20 YEARS
EET&D MAGAZINE
May/June 2018 Issue 3 – Volume 22

CELEBRATING GEORGE "LARRY" CLARK'S 50 YEARS WITH ALABAMA POWER COMPANY

EET&D MAGAZINE

May/June 2018 Issue 3 – Volume 22

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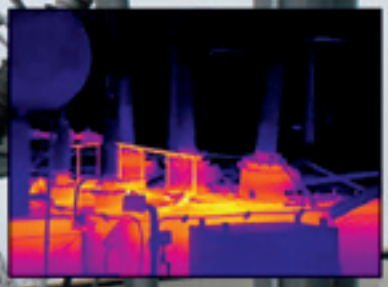

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AMEREN RECEIVES TOP DIVERSITY RANKING FROM DIVERSITYINC FOR FOURTH CONSECUTIVE YEAR

March, 2018

For the fourth consecutive year, DiversityInc® ranked Ameren Corporation first in the United States on its 2018 listing of the nation's Top 5 Utilities. In addition, Ameren was ranked first on DiversityInc's Top 10 Regional Companies list, recognizing a regional focus in the company's employee base, increased workforce and management diversity as well as strong supplier diversity.

Since 2010, Ameren has been recognized among DiversityInc's top utilities for creating an inclusive workplace, supporting the diverse communities it serves and developing strong partnerships with diverse suppliers.

> ***"Ameren's commitment and focus on diversity and inclusion is something for which our highest levels of leadership advocate."***
>
> – Sharon Harvey Davis, Ameren's vice president of diversity and inclusion and its chief diversity officer.

"We are committed to our best-in-class programming, and we strive to continuously improve our contributions to Ameren's culture and to the communities we serve. A diverse and inclusive workplace not only aligns with our core values, it is essential for Ameren to achieve our long-term strategy."

The DiversityInc honor is the latest in a series of recent recognitions highlighting Ameren's ongoing commitment to creating an inclusive and diverse workplace. In January, Black Enterprise named Ameren to its list of the Top 50 companies for Diversity. In November 2017, Ameren received a perfect score of 100 percent on the 2018 Corporate Equality Index (CEI) administered by the Human Rights Campaign Foundation.

> ***"Attracting, maintaining and supporting a diverse workforce is a priority at Ameren, because we know the value diversity brings to our organization and the communities we serve,"***
>
> – Warner Baxter, chairman, president and CEO of Ameren Corporation.

"Diversity is a driver for innovation and growth, and it will remain a key component in our business strategy as we strive to meet the evolving needs and expectations of our nearly 2.5 million customers today and in the future."

In addition to being a key component of its corporate culture, diversity and inclusion are foundational to Ameren's co-worker employee resource groups that reflect the population the company serves and employs. Ameren's employee resource groups include Ameren Military-Veteran Employees; Ameren Network of Minority Employees; Powering Connections for All Abilities; Gay, Lesbian, Bi-Sexual, Transgender Employees and Allies Network; Multi-Generational Resource Group; and Women Influencing Success in Energy. Each group commits to a mission and annual strategic business plan that identifies how it will support Ameren's business goals and objectives, participate in community outreach and educate and engage employees.

About DiversityInc

The mission of DiversityInc is to bring education and clarity to the business benefits of diversity. The DiversityInc Top 50 Companies for Diversity list began in 2001, when many corporations were beginning to understand the business value of diversity-management initiatives. The 2018 Top 50 Companies for Diversity results will be featured on DiversityInc.com. DiversityInc is a VA certified veteran-owned business and a USBLN certified business owned by a person with a disability. For more information, visit www.diversityinc.com and follow us on Facebook, Twitter and LinkedIn @DiversityInc.

NEW ANALYSIS CONFIRMS CARBON PRICING WORKS: IT WILL SIGNIFICANTLY REDUCE POLLUTION WHILE OUR ECONOMY GROWS

May, 2018

Canadians know polluting isn't free. Severe weather due to climate change is already costing Canadians billions of dollars a year in insurance costs. Across the country, Canadians have experienced first-hand devastating wildfires, extreme flooding, severe droughts and stronger storms. Canadians overwhelmingly support action on climate change and a growing economy.

New analysis by Environment and Climate Change Canada confirms that a price on pollution across Canada will significantly reduce carbon pollution while maintaining a strong and growing economy.

Carbon pricing is key to any credible climate plan because it's a cost-effective way to significantly reduce pollution while driving clean innovation and creating new jobs. A price on carbon works because it creates a powerful incentive to cut pollution, encouraging people and businesses to save money by making cleaner choices like better insulating their homes or upgrading to more efficient equipment. As a result, carbon pricing is a foundation of Canada's clean growth and climate action plan.

The study found that, by 2022, a nation-wide price on carbon pollution that meets the federal standard would eliminate 80 to 90 million tonnes of greenhouse gas emissions - making a major contribution to meeting Canada's climate target under the Paris Agreement. That's equivalent to taking between 23 and 26 million cars off the road or closing between 20 to 23 coal plants for a year.

The study also found that GDP growth would remain strong with a nation-wide price on carbon pollution. Canada's GDP is expected to grow by approximately two per cent a year between now and 2022 - with or without carbon pricing. This does not include the huge opportunity that clean innovation spurred by carbon pricing will have in helping Canadian companies create jobs and compete successfully in the global shift to cleaner growth - an opportunity the World Bank estimates will be worth $23 trillion globally between now and 2030.

Four out of five Canadians live in jurisdictions that are already pricing pollution today. Those four provinces - Quebec, Ontario, Alberta and British Columbia - had the strongest economic growth in the country last year. By ensuring all parts of Canada price pollution to the same standard, the federal government can help ensure we drive down our emissions and grow our economy.

Alberta, British Columbia, Ontario and Quebec have opted to reinvest the revenues from pricing in their provinces through measures like:

- targeted rebates or tax cuts to households and businesses
- clean growth investments that benefit individuals and business, such as home retrofit programs, support for businesses with clean solutions, and better public transit.

Each province and territory is responsible for designing a carbon pricing system that meets the federal standard. The federal government has been clear that revenues from pricing pollution will remain in the jurisdiction they come from. Our approach gives provinces and territories the flexibility to design their own systems, provided they meet the federal standard, and to decide how best to use the revenue from pricing pollution to support individuals and businesses in their jurisdiction and grow a clean economy.

"Canadians expect the federal government to take serious, practical and cost effective action on climate change while positioning Canada to take advantage of the trillion dollar opportunity in the clean growth economy. All parties in Parliament support meeting our Paris Agreement targets - and any credible plan to fight climate change must include a price on pollution. Experience from Canada and around the world confirms that pricing pollution works: it spurs clean innovation and growth, creates good middle-class jobs and gives families and businesses an incentive to make choices that will help them save energy and money. The environment and the economy go hand in hand."

– Catherine McKenna, Minister of the Environment and Climate Change.

Environment and Climate Change Canada's analysis of carbon pricing outcomes is based on preliminary estimates. The final outcomes will be determined by how provinces and territories design their carbon pricing systems, and the choices they make about reinvesting carbon pricing revenues in the economy. The net effect of pricing pollution on households will depend on those choices.

