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State of the Smart Grid Briefing

A Service from Modern Grid Academy

We are very excited to release our sixth quarterly newsletter and our second one for 2014. We have three articles again. Article 1 is an excerpt from a world-class white paper from CMG (yours truly is an author) on the broader discussion on the disruption of the electric utility and what they can do to become successful. Article 2 is an excerpt from a new book by Lawrence Jones on renewable energy. The last article is an excerpt of an article from the IEEE Smart Grid Newsletter and discusses an architecture for managing and operating in a distributed energy environment. Don't miss our [Online Training Coupon](#) on this page and on the last page.

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. Key Highlights

\$33 M in Funding for Fuel Cell Technologies

ARPA-E announced funding for 13 projects developing fuel cell technologies for distributed power generation. Funded through ARPA-E's REBELS¹ program, these are focused on improving grid stability, and balancing intermittent renewable technologies.

Fuel cells convert chemical energy of a fuel source into electrical energy and are optimal for distributed power generation systems.

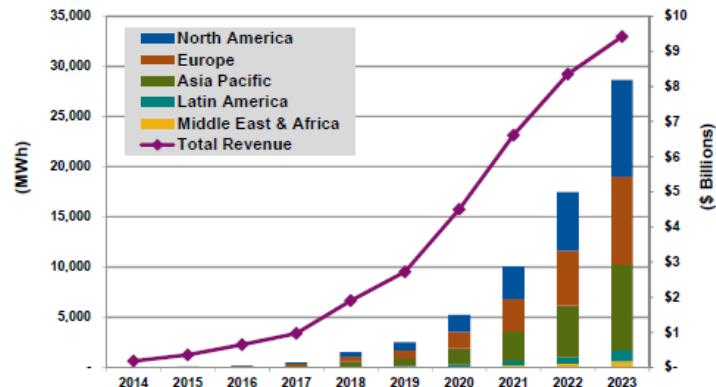
Unlike current, state-of-the-art fuel cell research that generally focuses on technologies that operate at high temperatures for grid-scale applications or low temperatures for vehicle technologies, this effort emphasizes Intermediate-Temperature Fuel Cells. These innovative technologies are expected to fundamentally change the way America generates and stores energy.

Among the 13 project winners are Oak Ridge National Laboratory, Palo Alto Research Center, University of California Los Angeles, and Argonne National Laboratory.

¹ (REBELS) Reliable Electricity Based on ELectrochemical Systems

\$9.4 B in Adv Batteries Revenue by 2023

The emergence of new battery chemistries is expected to feed the enormous increase in the world's appetite for advanced storage devices. Navigant reports overall battery demand to increase from about 65 GWh to 225 GWh in 10 years. While most of today's batteries are based on Li-ion technology, we expect to see a growing niche of new chemistries driven by advances in basic science and manufacturing in battery electrochemistry in the last 2 decades. By 2023, next-generation chemistries will account for 28.6 GWh of batteries sold for more than \$9.4 billion in revenue.



Source: Navigant Research

Next-Generation Advanced Battery Energy Capacity and Revenue by Region, All Applications, World Markets: 2014-2023

2. CMG White paper – Disruption Becomes Evolution

Disruption Becomes Evolution – Creating the Value-Based Utility

This paper was written for power and energy executives and regulators faced with rationalizing the rapid and numerous changes currently pressuring the traditional structure of the utility industry. It shows how disruptive change in other industries caused the "rules of the road" to be changed, and how the lessons learned from those experiences can be applied to the utility industry.

New business models and cutting edge technologies such as distributed solar and CHP, demand response, microgrids, energy storage, electric vehicles, cyber-security, advanced wholesale

markets, and new competitive retail markets are all impacting the traditional regulated utility industry. Generation, grid operations, and wholesale and retail energy sales are being transformed by innovation and competition, forcing utilities faster than ever to make critical choices about business models and technologies.

