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State of the Smart Grid Briefing

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Modern Grid Solutions would like to wish each and every reader – may all your endeavors be met with huge success and appreciation. Wishing you all A Very Very Happy New Year. In this issue, we have a focus on Smart Cities with three original articles on (1) Smart Transportation (2) Smart Health and (3) Smart Energy.

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

- “State of the Grid” briefing – our newsletter continues to attract subscribers. We have crossed 1200. Thanks for your interest.
- Modern Grid Solutions is now growing. We have new clients, new relationships and an enhanced team. Our newly enhanced team has over 20 people with 25-40-years expertise in their specific fields.
- The book “Electric System Operations – Evolving to the Modern Grid” debuts at Stony Brook University. 6 Universities use it.

2. Key Highlights

Multi-Year Tax Credits for Solar and Wind

In December, Congress passed a spending package that includes multi-year extensions of solar and wind tax credits. Under the legislation, the 30 % Investment Tax Credit (ITC) for solar will be extended for another three years. It will then ramp down incrementally through 2021, and remain at 10 % permanently beginning in 2022. The 2.3-cent Production Tax Credit (PTC) for wind will also be extended through next year. Projects that begin construction in 2017 will see a 20 % reduction in the incentive. The PTC will then drop 20 % each year through 2020.

The ITC extension is expected to spur nearly 100 cumulative GWs of solar installations by 2020, resulting in \$130 B in total investment. The PTC extension is expected to support tens of GWs of new wind projects through 2020.

NY IOUs Ask for Changes to DSIP Guidance

The New York Public Service Commission (PSC) issued proposed guidance to New York utilities for the structure and content of their Distributed System Implementation Plans (DSIPs). The DSIPs are the plans through which each utility will establish a Distributed System Platform (DSP), a foundational element of the Reforming the Energy Vision (REV) proceeding. While the utilities support the majority of the recommendations provided in the DSIP Guidance Document, they are seeking clarification on two key issues.

1. Guidance regarding the specific actions that utilities should take to facilitate role of market participants in developing DER.
2. Guidance on what utilities need to do for customers, sectors, services, and technologies that market participants are not able or willing to serve, particularly during the transition to a market that is more reliant upon market participants.

BPA plans for New Washington-Oregon Power Line

The BPA has proposed a 500-KV transmission line. Final approval for the line is expected in 2016, with construction beginning as early as 2017. It will include about 80 miles of transmission line stretching from Castle Rock, WA, to Troutdale, OR, connecting new substations at each end. According to BPA, the \$459 MM line is needed to ease congestion and add capacity for future growth.

PG&E - Innovative Storage Contracts w/CPUC

Counterparty (Project Name)	Storage Technology	Size (MW)
Amber Kinetics (Energy Nuevo)	Flywheel	20.00
Hecate Energy (Molino)	Lithium Ion Batteries	10.00
NextEra Energy (Golden Hills)	Lithium Ion Batteries	30.00
Convergent (Henrietta)	Zinc/Air Batteries	10.00
Western Grid (Clarksville)	Zinc/Air Batteries	3.00
Hecate Energy (Old Kearney)	Lithium Ion Batteries	1.00
Hecate Energy (Mendocino)	Lithium Ion Batteries	1.00

Source: pge.com

PG&E presented its first 75MW of energy storage contracts to the CPUC for review and approval. California's Energy Storage Decision requires investor-owned utilities to procure 1,325MW of storage by 2020. PG&E's share is 580MW.

Storage is expected to play an increasingly important role for California utilities as they work to achieve the states ambitious clean energy goals. By the end of 2015, PG&E forecasts that about 30 percent of its retail electric deliveries will come from renewable sources. Energy storage will help integrate many of those resources, such as wind and solar, which are intermittent or provide peak output during times of low demand.

3. Smart Transportation

To design, build and sustain smart transportation to serve a smart city, the transport system needs to be safe, efficient, fast, multi-modal, integrated, scalable, environmentally friendly, reliable and simple enough for citizens to use it. To achieve this, one starts with DATA. This data is needed in real-time and continuously to know about traffic conditions, accidents on roads, toll schedules, roadway closures, weather conditions, transit schedule, rail schedule, inter-modal transfer facilities, trip origin, trip origin time, trip destination, parking cost, parking availability, etc. With all this information centrally located, users can find the best way to reach their destination in an optimal manner.