Quick facts

- Eighty percent of Canadians live in jurisdictions that have a price on carbon pollution, and in 2017, those provinces - British Columbia, Alberta, Ontario and Quebec - had the strongest GDP growth in Canada.
- Pricing carbon pollution helps Canadian companies create jobs and compete successfully in the global shift to cleaner growth - an opportunity the World Bank estimates will be worth $23 trillion globally between now and 2030.
- From 1983 to 2004, insurance claims in Canada from severe-weather events totalled almost $400 million a year. In the past decade, that amount tripled to more than $1 billion a year.
- According to the World Bank, nearly half the world's economy is pricing pollution today, including China, California, and the EU.
- Canada's five major banks, along with many companies in the consumer goods, energy and resource development sectors also support putting a price on pollution, as members of the Carbon Pricing Leadership Coalition - which includes 32 national and sub-national governments, 150 businesses and 67 strategic partners globally working to support and accelerate carbon pricing around the world.

NORTHERN PASS SEEKS RECONSIDERATION OF NH PERMIT DECISION

May, 2018

Northern Pass officials today (4/27) asked the N.H. Site Evaluation Committee to reconsider its denial of the project's application. In its motion filed today, the project emphasized the SEC's responsibility to thoroughly evaluate the comprehensive solution proposed by Northern Pass and discharge the committee's legal obligation to consider all criteria by which an application is to be measured. The SEC is expected to deliberate on the project's motion on May 24.

> ***"We have presented to the SEC a solution that fully addresses the issues they pointed to in their order denying the permit."***
>
> – Eversource New Hampshire President Bill Quinlan.

"The solution is a comprehensive set of commitments and conditions, many of which were proposed by Counsel for the Public, that can be imposed to address the SEC's concerns."

The SEC on February 1 abruptly ended deliberations on Northern Pass' application after two-and-a-half days, with no consideration of conditions that were proposed by the project and others, and having voted on just two of the four required statutory criteria.

Key Commitments

In its original SEC application, Northern Pass contemplated the need to further economic development, tourism, community investment and clean energy innovation, and these are the four focus areas for its $200 million Forward NH Fund. Key commitments highlighted by the project include the following specific allocations from the Fund:

- $25 million to address property value impacts in affected communities
- $25 million for promoting tourism and recreation in the affected areas
- $25 million for economic development in host communities to address local impacts

In addition, the proposed commitments include:

- Horizontal directional drilling (HDD) in the downtown areas of both Plymouth and Franconia to reduce construction impacts to businesses and residents
- Energy cost benefits for business and low-income customers from the sale of clean energy attributes (up to $300 million)
- Transmission upgrades in the North Country to promote existing (400MW) and new small-scale renewable generation ($50 million)
- Dedicated funding for the North Country Job Creation Fund to support economic development and job growth ($7.5 million)
- Public interest program funding to advance energy efficiency programs for customers ($20 million)
- Right-of-way lease benefits that will lower customers' transmission costs and advance distributed generation, energy storage and electric vehicle initiatives ($30 million)
- The unallocated balance of the $200 million in the Forward NH Fund is available to the SEC for further conditions ($100M)

IEEE PUBLISHES STANDARD REVISION FOR INTERCONNECTION AND INTEROPERABILITY OF DISTRIBUTEDENERGY RESOURCES (DER) WITH ASSOCIATED ELECTRIC POWER SYSTEMS INTERFACES

April, 2018

IEEE, the world's largest technical professional organization dedicated to advancing technology for humanity, and the IEEE Standards Association (IEEE-SA), today (4/26) announced the publication and availability of IEEE 1547-2018 Standard for Interconnection and Interoperability of Distributed Energy Resources (DER) with Associated Electric Power Systems Interfaces.

IEEE 1547 provides technical specifications for the interconnection and interoperability between utility electric power systems and distributed energy resources, addressing performance, operation, testing, safety considerations, and maintenance of the interconnection. The standard includes general requirements, response to abnormal conditions, power quality, islanding, and test specifications and requirements for design, production, installation evaluation, commissioning, and periodic testing.

> *"With the expansion of distributed energy resources, a cross-section of Industry stakeholders has come together to address numerous changes related to the rising levels of solar and other DERs on the grid, such as meeting requirements for the provision of reactive power and to ride through voltage and frequency disturbances"*
>
> – David Narang, chair, IEEE 1547 Revision Working Group.

"The publication of IEEE 1547 provides utilities, DER developers, regulators, service companies, and equipment manufacturers a uniform set of consensus-based requirements for grid interconnection and grid support across any type and size of DER implementation."

IEEE 1547 requirements for the interconnection of DER include those for synchronous machines, induction machines, or power inverters/converters typical to most installations. The criteria and requirements apply to all DER technologies interconnected to electrical power systems at primary and/or secondary distribution voltages. Installation of DER on radial primary and secondary distribution systems is the main emphasis of the standard, although installation of distributed energy resources on primary and secondary network distribution systems is also considered.

IEEE 1547 is available for purchase at the IEEE Standards Store.

To learn more about IEEE-SA, visit us on Facebook, follow us on Twitter, connect with us on LinkedIn or on the Beyond Standards Blog.

POWER POINTS

A BUSY APRIL

AND A COUPLE OF INDUSTRY CONCERNS

ELISABETH MONAGHAN
Editor in Chief

April is the first full month of spring; at least it is in the Northern Hemisphere. Among the themes associated with April, are National Volunteer Month, Black Women's History Month and Autism Awareness Month. In the U.S., April also is National Stress Awareness Month. Perhaps that is why I experienced a bit more stress. It also could be that it was a busier month than usual. Not only was *EE T&D Magazine* on deadline for the May/June issue, but I also attended the SAS Utility Advisory Board's spring meeting, which took place at the end of the SAS Global Forum in Denver, Colorado. Even though it was only Wednesday, everyone gathered for the Utility Advisory Board meeting already had endured several long days of sessions, meetings and networking. Tacking the meeting on at the end of the Global Forum was the best option for bringing together a large group that rarely has a chance to meet in person.

I scanned the faces of the people around the room, expecting to see a few of them nodding off. I figured they would be weary from all of the working and socializing over the past three days. By the time most returned to their offices, they would find their inboxes full of unread messages, and they would have countless phone calls to return. Maybe I am one of the few who find conferences draining because those who attended the advisory board meeting remained alert and participated in lively discussions.

The week following the SAS Global Forum was the IEEE PES T&D Conference. Like the SAS event, the IEEE conference took place at the Convention Center in Denver. There were approximately 14,000 attendees at the conference, so there was no shortage of sessions, demonstrations or conversations. Of the 920 companies exhibiting at IEEE PES, 280 were first-time exhibitors.

This year's IEEE PES T&D Conference presented the *EE T&D Magazine* crew with the opportunity to tell people about the first-ever IEEE PES GTD (generation, transmission and distribution), Asia, coming up next March in Bangkok, Thailand. Although this will be IEEE's first PES GTD conference in Asia, more than 10,000 are expected to attend, with at least 400 companies exhibiting. Because *EE T&D Magazine* is the media sponsor of the Asian event, we were able to meet with the organizers of IEEE PES GTD Asia and make introductions for them. Their vision for the conference is an exciting one. For companies entering, or exploring entry into, the Asian market, this conference will be ideal for making direct contact with decision-makers and prospective industry partners.