In this white paper, CMG experts answer a fundamental question – “How do we create better customer experiences, products, and services in response to the multiple drivers that are changing the rules and status quo?”

CMG experts bring their deep professional experience and a global view of these trends and opportunities to suggest how the market can accelerate its digitalization and transformation toward a truly robust and sustainable energy future.

Authors: Bob Barker, Andy Bochman, Andres Carvallo, Bruce Hamilton, Dr. Erfan Ibrahim, David Shpigel, and Dr. Mani Vadari. Download it at <http://www.512cmg.com/services/white-papers/>.

Google's bringing Tools for Utilities

Google is planning a second try into the utilities marketplace by developing tools for utilities to deliver electricity to homes and businesses more efficiently. It has also begun building tools to manage power lines and other infrastructure. The need for grids to be more flexible and efficient in managing solar, wind and other renewable energy sources is a huge market opportunity.

Google has increased investments in the energy industry – \$3.2 B to acquire Nest Labs, investor in Atlantic Grid Development, a project to deliver wind-based electricity to NJ. It has invested over \$1 B into environmentally friendly power projects in U.S. and outside.

Middle East and Smart Grid Roll Out

The Middle East is likely to see wide scale roll out of Smart Grid technologies within the next two years, according to Siemens. A number of countries, led by Saudi Arabia and UAE, are piloting projects. Utilities are piloting to confirm the technology before a mass roll out. In next 1-2 years, when the pilots are completed, it may be possible to see large scale deployment of metering, Demand Response, and distribution management systems.

Huge electricity demand growth, regional interconnection of the grids and potential for renewable energy, provide opportunities for companies engaged in Smart Grid sector in the Middle East.

3. Mergers & Acquisitions

Alstom Board Chooses GE Offer

Alstom Board of Directors unanimously decided to positively recommend GE's offer to acquire the Power and Grid businesses of Alstom. The deal is expected to close in 2015. GE's offer to acquire Alstom totals about \$17 B. Once closed, GE and Alstom would form three joint ventures:

- Global Nuclear and French Steam: Alstom's production and servicing of equipment for nuclear power plants, and development/sales of new nuclear equipment; and Alstom's steam turbine equipment and application servicing in France.
- Grid: the combined Grid assets of GE and Alstom
- Renewables: Alstom's Off-shore Wind and Hydro businesses

The cumulative cash investment by Alstom in the joint ventures would be about \$3.5 B.

Bel Fuse Acquires ABB Power One Solutions

Bel Fuse, completed its acquisition of Power One Solutions from ABB.

Bel acquired the business for about \$117 MM. The acquisition of Power Solutions is a major step forward in the development of Bel's power business to deliver its strategy of enhanced growth and profitability. The new entity would create a dynamic enterprise capable of competing effectively on a global basis.

A123 Acquires Key Battery Technology

A123 Systems announced acquisition of certain intellectual property from Leyden Energy - battery materials covering lithium titanate (LTO) and non-flammable electrolyte developments. In the deal, key technical staff also agreed to join A123 Systems.

Leyden is the recent recipient of significant development funding from United States Advanced Battery Consortium. Under the program, Leyden achieved outstanding progress on development of technology for applications in automotive market. This acquisition complements the lithium iron phosphate (LFP) materials portfolio that A123 commercialized earlier.

4. Book Review – Renewable Energy Integration

Renewable Energy Integration - Practical Management of Variability, Uncertainty, and Flexibility in Power Grids
Edited by Dr. Lawrence Jones.

Renewable Energy Integration is a new resource – this is the first book to offer a distilled examination of the intricacies of integrating renewables into the power grid and electricity markets. It offers informed perspectives from internationally renowned experts on the challenges to be met and solutions based on demonstrated best practices developed by operators around the world.