What does the future entail?

Western countries have been enjoying benefits of real-time data uses in transportation. Key examples of this include ramp metering at the freeway ramps; arterial intersections monitored by video cams and fine-tuned for better intersection operations; Active Traffic Management - warning messages ahead of accidents and backups on freeways; dynamic toll costs etc.

Connected vehicles – will improve safety; flow on roadways; will make driving easier by eliminating human error in some situations – like following another vehicle too close; falling asleep on wheel; distracted driving; leaving lanes etc. Many functions in today's cars are already controlled by computers. Fifteen years from now, most cars on the road will have the connected vehicles technology.

Autonomous Vehicles - Companies are also investing resources on autonomous vehicles. There are many unanswered questions at this point. While we may not see roads filled with autonomous vehicles in the next 15 years, but it is feasible to see autonomous vehicles for moving freight. We could see a convoy of autonomous freight trucks moving from one distribution center to another.

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BGE's Microgrid Pilot Program

Baltimore Gas and Electric Company (BGE) is planning to develop two microgrids as pilots; one in Baltimore City and one in Howard County. Both areas selected meet criteria conducive to the tests; a mix of community services beneficial to the public, such as grocery stores, pharmacies, clinics, gas stations and public buildings that could potentially be used for emergency coordination and shelters.

BGE has filed the proposal with PSC, including a plan to recover costs of developing and operating the microgrids. The charge to customers is estimated to be approximately \$0.04 per month.

The utility expects to use results of the 12-month pilot to explore future microgrid development throughout Central Maryland.



Source: tdworld.com

4. Smart Health

Global healthcare challenges are many. Rapid population growth coupled with healthcare resources and infrastructure in short supply, rising costs for treatment and a lack of public awareness about health matters are leading to an alarming rise in obesity, diabetes, hypertension to name a few problems. Technology has shown much promise for streamlining the healthcare delivery process, increasing the value of services and controlling costs.

At the consumer level, several products and services are available for home use. For example, in the case of seniors, a group susceptible to chronic illness and injuries from falls, remote monitoring devices are available. These devices monitor and collect data on movement, falls and other vital medical parameters. The data is uploaded to a healthcare call center for review and action by medical professionals. These devices and services help reduce costs, enable timely detection of problems and dispense necessary treatment.

Also very popular in the fitness arena are the activity and fitness tracking devices, such as Fitbit and iWatch. Websites are available for guidance for diet, weight management and overall wellness. The data collection from use of the devices and the websites can be stored and transmitted to healthcare providers for further analysis and guidance. This is another example of technology enabling interaction between the provider and the patient in the context of the Smart Health system.

As cities around the world try to continue this process of driving improvements, they have the challenging role of delivering quality health to a growing world population in the facing of decreasing availability of healthcare professionals and other medical infrastructure. For this to happen, we need more technologies some that are defined above and others which are yet to be developed have a key role in Smart Health.

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ASEAN Countries Adopt Renewable Energy Target

Energy ministers of the Association of Southeast Asian Nations (ASEAN) announced the adoption of a target to increase share of renewable energy in the regional fuel mix to 23% by 2020. They also adopted a target to reduce the region's greenhouse gas emissions by 20% over a period of 10 years.

The larger members of the group are poised to take lead in the development of renewable energy infrastructure. Malaysia, Indonesia, Thailand, and Philippines have substantial regulatory

support for renewable energy projects and are working to rapidly expand the installed capacity. Thailand and Philippines are already popular investment destinations for foreign investors in the solar power sector. Indonesia is looking to develop several renewable energy technologies through international cooperation, including geothermal energy.

CAISO Approves Next Steps for Western EIM

The CAISO Board of Governors approved policies that further implement the western Energy Imbalance Market (EIM) governance structure, enabling stakeholders to begin the process of selecting representatives for the EIM Governing Body nominating committee and liaisons to the regional issues forum. The board also approved updated rules for distributed energy, including rooftop solar units, to participate in wholesale energy markets.