Certain topics come up frequently in my discussions at industry events. In several conversations during the SAS Utility Advisory Board meeting and the IEEE conference, people raised these same topics. One is the growing concern over the aging workforce. It is no secret that as more Baby Boomers, who make up the "old guard," retire, there will not be enough experienced Gen Xers or Millennials to replace them.

Additionally, younger professionals may be intelligent, proactive and insightful, but most of these up-and-comers still are in the process of gaining the managerial and life experience leadership requires. If there is not a solution to address the question, "who will fill the gap when the older workers retire?" this challenge could soon become a harsh reality that will impact every industry.

At the rapid pace at which technology already has transformed the energy sector, it may not take long for artificial intelligence to advance as tomorrow's employee. Fortunately, there are a number of manufacturers and consulting companies who are partnering with colleges or trade organizations to provide advanced training for current industry workers, while also training younger students for a variety of jobs, including management. We will cover these partnerships and programs in a future issue of the magazine.

The changing customer mindset is another topic of conversation that comes up frequently among industry partners. Today, energy consumers want to be in control of how and when they use their energy. As they gain more knowledge about renewable energy and how they can save on cost and output, customers will expect better communication and service from their utilities. In our *Powherful Forces* column for this issue, we feature Juliet Shavit, CEO, and president of SmartMark Communications. Shavitbelieves it is time for utilities to acknowledge how the customer's role has changed. "Never did utilities think customers would play a role in AMI or meter deployments," said Shavit. "I don't think utilities factored in how important the role of the consumer was going to be, and it will only become more important to consider their customers as utilities shape their plans and investments for the future." In our profile of her, Shavit also shares some ideas on what utilities can do to improve their customer engagement. Learn more about Shavit and her role as a leader and industry influencer in Powherful Forces.

In her bylined article, Roberta Bigliania, vice president for IDC Energy Insights, expounds upon the relationship between utilities and customers. Bigliania also points out pitfalls utilities can avoid and shares steps utilities can take to ensure a positive customer experience.

The concerns over the aging workforce and evolving role of energy consumers can be disheartening, but as contributors to our magazine repeatedly demonstrate, there are new approaches coming forth to address, and possibly, even resolve these issues.

For readers who could use a generous dose of inspiration, our feature on George "Larry" Clark should fit the bill. As someone who has been through half-a-century of industry change, Clark remains enthusiastic about his work. We had a chance to speak with Clark about his experience and what he feels the future holds for the power sector. To understand Clark's work as an industry leader, whose tenure and contribution deserve recognition, check out this issue's Grid Transformation Forum.

If you would like to contribute an article or if you have an idea about interesting technology, solutions, or suggestions, please email me at

Elisabeth@ElectricEnergyOnline.com.

Elisabeth

CELEBRATING GEORGE "LARRY" CLARK'S 50 YEARS WITH ALABAMA POWER COMPANY

ELISABETH MONAGHAN

Hitting the 20-year mark as a trade publication that continues to thrive is a significant milestone for *EET&D Magazine*, but if 20 years seems like a big deal, George "Larry" Clark's 50 years in the industry is quite remarkable. That is why we could not let the year get any further along without featuring Clark on the cover of *EET&D* and in our Grid Transformation Forum for our May/June issue.

We had a chance to speak with Clark about his illustrious 50-year career with Alabama Power and asked him to share his insights about where the electric energy space has been and where it is going.

EET&D – How did you end up working for Alabama Power Company?

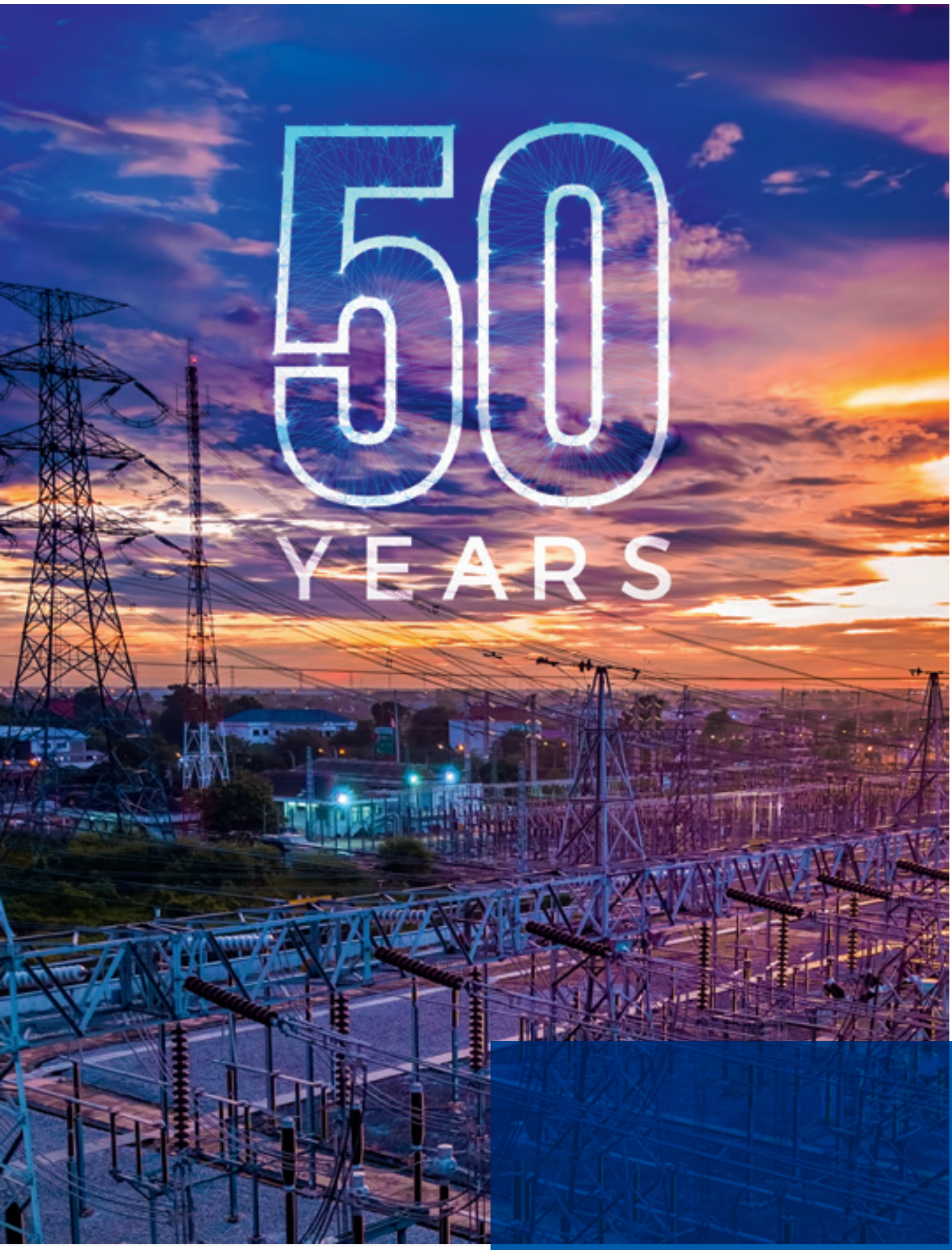
CLARK – I was a sophomore in 1967 at the University of South Alabama in Mobile, when I successfully applied for a summer job with Alabama Power after a company recruiter visited the campus that spring. In November 1967, I was approached at an Institute of Electrical and Electronics Engineers (IEEE) section meeting and asked if I was interested in a student engineer position at Alabama Power. On December 15, 1967, I resumed my employment with the company.