The book's focus on practical implementation of strategies provides real-world context for theoretical underpinnings and the development of supporting policy frameworks. The book considers a myriad of wind, solar, wave and tidal integration issues, thus ensuring that grid operators with low or high penetration of renewable generation can leverage the victories achieved by their peers. Renewable Energy Integration highlights, carefully explains, and illustrates the benefits of advanced technologies and systems for coping with variability, uncertainty, and flexibility.

Heliocentris Acquires FutureE

Heliocentris Energy Solutions acquired FutureE Fuel Cell Solutions GmbH. FutureE develops and manufactures scalable fuel cell systems for telecom and industry.

This acquisition creates a new market leader in Germany for stationary fuel cell based power solutions in the 1 – 20 KW range. Integrating Heliocentris' energy management system into FutureE's fuel cell technology enables high performance solutions for UPS and allows significantly lower operating expenditure as compared to conventional solutions based on diesel generators.

Landis+Gyr on Acquisition Spree

Landis+Gyr signed an agreement to acquire GRIDiant, a utility analytics company focused on the electric distribution grid. This transaction will expand L+G's software analytics portfolio, further enhance end to end solution capability. GRIDiant's analytics suite will be integrated into L+G's advanced metering infrastructure (AMI), distribution grid management and cloud-based solutions for utility customers.

L+G also announced acquisition of PowerSense, Denmark-based developer of optical-based MV sensors and a monitoring and control system for MV/LV distribution grid management. L+G will integrate the new firm into its portfolio in Europe, helping utilities around the globe balance and better manage MV and LV grids.

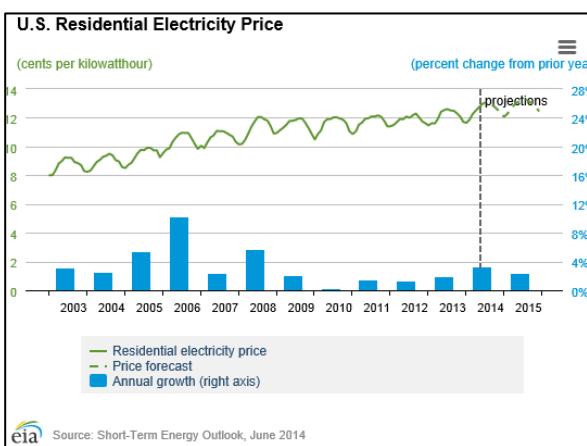
NEC Corporation Acquires A123 Systems

NEC Corporation announced its acquisition of A123 Energy Solutions, the grid energy solutions and commercial energy systems business, from China's Wanxiang Group.

A123 Energy Solutions will now operate as NEC Energy Solutions, Inc. (NECES) and will build energy storage systems for utility companies and power producers worldwide. As part of this acquisition, NECES and Wanxiang will create a JV to develop a grid energy storage and commercial systems business in China. NEC Energy Solutions will also manufacture and continue the launch of NanophosphateR ALM Series Lead Acid Replacement Batteries.

EIA U.S. Electric Retail Price Outlook

EIA predicts an average 2014 U.S. residential electricity price of 12.5 c/KWh, a 3.4% increase from 2013. Growth in electricity prices for the commercial and industrial sectors are higher than residential sector: 4.8% and 4.6%, respectively. Projected residential prices increase an additional 2.4% during 2015.



EIA forecasts the U.S. residential electricity expenditure of 4.9% more during summer than during the same time last year. This increase in residential bill reflects a 1.2% increase in usage and a 3.7% increase in retail price of electricity.

5. A New Architecture for Distributed Energy Management

A New Architecture for Distributed Energy Management

Excerpts: Utilities have tended to handle integration of each new distributed resource ad hoc as it comes along, so that collectively resources very often are managed completely independent of each other. Take demand response, for example. Utilities may have more than one program, and programs are developed somewhat independently of each other to achieve different objectives. Most programs start as pilots, and some may stay at the pilot stage for extended periods of time. What is more, some are implemented in response to regulatory mandates, and many of them are implemented in systems that are incapable of handling more than one system at a time.

