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State of the Grid

A Service from Modern Grid Academy

Welcome to the 1st quarter 2018 newsletter from Modern Grid Solutions. It is now going to an organically evolving subscriber list that has passed 1900 people.

This time, we have 4 original articles – the first one is from EPRI on efficient electrification. The second one is on potential for implementation of Blockchain in the energy sector. The third is a fascinating article about detecting and identifying all IoT devices in your enterprise. The last one is my favorite and on the implications of AI for all of us. It is a packed newsletter full of very interesting articles that I believe you would enjoy.

Sincerely yours Mani Vadari, Modern Grid Solutions

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1. MGS news – Hot off the Press

- Dr. Vadari's second book "**Smart Grid Redefined: Transformation of the Electric Utility**" has been released and is now available at bookstores near you and online.

At the publisher web-site – <http://us.artechhouse.com/Smart-Grid-Redefined-Transformation-of-the-Electric-Utility-P1944.aspx>.

And at Amazon.com - https://www.amazon.com/Smart-Grid-Redefined-Transformation-Electric/dp/1630814768/ref=sr_1_1?ie=UTF8&qid=1522081545&sr=8-1&keywords=vadari

- Dr. Vadari will present at the 3rd Annual Grid Modernization Forum, May 23-24, 2018 in Chicago. The topic of the presentation is "Grid Modernization and the Imperative for Utility Transformation"
- Dr. Vadari is a keynote speaker at the CARILEC Renewable Energy and Smart Grid Conference to be held in Miami in September 23-27, 2018.

MGS's experts (more than 20) are making a difference. 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

Stina Resources buys Gildemeister

Stina Resources reported its acquisition of the assets of Gildemeister, one of the world's first and largest researchers, developers, makers, and distributors of vanadium flow batteries. As an industry leader, Gildemeister has installed vanadium flow batteries at over 100 sites around the world. Stina has created a subsidiary to assume the assets and operations of Gildemeister, called Enerox, an Austrian company headquartered in Vienna.

Franklin Energy Acquires PlanetEcosystems

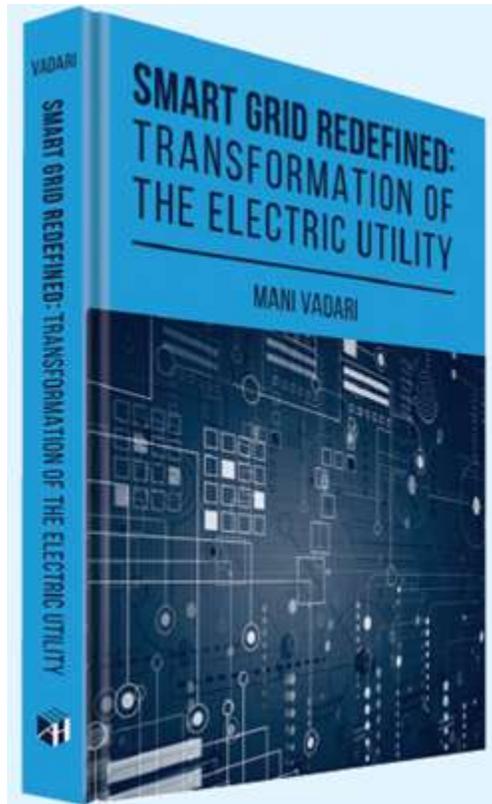
Franklin Energy, a national-level demand side management implementation firm, announced that it has acquired San Francisco-based PlanetEcosystems, developer of a customer engagement platform. This acquisition allows the team to seamlessly connect energy efficiency, demand response and other distributed energy resources programs through automated participation paths tailored to customers' needs and desires. The result is portfolio-level programs implemented in a more customer-centric and engaging way.

3. A Better Tomorrow Through Efficient Electrification

Grid operators are facing a new era as demand for more sustainable and responsible energy generation is at an all-time high, and as regulation continues to further define industry renewable standards. The Electric Power Research Institute (EPRI), a global nonprofit research organization, is leveraging years of expertise and research to raise the profile of electrification and the potential benefits it can have on the energy sector as it deals with these major shifts.