EET&D – What do you think is the biggest difference in the utility industry between when you first started your job and today?

CLARK – The evolution of the digital computer environment in the office, in the substations and along the distribution lines. Today, work practices in the office are all performed within the digital environment. The digital computer capability has been extended to the operations of the distribution lines. None of this capability existed when I started as a student engineer.

EET&D – Do you describe the industry today differently than how you talked about it 50 years ago?

CLARK – Yes, the utility industry is *very* different. The digital environment has opened doors to improved efficiencies and more effective means to manage and control the electric system. →


50
YEARS

EET&D – How has the industry changed since you first started your career?

CLARK – The industry is encouraging technology development all the way to the end user. The advent of the Smart Grid helped to accelerate the deployment of technology throughout the industry and inside of the utility. Consumer expectations are increasing and leading the utility industry to find improved operational techniques.

EET&D – What has surprised you most about any of these changes?

CLARK – The adoption of change is most surprising. The implementation of the digital operating environment inside the control room was well received. The distribution operators were eager to embrace the digital age to operate and control the Smart Grid.

EET&D – What has been your greatest challenge with the industry?

CLARK – The greatest challenge is staying current with the rapidly changing electric industry.

EET&D – How did you overcome this challenge?

CLARK – Involvement in the industry is the best way to overcome this challenge. I am the current chair of the IEEE Power and Energy Society (PES) Smart Distribution Working Group. I participate in the Distribution Automation Track for the annual DistribuTECH Conference. I am a frequent speaker at other industry conferences which provide opportunities to meet and exchange ideas with leading industry experts. I started attending local IEEE meetings while in college. Over the years, this IEEE involvement has expanded to a national level within the PES. The short answer is to stay engaged within your chosen field of endeavor.

EET&D – What is an important lesson you would like to pass on to your younger counterparts?

CLARK – The most important lesson is to be open and receptive to new and innovative ideas. Challenges are opportunities to expand one's knowledge and value to the enterprise.

EE T&D – What do you think is the biggest challenge facing young employees just joining the electricity sector?

CLARK – The biggest challenge is grasping the rapidly developing digital environment that is frequently referred to as the Smart Grid. This is the obvious future of the electric utility industry.

EET&D – What are the two greatest accomplishments of your career?

CLARK – My number one accomplishment is raising my family alongside my wife, Brenda. We have two children with spouses and six grandchildren. This is my whole reason for being.

My number two accomplishment is the development and deployment of Distribution Automation (DA) for Alabama Power's electric distribution system. In my opinion, the DA initiative is a flagship demonstration of the benefits of automating the electric system. Improved visibility of the electric system has been achieved while advancing its operations and efficiency.

EET&D – What are you most proud of about your work?

CLARK – The opportunities that were provided to influence and expand DA techniques. DA is a foundation technology of the Smart Grid for now and the future. I was proud and honored to be recognized by my industry peers with the 2014 IEEE PES Douglas M. Staszesky Distribution Automation Award for pioneering significant contributions to advanced Distribution Automation technology deployment and integration of smart distribution applications, and with the elevation to the grade of Fellow in IEEE in January 2016 for contributions in distribution automation for power.

EET&D – What are you most proud of about your personal life?

CLARK – My family is my greatest personal achievement.

EET&D – Where do you see the industry five years from now?

CLARK – Technology growth seems to be becoming exponential. Digital communications are improving rapidly. The visibility of the electric system will extend into consumers' homes as the Internet of Things (IoT) rapidly becomes a viable reality. Consumers will use the same IoT communications path to manage the energy exchange with the addition of renewables at their homes.

EET&D – What should today's utility companies know to position themselves for a successful future?

CLARK – Today's utility company should be willing to embrace and implement technology advancements. The Smart Grid is an achievable goal. Someone once said that Rome was not built in a day. And, neither will the Smart Grid be achieved in a day. But, attention to the details will ensure that the Smart Grid becomes a reality.

EET&D – What would you have done if you had not been an engineer or worked for Alabama Power?

CLARK – If not an engineer, I believe that I would have considered a career in music. I grew up in the Rock & Roll era. I enjoyed listening to and playing the songs of the golden age of Rock & Roll.

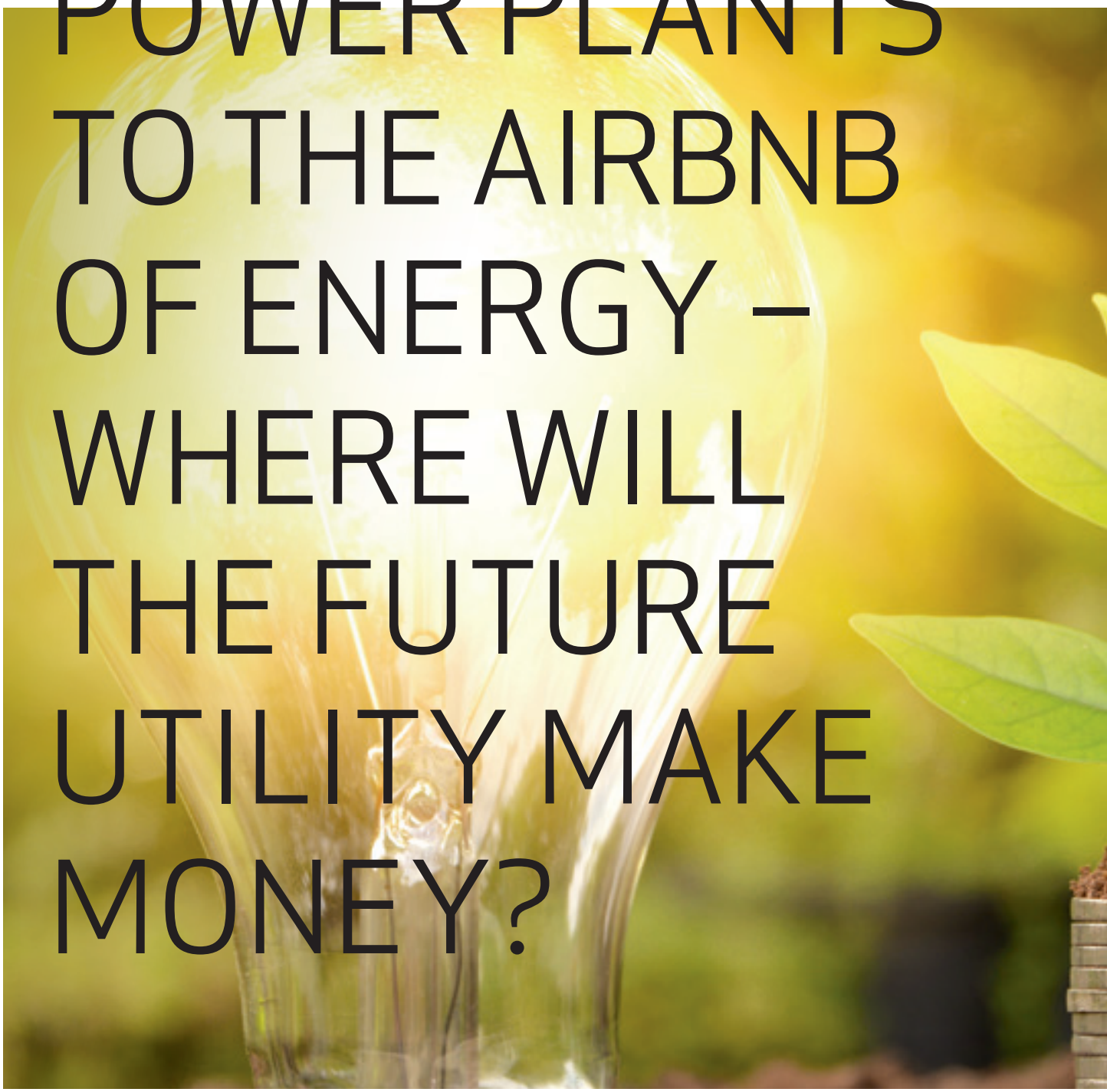
EET&D – What else would you like people to know about you, the work you do, and the company for which you work?