5. Mergers & Acquisitions

CleanSpark Acquires Specialized Energy

CleanSpark, announced its acquisition of Specialized Energy Solutions (SES). SES specializes in the engineering and construction of 100% clean energy technologies. In addition to several US-DoD installations, SES recently completed 4MW of ground-mounted distributed solar projects in City of Colton, with plans for more projects in California. The acquisition expands CleanSpark's ability to provide clients true energy security and independence, while increasing CleanSpark's load to 6MW.

PowerSecure Acquires ESCO Energy Services

PowerSecure International, Inc. announced acquisition of ESCO Energy Services, Inc. (ESCO), a private company that provides lighting retrofit solutions delivering energy savings for customers across North America for \$1.8 MM. ESCO provides turnkey energy efficiency services including energy audits, engineering and design, materials procurement, project management, implementation and verification. The acquisition is expected to enhance PowerSecure's energy efficiency capabilities.

Direct Energy to Acquire Panoramic Power

Direct Energy, agreed to acquire Panoramic Power for \$60 million. The Panoramic Power energy management solution offers commercial and industrial business customers a wireless and self-powered circuit-level technology with cloud-based analytics. The solution is designed to give customers real-time visibility into their business operations. The acquisition supports Direct Energy's growth strategy of offering energy management technology and expertise to further increase customer growth.

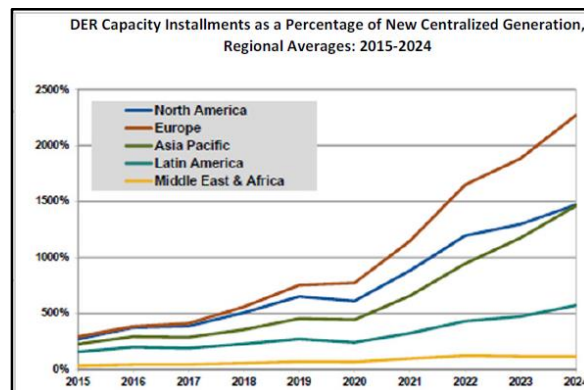
Twenty First Century Utilities Buys GridPoint

Twenty First Century Utilities (TFC), a company founded earlier this year, acquired GridPoint. The GridPoint acquisition is integral to TFC Utilities' campaign to transform regulated utilities and facilitate wide-scale adoption of new energy technologies, including DERs and other behind the meter applications.

DER Capacity to Reach 530 GW by 2024

DER penetration is increasing globally. Annual installed capacity across the global DER market is expected to grow from 136 GW in 2015 to 530 GW in 2024. Europe is expected to have the greatest percentage of new DER capacity deployed compared to centralized generation. In 2015, it is anticipated that DER additions will outpace centralized generation additions in the region by 300%,

growing to 2200% by 2024. NA and Asia Pacific will see similar levels of growth in new DER resources compared to centralized generation.



Source: Navigant

6. Smart Energy

Energy, Telecom and mobility/transportation are considered the three foundational pillars of Smart Cities. Energy encompasses all infrastructures that cities use to produce and deliver electricity, gas, steam, renewables, etc.

Energy for the Smart City can come from a variety of sources.

- **Electricity:** Can be fossil-fuel based, nuclear, hydro, wind, solar, etc. Used to power homes, businesses, industries, etc.
- **Natural Gas:** Used to generate electricity; directly used as cooking and heating fuel; powers natural gas vehicles
- **Steam:** Can be geothermal or from boiling water. Used to generate electricity, heating.
- **Renewables:** Various sources: solar, wind, tidal, biomass, etc.

There are also a lot of areas of interplay between energy and other areas – all potential areas for optimizing use of energy.

- Water for electricity. Power plants account for 41 % of water use.
- Energy for water treatment. 7% of electricity consumed to pump and treat water and wastewater.
- Communications to collect and analyze data from sensors and communicate with end users on usage and outages.
- Energy needed for the operation of cell towers, equipment, and networks.
- Transportation needed to move fuel (coal, natural gas and others) from mines to plant.
- Energy needed to operate electric and gas vehicles, and also as backup power for hubs, control centers.
- Energy is needed to operate HVAC, lighting, appliances, security cameras in homes, offices, buildings.