In 2017, EPRI launched the Efficient Electrification Initiative, exploring electrification across the global energy system, analyzing the customer value – lower cost, energy use, reduced emissions, improved indoor environment, and increased productivity – provided by advanced, end-use technologies that efficiently amplify the benefits of cleaner power generation portfolios.

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ARTECH HOUSE

PRACTICAL BOOKS FOR ENGINEERING PROFESSIONALS

Smart Grid Redefined: Transformation of the Electric Utility

Mani Vadari

- Guides professionals in the evolution of the Smart Grid and offers insight into distribution automation, storage, and microgrid;
- Highlights the journey to a transformed electric utility, provides solid examples, and includes real-world case studies;
- Presents new energy storage solutions and electric value chain disruptors;
- Learn how to overcome challenges related to integrating supply and demand diversity;
- Discusses how new technologies impact the day-to-day operations of a utility and how these technologies can transform the normal functioning of the utility;
- Provides discussions about how a transformed utility can be a springboard to a smart city;
- Demonstrates how to apply the strategies of technologies in this resource to guide them to success in the field;
- Defines the roadmap to the utility of the future and provides a vision for how utilities can thrive in their new environment.

Continued from page 1

This month, EPRI released the [U.S. National Electrification Assessment \(USNEA\)](#), which examines customer adoption of electric end-use technologies over the next three decades and identifies key implications for efficiency, the environment, and the grid. EPRI's USNEA brings forward a view informed by years of extensive lab testing and field demonstration projects to quantify the potential benefits of electrification.

Examining four different scenarios for how opportunities, drivers, and challenges impact electrification, the study found that despite a range of assumptions, economy-wide electrification leads to a significant reduction in energy consumption – a possible reduction of 22% by 2050. Even with this reduction in energy consumption, the study found that electrification spurs steady electric load growth, increases grid efficiency and flexibility, and could reduce greenhouse gas (GHG) emissions 20% by 2050. Finally, the USNEA recommends five actions as fundamental to realize the full benefits of electrification, including expanded R&D to accelerate technology development, new regulatory and policy designs, new electricity marketing designs, and new analytical tools.

The USNEA is only the beginning of a broader conversation that has the potential to transform the entire electric sector. EPRI is furthering the conversation on efficient electrification at its inaugural [Electrification 2018 International Conference & Exposition](#), August 20-23, 2018 in Long Beach, Calif. This event will bring together industry and related stakeholders to explore the technology, policy, regulatory, environmental, and implementation issues surrounding efficient electrification.

Mark Duvall, Director, Energy Utilization, EPRI
mduvall@epri.com

Subscribe to EPRI's Efficient Electrification monthly newsletter, contact Annie Haas (ahaas@epri.com)

ION Energy Acquires Freemens

Indian energy storage startup ION Energy has acquired French battery management company Freemens SAS, as part of a cash-and-equity deal. Post-acquisition, Freemens engineering and sales team will be joining ION. Freemens will continue working with their current clients which include Airbus Safran, CarWatt, NTN SNR and 20+ others. With the acquisition, ION will invest into this business and grow the portfolio of customers in India, US & other parts of EU. The acquisition, is in line with the energy storage company's aim to expand its portfolio of customers across India, the US and other parts of EU.

4. Key Highlights

Hybrid Renewable Projects in Store for Utilities

Very few U.S. utilities are pursuing hybrid projects that combine wind, solar and/or battery storage in various combinations. Kauai Island Utility Cooperative (KIUC) is operating a solar-plus-storage project that may be the first U.S. renewables-powered peaker plant. Arizona Public Service (APS) just contracted with First Solar for what is said to be the first utility-scale renewables peaker plant. Unlike single renewables, hybrids offer load profiles that meet system needs across the day and the year, fuller use of transmission, and two-for-one bargains on the costs of interconnection, siting, and operations and maintenance.

The global hybrid market could be \$1.47 B by 2024 and the U.S. market is projected to grow from 2015's \$195 MM to more than \$300 MM by 2024. The appeal is that they operate similarly to

baseload power and eliminate the choice between wind or solar or storage by combining the best of all three.