CLARK – Work is not an adequate word to describe what I do. I enjoy the challenges of solving problems, helping others to be successful and sharing my 50 years of experiences.

ABOUT LARRY CLARK:

With 50 years of employment, Larry Clark is principal engineer for Alabama Power Company supporting Distribution SCADA, Distribution Automation and Switching Operations technologies, and Integrated Distribution Management System and Smart Grid Strategy. Clark is registered engineer in the State of Alabama and Life Fellow of IEEE.

FROM BIG POWER PLANTS TO THE AIRBNB OF ENERGY – WHERE WILL THE FUTURE UTILITY MAKE MONEY?



CHRISTIAN FEISST, PH.D.

The energy market is changing, rapidly and drastically. Deregulation, decarbonization, decentralization and digitization pose new challenges, and it will be up to utilities to find solutions. To succeed, energy companies must become data companies rather than sellers of kilowatt hours, service providers rather than product suppliers. Other industries undergoing digitization and bringing companies like Airbnb, Uber and Amazon to the top may serve as a blueprint.

The Old Energy World

For decades, the energy market worked the same way: A centralized, fossil-fueled, analogous and highly regulated system provided electricity to customers, who neither had the means to produce energy themselves nor could they switch providers. The energy supplier, on the other hand, knew that large-scale investments like setting up power plants would pay off over their lifetime of several decades. However, this is changing.

Deregulation, Decarbonization, Decentralization and Digitization Change Everything

Deregulation brings competition

Starting with the United Kingdom under Margaret Thatcher in the late 1980s, many countries have begun to deregulate their electricity and natural gas industries. Among others, Japan, parts of the US and the huge majority of Europe, have liberalized or started to liberalize their markets. Today, 35 countries that make up 44 percent of the world's energy consumption have begun deregulating their energy sectors.

This means competition for utilities: Competition in the wholesale market and competition for winning new customers, as well as keeping existing customers. →

FIGURE 1

Figure 1: *The countries that have deregulated or have started to deregulate their energy markets are in black. These markets make up 44% of the world's energy consumption. Graphic: GreenCom Networks. Data source: en-powered.com.*

Decarbonization stirs up the wholesale market

Adding to this competition of deregulated markets is the pressure of decarbonization and renewable energy sources on classical fossil power generation. Running old coal-fired or nuclear power plants does not guarantee solid revenue streams anymore – steady baseload cannot be achieved for central power plants with volatile renewables pushing into the market at any time. Also, with having almost zero marginal costs, renewables push many fossil-fueled plants to unprofitability – see merit order effect. (see **Figure 2**)

Currently, Bloomberg estimates, renewables provide more than 33 percent of the world's installed electricity generation capacity. This percentage is growing and will reach almost 50 percent by 2030 and 66 percent by 2040. With these numbers, renewables are not just a mere green policy project but will determine how players in the energy market will be successful.

FIGURE 2
RISING SHARE OF RENEWABLE GENERATION CAPACITY

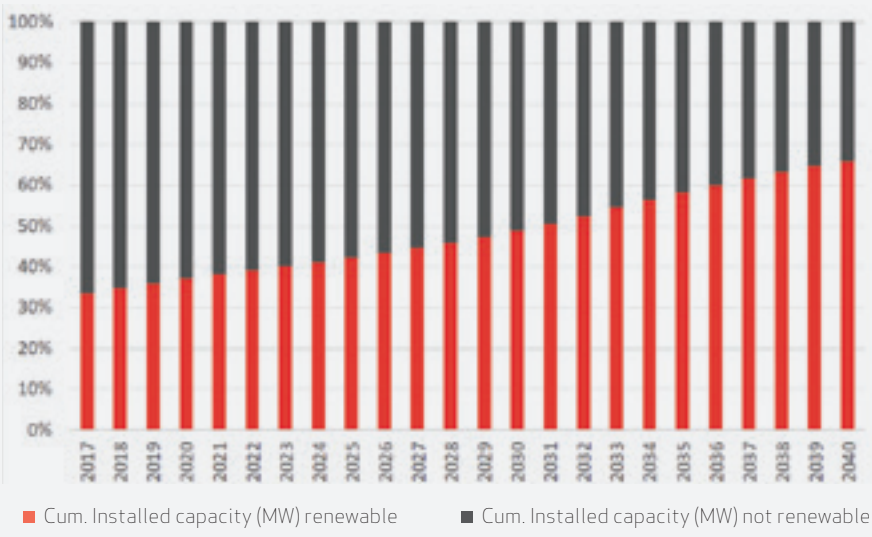


Figure 2: *Forecast: Share of cumulated installed capacity worldwide. Data: Bloomberg, BI SOLRG, long-term forecast, accessed 23.03.2018; Diagram: GreenCom Networks.*

Decentralization eats market shares

Unfortunately for many utilities, the recent trend of decentralization diminishes an old and secure revenue stream: Selling kilowatt hours to customers. Take for example, Bill. Bill owns a house and has a solar PV system installed on his roof. He currently buys around 30 percent less electricity from the grid. Adding to that, Bill wants to increase his own consumption and doubles it by putting battery storage in his garage. However, Bill's utility now has a customer that buys less energy and potentially causes problems by feeding in electricity whenever he does not need his own electricity, and his storage is full. (see **Figure 3**)

Currently, more than 10 percent of the installed generation capacity is decentralized – this includes on-shore windmills and Bill's small-scale solar PV system from our example above. This number will increase nearly 30 percent by 2040, increasing the mentioned challenges of dwindling sales and a growing number of volatile and uncontrollable energy generation sources feeding into low voltage grids.