Yet all such resources have very specific characteristics that, when used in conjunction with each other, have the potential to create synergies at a variety of levels. The very fact that they are broadly distributed across retail and wholesale grids means their locational characteristics can also be taken into consideration in addressing broad concerns such as congestion.

The article presents a new architecture for managing all aspects of distributed energy, both load and supply, taking into account both non-dispatchable energy like wind and solar and dispatchable (such as micro-turbines, demand response and storage). The architecture positions the utility to evolve with change and allows utilities large and small to work with all sources of supply and load in their jurisdictions. That is, it allows for optimization of available centralized generation and dispatchable sources of supply against load and generation from non-dispatchable sources of energy. The key is to use principles of transactive energy all the way down to the retail/premise and optimize all available sources of energy based on their pricing characteristics and user preferences (if available or a part of the market rules).

Dr. Mani Vadari
President, Modern Grid Solutions

6. Smart Grid Venture Capital Funding

VC funding in the Smart Grid sector in Q1 2014 came in at \$101 MM in 21 deals. Smart Grid Communication technology companies received most of the VC funding, raising \$62 M in 11 deals followed by Demand Response companies that raised \$14 M in three deals, Data Analytics \$13 M in three deals, and Grid Optimization with \$8 M in one deal.

Top 5 VC Deals in Q1 2014

Company	\$M	Investors
SIGFOX	20.6	Idinvest Partners, FSN PME, Digital Ambition, Fund, Intel Capital, others
enverv	15.4	Cassiopeia Capital Partners, Cisco, UMC Capital, Benchmark Capital, others
swg-Smart Wire Grid	13.4	RiverVest Venture Partners
AutoGrid	12.8	E.ON, Foundation Capital, Voyager Capital
GRID20/20	8.1	Undisclosed

Source: Mercom Capital Group, LLC

New Revenue Opportunities for Utilities

An Accenture survey has found that more than half of global energy consumers would consider installing connected-home solutions or solar panels in the next five years, or purchasing an electric vehicle in the next 10 years.

Interest in connected-home products and services such as energy management and other monitoring and control solutions is projected to rise from 7 percent to 57 percent in the next five years, due to the expectation that they will help reduce energy bills, increase comfort and convenience, and enable remote control of home devices.

Customer interest in solar panel installations is expected to increase six fold in the next five years, driven predominantly by a desire for energy independence, but also by the availability of subsidies and the ability to reduce environmental footprint.

In summary, two massive new markets are opening up. Consumers originally preferred to get these things from utilities, but that preference is eroding due to utility inaction. Today utilities are in second place. In these nascent, rapidly expanding and converging markets, the opportunity to capture market share is a wide-open field and success will come down to those providers who perfect the digital customer experience.

7. News from Modern Grid Solutions

Hot off the Press: Dr. Vadari is now also a Sr. Consultant with the CMG group.



Training news

- Our [online training](#) with voice-over is becoming a hit with all. We are adding more courses and also adding new clients for whom we are becoming the exclusive provider of all Smart Grid and System Operations Training.
- We are releasing more online self-paced courses and many of them are 1-hr in length making it easy to take on the go. For a full list, check out our online store at <http://www.moderngridsolutions.com/smart-grid-training/smart-grid-online-training-courses.html>.

Electric System Operations – Evolving to the Modern Grid

Dr. Vadari's book "[Electric System Operations – Evolving to the Modern Grid](#)" continues to be received well in the industry. Buy them soon at Amazon.com and other leading retailers.

Events and News

- Dr. Vadari will present at IEEE General meeting to be held in Washington DC. The topic of presentation is "**Defining a new architecture and functions to allow the system operator to manage distributed energy**".
- Dr. Vadari is will present at special invited talk on **robustness, resiliency and reliability of energy systems** at the IEEE International Test Conference (Oct. 21-23, 2014, Seattle).



For more information contact us at
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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.