5. Catalyzing Blockchain Innovation in the Energy Sector

The infrastructure of the energy sector was put in place many decades ago. A lot of regulation active nowadays, is no younger than 100 years old. As a side effect, the energy markets have historically been extremely centralized, with monolithic generators feeding electricity to the consumers for a given price.

However, the booming market of Distributed Energy Resources, such as solar PV panels and batteries, has created a big appetite for decentralization in the energy sector. Due to the rapid integration of DERs, supply and demand are becoming increasingly intermittent and grid operators and regulators face a logistical challenge of monitoring and planning for an increasing number of small energy producers.

On one side, allowing the uncontrolled connection of new generation points at the edges of the grid could compromise the stability of the system. On the other, preventing these new sources of clean energy from participating in the market is not an effective utilization of our energy industry.

Blockchain technology has the potential of unlocking this situation (and many more) while enabling the transition towards a decentralized, decarbonized and digitized energy sector. However, for blockchains to live up to the expectations and materialize its value proposition in the energy sector, several key issues needed to be resolved. The scarcity of talent and a futile repetition of efforts was preventing the arrival to commercial stage of many energy blockchain projects.

The Energy Web Foundation is a non-profit organization addressing all those issues by creating a public and open blockchain tailored after the specific needs of the energy sector: limitless scalability, strong cyber-security, low energy consumption and regulatory compliance. The Energy Web Blockchain, once fully operational will be able to host and run any blockchain-based energy application, accelerating the development of the industry to all-time heights.

The goal of the EWF is to foster the transformation of the energy sector. Therefore, the Foundation is engaging with both large utilities and innovative start-ups to help them adopting the technology for their respective use cases and large groups.

The ecosystem around the Energy Web Foundation has rapidly grown since its birth on January 27, 2018. More than 40 Corporate Affiliates (leading energy companies) and a growing number of Ecosystem Affiliates (innovative start-ups) are building their applications on the Energy Web Blockchain, in preparation for its release, scheduled for Q2 2019.

A common effort paving the way towards the transition to a new energy paradigm.

Oriol Pujoldevall, Strategic Partnerships manager
Energy Web Foundation
oriol.pujoldevall@energyweb.org

Market-based IRPs-A new paradigm for grid planning

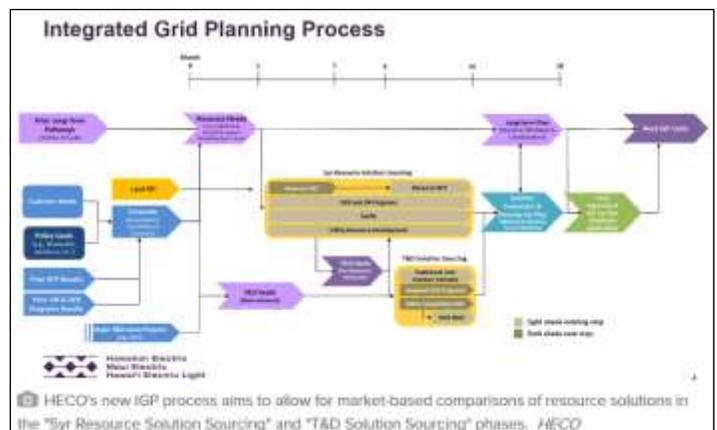
Utilities like Hawaiian Electric and Xcel are beginning to use real-world prices in their integrated resource plans. Traditional

planning at vertically integrated utilities is a very serial process. Utilities go through a series of forecasting steps, modeling expected electricity demand and cost of different resources. Once those assumptions are approved by regulators, utilities can then go out and issue an RFP to procure the resources they need.

HECO devised new model that removed the theoretical resource cost estimates, replacing them with preliminary RFPs and requests for information (RFIs) that would allow the private market to demonstrate what the actual cost of resources would be during the planning process. The new process works for more than just generation. The utility could also issue an RFP for transmission and distribution solutions, allowing DER providers to potentially defer or replace those costly power line upgrades with batteries or other technologies.