Digitization will disrupt the energy industry

We have seen what digitization can do to large and established industries: The music industry was forced online and into streaming with Spotify and Apple's iTunes being the development pioneers; the movie industry struggles with competition from streaming services like Netflix offering a subscription model rather than a pay per movie fee, and telco companies have put large parts of their customer care online as well as established flat rate tariffs. Finally, retail stores are now sharing a market with Amazon, Alibaba and the like, while Airbnb is the largest hotel chain without owning a single bed.

What will digitization mean for the energy sector? The upcoming developments can be categorized into three sections with some already underway:

1. To many, digitization means having the same processes in a computer, rather than on a stack of paper. Examples would be a chat function on the website instead of a hotline, electronic bills or functionalities like changing supplier, changing address, etc. on a web portal for customers. This is already happening but only constitutes a small part of what digitization can be.

2. Still relying on established processes but automating them are several start-ups and digital companies. Comparison portals help customers to switch utilities fast and without any paperwork. A start-up in Germany makes switching completely automatic – customers just sign up and benefit from the switching bonus every year. The start-up gets a small part of the bonus.

3. In the future though, we will see more business models that aim at changing whole processes. Peer-to-Peer trading for "prosumers" – meaning people who produce and consume at the same time – will offer homeowners with decentralized energy assets like Bill, the opportunity for better prices and more flexibility. Another example of changed processes could be the settlement of EV-charging payments via blockchain making the middleman obsolete. →

FIGURE 3
RISING SHARE OF DECENTRALIZED GENERATION CAPACITY

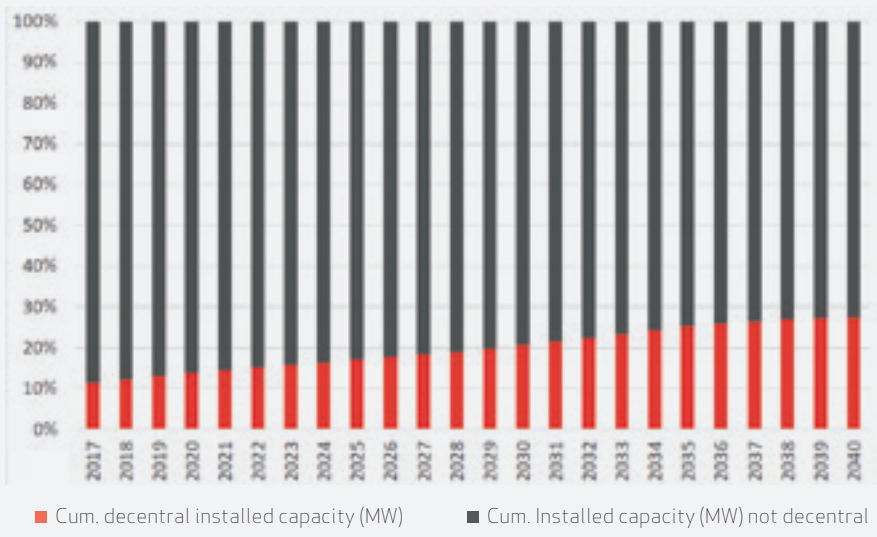


Figure 3: Forecast: Share of cumulated installed capacity worldwide. Data: Bloomberg, BI SOLRG, long-term forecast, accessed 23.03.2018; Diagram: GreenCom Networks.

The Future Energy Market and its Challenges

Following these trends – deregulation, renewables, decentralization and digitization – four major challenges for the future energy market become clear:

1. Meeting climate goals – generating power while reducing emissions remains a challenge.
2. Integrating renewables – even more so, environmentally- friendly generation almost always means hard to handle generation, putting the grid under pressure and causing volatile prices.
3. Keeping customers – with the next provider offering a bonus for switching with just a few clicks, utilities struggle with high churn rates – the longer the more. Also, prosumers may remain customers but buy less.
4. Making money – uncertain revenue from generation, hard to integrate renewables and customers that switch or consume less. For utilities, it will become more difficult to make money with existing products.

Meeting Challenges – Services instead of Products, Data instead of Kilowatt Hours

To win in the new energy market, a paradigm shift will be necessary. It should not be about selling kilowatt hours or about products anymore. Rather, services and data will become vital resources. Or as one global professional services firm puts it, "Data is rapidly emerging as the most disruptive commodity in the 21st Century and an increasingly important opportunity for market differentiation among market actors." [1]

Meeting climate goals & integrating renewables

Decarbonization of energy generation takes the right means of generation and storage – solar PV and battery storages for instance. However, ramping up capacities of renewables alone will cause major grid problems and bring little revenue. Knowing how much energy will be produced or used at a given time though, will guarantee either cost savings or revenue if monetized. To do so, utilities will have to be able to collect, aggregate and interpret millions of data points to form actionable inputs for grid operators or to develop their own services.

Picture our example of Bill with his solar PV and battery storage. He is not buying much electricity anymore but is highly interested in a high self-consumption – with the right data his utility guarantees him 70 percent self-consumption. Bill, in return, agrees that his service provider may use up to 10 percent of his battery storage for ancillary services.

Empowering consumers to become prosumers will hurt utilities' businesses at first. In the long run, however, providing services can generate new revenue streams besides an uncertain generation business.

Keeping customers

With comparison portals, electricity has become a pure commodity product. Even green tariffs can be compared, and suppliers can be switched within minutes. Once utilities start to offer unique services though, churn rates will drop.

Say, Bill has an EV, which he likes to charge once he gets home; however, he doesn't like to use grid electricity for that. His utility offers a community to its customers, where energy can be shared freely among all members. The utility collects a small fee per month, whereas Bill can now share the surplus of his generation and use more energy in case his Solar PV and battery storage do not provide enough electricity.

Making money

Offering services based on data will cause one issue though: These business models are based on software platforms, meaning that they are highly scalable but only work if there are many customers integrated. A consolidation of the market is therefore very likely. In the end, there will be many utilities left with a shrinking generation, transmission and distribution business and several providers left dominating the market with their access to customers and the data they control – see Google, Amazon, Uber, Airbnb and Spotify in their industries.

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Obstacles on the Way to the Utility of the Future

However, there are several obstacles in the way to becoming a data-driven, service-providing utility of the future:

1. Scalability – although software platforms are highly scalable they may not scale over different markets with varying regulations or preferences of customers. This may be solved by adjusting, of course, but that may not be profitable for smaller markets.

2. Laws and regulations – many countries have different laws and regulations to the point where even different states in the same country (the U.S., for example) have differing regulations. In many instances, business cases such as peer-to-peer-trading are currently not allowed.

3. Young market – the energy industry is changing. No doubt about that. However, the new evolving decentralized market segments are still quite young and don't offer the stability of mature markets.

4. Deregulated markets only – digitization in regulated markets only brings efficiency gains; in deregulated markets, digitization brings a large variety of new services with significant value added.

5. Interoperability among different manufacturers – currently, the Internet of Things is still in an early stage. There are numerous protocols and different manufacturers with devices not able to communicate in one common language. The new digital utility will integrate at least a majority of devices or set a standard itself.

