](#)”, an Intel Blog Series, Article #3, is listed in Grid Insights, a series sponsored by Intel at Grid Insights by Intel, September 8th, 2016.
- “[Utility of the Future – The Beginning of Transformation](#)”, an Intel Blog Series, Article #2, is listed in Grid Insights, a series sponsored by Intel at Grid Insights by Intel, August 1st, 2016.

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.