Source: utilitydive.com

Coal, Nuclear Plant Operator Files for



Bankruptcy

FirstEnergy placed its coal and nuclear generation units under chapter 11 bankruptcy. Although coal and nuclear plants across the country have struggled to compete with the low prices of natural gas, FirstEnergy's filing is unique because it stands to take on a political dimension. Just two days before the bankruptcy filing, the company petitioned the Department of Energy (DOE) for an emergency bailout, citing concerns about reliability. In FirstEnergy's petition, it asked the DOE to require East Coast grid manager PJM to buy power from its coal and nuclear plants and to have PJM compensate those plants for the full benefits they provide to energy markets and the public at large.

Improving Transmission Efficiency with Carbon Nanotubes

Carbon Nanotubes (CNTs), are small tubes composed of carbon atoms, and are ideal for transmission network cables and wiring. Due to their physical and chemical properties, they offer an extremely high strength-to-weight ratio and superior conductivity, however, high costs and other challenges have so far deterred adoption. The utility industry stands to benefit tremendously from the conductivity and strength-to-weight characteristics of CNTs, as the tubes could be integrated into transmission and distribution (T&D) networks to enhance power delivery efficiency and reliability. With the right strategies, key players in the CNT market have the potential to improve transmission network efficiency and reliability.



The 3rd Annual Grid Modernization Forum, May 23-24, 2018 in Chicago, closely examines lessons learned to date by industry leaders pushing the frontiers of grid modernization and reliability. As in previous editions, key technology innovators and executives will come together to share perspectives on how best to leverage smart grid investment, effectively engage customers, and meet the challenges of the changing energy ecosystem.

Organized by the Smart Grid Observer, (www.smartgridobserver.com), the event will discuss case studies of improved network performance, resiliency, outage restoration, and distributed energy resource (DER) integration, with the intent of determining best practices and evaluating technology advances for possible implementation. As in prior years, this is a unique opportunity to network with top industry professionals who are leading the way toward effective grid modernization and the integrated, interoperable, resilient energy network of tomorrow.

The Thursday morning keynote will be by Dr. Mani Vadari

8:00 - 8:30 am [Grid Modernization and the Imperative for Utility Transformation](#) [details](#)

[Dr. Mani Vadari](#), President, **Modern Grid Solutions**

Organizations confirmed to speak include [Modern Grid Solutions](#), ComEd, National Grid, AES, DTE Energy, ConEdison, Ameren, NextEnergy, Argonne National Lab, DNV GL, Midwest ISO, the University of Illinois at Chicago, EPRI, NEMA and many others. Visit www.grid-modernization-forum.com

SolarWindow teams with DOE labs to improve its wares

SolarWindow Technologies, developer of transparent electricity generating coatings for glass windows and flexible veneers, announced it was awarded its first-ever advanced materials manufacturing cooperative R&D agreement (CRADA) by the US DOE's Office of Energy Efficiency & Renewable Energy's (EERE) Advanced Manufacturing Office (AMO). The CRADA was awarded for a proposal outlining the firm's process technologies and fabrication methods to the DOE's Roll-to-Roll Advanced Materials Manufacturing Consortium, led by Oak Ridge National Lab (ORNL) and partnering with Argonne National Lab (ANL), Lawrence Berkeley National Lab (LBNL), and the National Renewable Energy Lab (NREL). The CRADA will be carried out with the DOE by SolarWindow, ANL, and NREL.

Renewables maker Energify World shows off blockchain

Energify World, China-based maker of solar panels and EV charging stations for US customers, announced yesterday it became one of the first energy firms to conduct live vendor payments on a blockchain network. Blockchain consultancy HashCash Consultants made the payments possible. The renewables firm envisions a world where people drive high performance cars powered by clean energy sources and it strives to create an environment where EVs are the transportation of choice for auto buyers. Vendor payment is the first of several blockchain applications the firm intends to implement. Blockchain based supply chain management and part tracking is another area of interest and IOT and managing off-grid solar networks is also where the firm sees blockchain potential.

6. Why you should care about all connected devices?

We try to be data-driven in our day-to-day decision making, yet, when it comes to managing our enterprise infrastructure/facilities we tend to fly blind. Most enterprises don't have an accurate understanding of how many connected devices are deployed in their infrastructure. Lack of visibility causes enterprises to perpetually remain in an unpredictable state because they must react to situations as opposed to proactively preventing potential issues from occurring. Gartner predicts ~50 Billion active connected devices by 2020, so this is a gargantuan problem.