Outlook

Although the energy market is fundamentally different from the music, movie or retail industries, basic learnings can be applied. In all cases, collecting, managing and monetizing data is a key factor for success. The utility of the future should become an energy data company. It will offer services based on data rather than solely kilowatt hours. It will not rely on revenue streams from generation assets, but rather on data that allows integration of renewables and unique services for customers. All this, however, should happen soon. As the global professional services company cited above cautions "energy companies and utilities have less than five years to reposition their companies, or risk ceding significant market share to new market entrants already targeting opportunities focused on the energy customer.[2]

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1. Navigant, Energy Cloud 4.0 – Capturing Business Value through Disruptive Energy Platforms, p. 4. (https://www.navigant.com/insights/energy/2018/energy-cloud-4)
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REAL-TIME REMOTE MONITORING

OF SITES AND ASSETS – PART 1

RICHARD HARADA

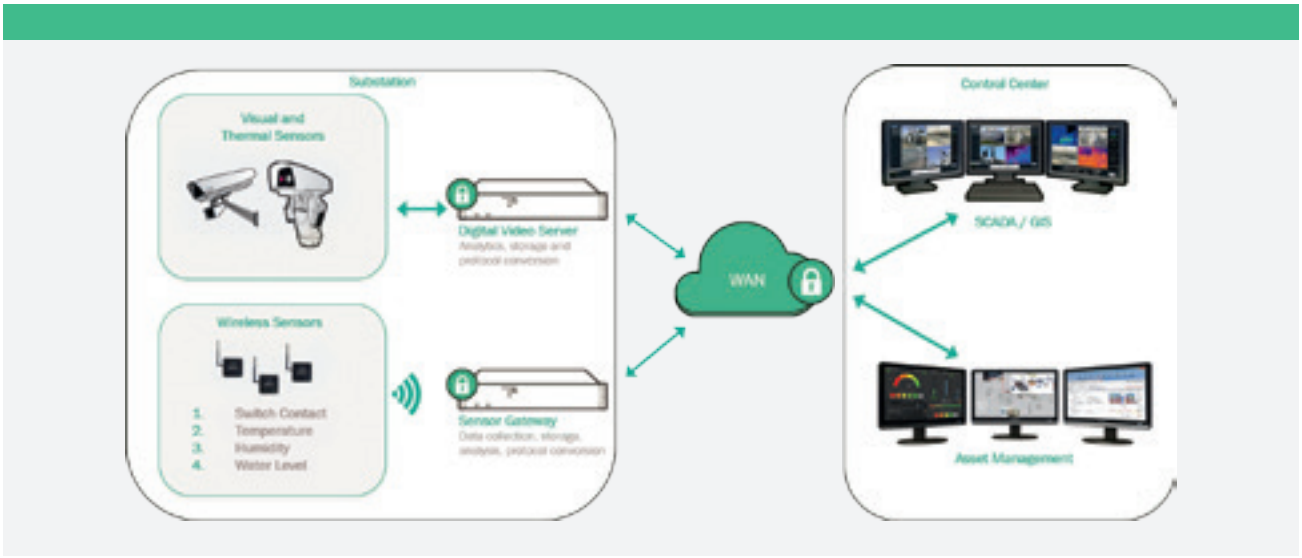
Overview

A growing trend in the electric power utility industry is the automated monitoring of remote sites and assets. An electric utility's assets must be maintained and repaired on a continuous basis to prevent equipment failures and outages and to keep the system operating safely. With the challenge of keeping costs under control and service reliability high, knowing how to prioritize maintenance and repairs to provide the most efficient and cost-effective results is a huge benefit. The development of both sensor technology and communications networks is now providing the means to deploy solutions that can track the health of assets and plan when maintenance should be scheduled to prevent failures. To prevent the utility from being overloaded with the wealth of data from the field, there are also applications available to view the data in real-time and process it to determine health scores and predict when and how failures might occur. Sensor technology can also allow the utility to perform remote inspections to make more efficient use of man and machine hours.

Sensors Provide a Long-Term View and an Immediate Status
Real-time monitoring gives operators a live dashboard view of the state of their assets. The automation part provides alarms so even if the operator isn't watching the dashboard they will be notified that something needs their attention. The operator sets the threshold parameters for the alarm analytics, allowing them to be in control of the system and tune it for their particular situation. The alarm level could depend on specifications from the equipment manufacturer, but it may take into consideration other situations, such as weather conditions and load. The dashboard allows operators the ability to drill down to get more details on what caused the alarm, so they have the data on hand to make informed decisions. Not only can the asset data be presented and monitored in real-time, but it can be stored in a historical database that can be used in predictive analytics to plan and prioritize maintenance, repair or replacement activities. As the sensors are reading information from the assets, the data is not only being presented in real-time but also digitized and stored so it can be used in multiple applications, such as in the calculation of an asset health index. The health index score helps in asset management to track the condition of assets and to determine if any actions are needed to maintain, repair or replace equipment.

Remote Inspections

It has long been thought that the only purpose for video cameras at a substation was to provide physical security at the site. Operators soon discovered that having cameras allowed them to do inspections without having to send field technicians to the site. While the camera system provided automated security through motion detection and perimeter violation, operators could also take control of pan, tilt, zoom, (PTZ), cameras to inspect transformers, switches, etc. The cameras provide real-time situational awareness, allowing operators to diagnose problems without having to dispatch a crew to the site and also ensured safety procedures were being followed when they were on site. →



One of the biggest expenses that utilities have is rolling a truck to a site; whether it's for maintenance at a remote site, or emergency repair or replacement, truck rolls take man-hours away from resources and these can be significantly reduced with the tools that are now available.

Modern communication networks can connect operators to sensors at remote sites; inspections can be done from the control center, allowing them to see the condition of the assets in real-time. Visual inspections can be done using cameras at the site that allow operators to pan and zoom into all areas of the site to inspect equipment, physical conditions and depending on the placement can even read gauges and equipment nameplates. Thermal cameras installed at the remote site can similarly allow a thermographer to do remote inspections. Most utilities are familiar with infrared cameras and will send thermographers to the site to do periodic inspections. Thermal imaging is a useful technology that can uncover many problems; in many issues, heat is a by-product of problem. Issues such as poor connection, failing insulation, load imbalances and partial discharge to name a few, all will produce excessive heat as result of a failing condition that can be detected with the use of thermal imaging camera. Although the technology has been in use for many years, advancements in the field now make the use of the technology even more useful and accessible. The thermal cameras can be programmed to rotate and automatically monitor several pieces of equipment and measure temperatures 24/7. This is an automated, non-invasive technique since it can monitor equipment and points without physical attachment and while the system is powered and under load. It can prevent or at least reduce the number of times the utility must schedule an outage to perform tests and diagnostics on the system. It gives the thermographer more information about the site under different load and weather conditions while saving trips to the site.

Added Safety

The added benefits of remote visualization of a site are the safety aspects. Remote inspections mean the work crews don't need to enter hazardous work areas as frequently and be exposed to the dangers of high voltage environments. When crews do have to enter the site, having remote visualization can ensure that the proper safety procedures are being followed. Knowing that the site is being monitored can change the behaviour of work crews and ensure that they are not taking procedural shortcuts. Remote inspections can ensure that the physical security elements such as fences and gates are in place and in good condition to deter the public from entering the site.