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Key Storage Projects to Watch in 2016

From New York and Hawaii to remote communities in Indonesia, these projects could change how power sector sees storage in 2016:

- **Ohio solar-storage project:** The municipal utility in Minster, Ohio, is developing a 7 MW energy storage project next to a 4.2 MW solar farm. The project is composed of 3 MWh of lithium-ion batteries alongside a master control system and 2-MW/2.5-MVA power conversion systems. The utility will use storage to

manage demand during peak, provide reliable back-up power, and reduce peak demand charges during the day. The project also aims to sell frequency regulation into PJM.

- **ConEd's behind-the-meter project:** ConEd's "Virtual Clean Power Plant," a demo project, aims to aggregate residential behind-the-meter solar and energy storage, with a total capacity of 1.8 MW and 4 MWh of aggregated energy output. The goal is to show how aggregated solar panels paired with storage in hundreds of homes can assist in grid resiliency.
- **Indonesia's Rural Electrification project:** Fluidic Energy, a commercial-scale zinc battery manufacturer, recently inked a deal with Caterpillar and Indonesia's state-owned utility Perusahaan Listrik Negara (PT PLN) to bring storage aimed at providing reliable energy to 500 remote Indonesian villages. Fluidic has shipped 10 MW of battery cells aimed at reducing dependency on diesel generators. Fluidic plans to deploy about 250 MWh of battery capacity for the project.
- **Hawaii Energy Storage project:** This project aims to prove that solar energy can be used at night. SolarCity inked a 20-year power purchase agreement to build the first-fully dispatchable solar+storage system on Kanua'i. Power generated by the solar

array will provide about 52 MWh of power to Kauai Island Utility Cooperative (KIUC). The system is designed to dispatch stored energy from 5 p.m. to 10 p.m.

7. Smart Grid venture capital (VC) funding

VC funding slowed to \$81 MM in 12 deals in Q3 2015, compared to \$104 MM in 18 deals in Q2 2015. Companies have raised \$370 MM compared to \$325 MM raised in the same period in 2014.

Top 5 VC Funded Smart Grid Companies in Q3 2015

Company	\$M	Investors
PubNub	20	Relay Ventures, Sapphire Ventures, Scale Venture
SemaConnect	15	Pear Tree Partners
LifeSmart	9.4	Haier SAIF, Foxconn
Bastille	9	Bessemer, Tom Noonan, Chris Rouland
LinkLabs	5.7	Blu Venture Investors, Inflection Point, Maryland Venture Fund, TCP Venture

Source: Mercom Capital Group, llc

8. News from Modern Grid Solutions

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 any 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.



MGS team grows its team of experts

MGS has assembled over 20 key industry leaders in its portfolio of experts, each with between 25-40 years of experience in their respective fields ranging from T&D Operations, Big data analytics, Grid Modernization, Utility regulatory and economics, Generation operations, Energy Efficiency and Demand Response and T&D Planning and Construction. Please ask us as to how we can help you.

Training news

- The MGS-led and developed certificate course – Introduction to Smart Grid – will be live on IEEE early in the year. Stay tuned for more information on this news.
- Dr. Vadari is delivering Smart Cities readiness workshops under the Smart Cities Council banner.

Events and News

- Under the Smart Cities Council banner, Dr. Vadari delivered several Smart Cities Readiness Workshop this year
 - In Dubai 26-27 April. The workshop was sponsored by the Dubai Real Estate Institute.
 - In Washington DC 14-16 September. The workshop was sponsored by the Smart Cities Week.
 - In Seattle 24 September. Dr. Vadari joined Jesse Berst delivered the workshop as a part of the ICMA annual conference
 - In Mauritius October 14-15. The workshop was delivered as a part of Mauritius Smart Cities 2015.
 - In Cape Town November 3-4. The workshop was delivered as a part of Metro Advance Forum 2015.
- Dr. Vadari is now a regular contributor to the IdeaXchange blogs managed by Transmission & Distribution World. Check out the latest one at the [T&D World](#) site.
- Dr. Vadari is now a regular contributor to the Intel energy series blog also. Check out the latest one at the [Intel site](#).

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*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.