What does that mean for your enterprise?

Quocirca research found that in 2016 the average business oversaw ~7,000 IoT devices. This data was gathered across many industries including transportation, manufacturing, utility, retail etc. That is a lot of devices to keep track of let alone having to manage and control them.

Why should you care?

Lack of connected devices visibility exposes your enterprise to a variety of risks, compliance issues and security vulnerabilities. Furthermore, the operational inefficiencies impact your margins. Every connected devices-related task takes longer, is more expensive and is error prone – for example, generating reports, audits, inventory management, identifying health of the devices, reducing MTTR, and so on. This situation has a massive opportunity cost because you are stuck in reactive-land and unable to innovate and progress on the maturity curve towards preventing outages by predicting issues or optimizing operations using Machine Learning/Artificial Intelligence.

Why is this still a problem?

Given the innovation, advancements in IT, you may wonder “Can’t I use my existing IT tools to get connected devices visibility?”.

Great question but unfortunately, it is not that easy.

IT took decades to standardize and converge on how best to connect with the variety of devices and interact with them. IoT is not there yet for several reasons: the vast number of industry-specific protocols, lack of standardization, fragmentation, and most importantly the lack of safeguards & technology maturity that goes into designing and implementing proper security measures in such devices. Additionally, existing IT tools and technologies are not designed to deal with the sheer scale of IoT, the variety and the fragmentation. Therefore, VC investments in this space have tripled since 2015.

Where do I start?

Start by understanding the importance and the role of connected devices in your enterprise. Then, reflect on the past/future missed business opportunities because you didn’t build an accurate picture of your enterprise’s connected devices.

Now that you have acknowledged these fundamental aspects to a successful IoT program, the next step is to take actions towards ongoing visibility – not a one-time inventory of such connected devices, but a solution that provides continuous updates on the status, health, risks and compliance issues.

Sridhar Chandrashekar, CEO
optio3 -beyond sensing; intelligent control
sri@optio3.com

7. AI: Back to the Future

I occasionally expose my kids to 80s nostalgia, and last month we watched “Wargames” where Joshua, a computer built to run military simulations, almost outsmarts the US into starting WWII. My kids were surprisingly engrossed (a rare feat) with this “Human vs. Sentient Machine” thriller.

Not surprisingly the movie was suggested as artificial intelligence has exploded beyond pop culture. It feels ubiquitous throughout media outlets, across a broad range of industries, as well as a favorite thread of tech-company marketing departments.

I was intrigued by a recent article (Ferreira, J. (Jan 31, 2018). Artificial Sentience vs. Artificial Intelligence. Retrieved from <http://linkedin.com>) that downplayed the hype of AI, as “a variety of software that tries, tests, and auto-corrects its strategies for a given task.” A continuation of what has been happening for decades where we automate and advance in relatively narrow lanes. Deep learning and increased computing power have achieved amazing things, but it is incremental and limited. Pieced together, these successes are progressing society, and the utilities industry, forward, but nothing revolutionary.

While worthy of praise, AI can never capture our full imaginations; what we crave are real-life “Joshua’s.” In that same article, the author posits the notion of Artificial Sentience (AS). Technology that can work side-by-side with humans across a wide range of topics and multiple capabilities. Looking at it through the lens of utilities, we expect some day to see customer service handled by software, substation/grid repairs completed (or assisted) by machines, replacement of operator functions, etc. That is revolutionary, but some ways off.

Admittedly, those examples are based on the current industry paradigm. In a grid that is becoming more information than electrons, who is going to leverage AI/AS to create a capability or

business model that turns this industry on its ear? Nothing imminent, but the buzz is palpable.

Michael Burck
michael.burck@gmail.com

People Power offers Stanford-tested behavioral DR

People Power, announced the company’s newest energy-centric service designed to achieve significantly improved consumer participation in Behavioral Demand Response (BDR) initiatives, People Power BDR 2.0. Built on research and field-testing in collaboration with Stanford University ChangeLabs, the new service is comprised of microservices, adding to the library of AI-based energy-centric microservices announced recently with People Power Pro Energy 2.0. The new service enables energy savings contests and transforms successes into points, rewarding those who conserve while motivating others who could perform better. Featuring microservices that incorporate the company’s leading smart home behavioral research, People Power BDR 2.0 is designed to keep participants engaged and responsive to energy efficiency efforts in their connected homes.

First Utility-Operated Microgrid Cluster at ComEd

Siemens will provide the microgrid management system software (MGMS) for what it called the first utility-operated microgrid cluster in the nation with Commonwealth Edison (ComEd). The software platform will manage microgrid clusters in Chicago. On Feb 28, the Illinois Commerce Commission (ICC) approved ComEd’s plan to build a microgrid in the Bronzeville neighborhood on Chicago’s South Side. It will connect with the microgrid on the nearby campus of the Illinois Institute of Technology (IIT), creating an opportunity for Siemens to work with ComEd in the testing and implementation of the software that will run within the MGMS.

The project will let ComEd take full advantage of work funded by two grants awarded by the US DOE. The first grant supported the development and testing of a microgrid controller and the second is focused on studying how large amounts of solar PV and batteries can be integrated into a microgrid.

ComEd’s software development includes advanced algorithms to manage and optimize the use of DER for multiple microgrids, enabling increased efficiency, resiliency, and environmental outcomes, it added. As a next step, the IOU will integrate its algorithms with Siemens’ MGMS software to implement control actions for the microgrid installations.

SGT, March-1

Centerpoint Energy Touts Smart Grid in New Report

CenterPoint Energy announced the release of its 2017 corporate responsibility report, “Stewardship through Values,” which listed some of the firm’s smart grid statistics among the benefits its policies have achieved. The report followed the Global Reporting Initiative (GRI) standards, and the firm called GRI the leading framework used by organizations to disclose environmental, social, and governance (ESG) performance. The theme of this year’s report, ‘Stewardship through Values,’ highlights its approach on environmental stewardship, enriching communities, and providing a safe, inclusive workplace.

Federal Omnibus Increases Support for Energy Storage in US

The 2018 federal omnibus spending bill signed into law last week demonstrates a continuing, bipartisan commitment by Congress to sustain public investment in energy technology innovation. The U.S. Department of Energy's (DOE) clean energy innovation investments will receive nearly \$1.5 B more in FY2018 than the prior fiscal year.

Notably, the Office of Electricity Delivery and Energy Reliability (OE) received a 32% increase to its grid energy storage applied research and development budget—among the biggest increases in DOE's budget—raising FY2018 investments in grid storage to \$41 MM as requested previously by House Republicans. These investments ensure progress on the next generation of batteries and other storage technologies, which will assist DOE in making the grid more resilient. Additionally, DOE will invest \$10 MM in demonstrations of innovative pumped hydro storage projects and

has received the green light to continue the work of the Joint Center for Energy Storage Research with an appropriation of \$24 MM.

8. Smart Grid venture capital (VC) funding

Smart Grid VC funding rose to \$422 million in 45 deals in 2017, compared to \$389 MM raised in 42 deals in 2016. Total corporate funding, including debt and public market financing, came to \$1.2 B in 2017, compared to \$613 MM in 2016.

Top VC Funded Companies in 2017

Company	\$ M	Investors
ChargePoint	82	Daimler, BMW I Ventures, Linse Capital, Rho Capital Partners
Actility	75	Creadev, Bosch, Inmarsat, Idinvest
Brilliant	21	August Capital, Miramar Ventures
Particle	20	Spark Capital, Qualcomm Ventures
Urjanet	20	Oak HC/FT

Source: Mercom Capital Group, llc

9. News from Modern Grid Solutions

New Projects at Modern Grid Solutions

MGS assists a broad range of clients performing a broad range of work. In summary, our current work with clients includes

- Developing the conceptual design for a grid innovation center in New York to support the REV mandate.
- Assisting the Pacific Northwest National Laboratory on a DOE project - development of an OpenADMS application development platform (GridAPPS-D).
- Assisting with an EMS integration effort
- Assisting with the evaluation of distribution operations
- Assisting with the evaluation of energy trading operations
- Assisting with the evaluation of a utility's DERMS needs

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 3.0

The book has been released and is now available in all leading bookstores and an online store near you.



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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.