Condition-Based Maintenance

Companies that practice time-based maintenance realize that often, they are inspecting and maintaining equipment that is in perfectly fine working order. They may spend many miles and hours of man and machine time for a paperwork exercise. Many companies realize that a more efficient means of maintaining a site and equipment is to use Condition-based Maintenance, (CBM). Usually, significant upfront investment is required to install the asset monitoring system before CBM can be employed; however, payback can be realized in various ways. Using CBM, sensors monitor various parts of the equipment under normal operating conditions that let the operator know if the equipment is working correctly. The data collected from sensors is represented in real-time and can also be stored in a database for further analysis. This is important because it can show how the operating characteristics are changing over time. As an example, the transformer and peripherals may be working well within operating limits, but sensors may show that partial discharge around the bushings is present and is actually increasing. This may also be causing a temperature

increase and acceleration of the condition. The data from the sensors can be input into an asset health monitoring application to generate a health index and a prediction when a failure may occur. Based on this information the utility will know how long it has to perform maintenance on the transformer/bushings before a failure. If multiple assets from multiple sites are all logged into the CBM system, then the prioritized list of maintenance activities can be generated resulting in a more efficient deployment of personnel and maintenance equipment.

Preventing Outages

There has been a long-standing interest in CBM and the supporting technology to deliver it in a cost-effective means is making it more accessible. With the maturing and coming together of technologies such as edge processing, cloud computing, the Internet of Things and predictive analytics, there are now ways and means to gather and process information in very fine detail that can help utilities predict when failures will occur, so repairs and maintenance can be carried out. Performing maintenance in a timely manner can not only prevent the loss of an expensive asset but also prevent outages that affect industrial customers and the public that result in cascading economic losses.

Calculating the Return on Investment

While utility companies may realize the benefits that remote visualization of sites and assets can bring in terms of maintaining the uptime of their service area, they may find it difficult to justify the cost of the system. The value of the information that automated sensor technology brings goes beyond convenience to operators and engineers and affects the company's bottom line in different ways, like capital spending, as well as operations and maintenance. It may seem that remote monitoring is like investing in insurance, buying something upfront in hopes of preventing future losses in other areas, but it doesn't take long to calculate the return on remote asset monitoring. The investment can be amortized over the expected life of the monitoring equipment and is factored against the potential expenses saved over the same amount of time.

Some of the saved expenses:

Reduced truck rolls and man-hours for:

- Visual and thermographic inspections
- Time-based maintenance procedures
- Emergency repairs that could have been prevented
- Loss or damage to assets that could have been prevented by early detection of faults
- Loss of revenue and penalties due to outages that could have been prevented by early detection of faults

Summary

Sensors are continuously evolving; becoming more sophisticated and providing more and more data that is available all the time and that can be gathered remotely. No longer is it required to dispatch crews to check on things at remote sites when the technology exists to perform automated monitoring. The communication technology that enables the Industrial Internet of Things, (IIOT), is also evolving, allowing sensors to be online all the time and to be constantly sending that data. It is becoming more common for remote substations to be connected with high-speed fibre links to monitor and control substations and connect them to SCADA/GIS and asset management applications. It will become more common for devices such as switches, reclosers and arrestors to be smarter and online all the time. With the growing number of sensors in the field, utilities are having to deal with "big data"; having more information available on hand than they have resources to review and analyze. At the same time, the applications and services are also improving to process the data and filter it to provide simpler and more valuable conclusions. Data can not only be viewed in real-time to provide online status of the grid down to the asset level, it can be stored and processed to provide health indices and predictive analytics to schedule maintenance activities. While the amount of data and the evolving technology to gather and process it may seem overwhelming, it will all eventually lead to a more efficient and reliable grid.

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Richard Harada has more than 20 years of experience in industrial networking communications and applications. Prior to joining Systems with Intelligence, Harada worked at RuggedCom and Siemens Canada, where he focused on product management and business development for industrial communications in the electric power market. Harada is an electronic engineering technologist and has a Bachelor of Science degree in computer science from York University in Toronto.

DIGITAL MARKETPLACES EMPOWER UTILITIES

TO TRANSFORM RELATIONSHIPS WITH CUSTOMERS

ROBERTA BIGLIANI

Growing the top line by finding new business models and revenue streams while carving efficiencies out of the operations of the traditional commodity business continues to top utilities' agendas, especially in Europe and more broadly, in competitive energy markets. The good news for utilities is that they have a customer base to work on. The bad news is that their customers (and more generally, consumers) do not have a great opinion about them. Several IDC studies find that consumers believe utilities do not understand their needs, find them difficult to deal with, and do not feel supported when they need their advice. Thus, it comes as no surprise that in Europe, for instance, most energy suppliers have a negative Net Promoter Score (NPS) and that many incumbent players have lost market share in favor of new digital and more demand-centric entrants. In the U.K., for instance, OFGEM data finds that in 2017, new energy retailers captured about 18 percent of the market by effectively engaging customers in an unexciting but vital product: electricity.

Energy retailers are seeking to transform themselves from commodity providers into energy advisors, capable of supporting a consumer's connected lifestyle and delivering value-added services and products. IDC predicted, that, "by 2020, 50 percent of competitive-market energy providers will drive their revenues by transforming into convenient lifestyle providers." However, IDC also stated that in "failing to deliver superior customer experiences, only one in five utilities will raise customer satisfaction scores by 10 percent, or reach positive NPS by 2018."

To successfully transform, energy retailers must engage their customers in a truly effortless experience — an experience that is meaningful to the customer as an individual, available when it matters and delivered through the most convenient channel in a continuous, consistent and relevant manner.

But what if energy retailers do not know their customers? How can they provide them with relevant advice or suggest relevant products or services? And, if consumers do not trust their energy suppliers, what chance do they have of cross-selling or influencing broader consumer behavior, such as buying behavior?

Becoming an energy advisor relies on helping customers make better decisions in a broader, more holistic context. This can, and should, include advising consumers on buying decisions for energy-efficient products for the home.

Online product and appliance marketplaces provide a foundation for utilities to build consumer relationships and help them transform into trusted energy advisors.

A digital marketplace is a website in which visitors can find multiple brands'/sellers' products and services. Since marketplaces aggregate products from a wide array of providers, selection is usually wider than on a vendor-specific online retail store. In many cases, the marketplace operator may process sale transactions. In many others, it enables visitors to directly access sellers' e-commerce portals. →

The marketplace operator business model is typically multifaceted: from affiliate marketing fees, to advertising and lead generation, and data capture and monetization.

Energy-/utility-centric marketplaces usually enable browsing a vast range of energy-related products, typically for homes, including televisions, refrigerators and freezers, projectors, washing machines and dryers, dishwashers, air conditioners, light bulbs, monitors, tablets, video games consoles, etc. Digital marketplaces can power relationships both with consumers and business customers (B2C and B2B).

Digital Marketplaces' Adoption

In the past few years, online marketplaces have boomed outside the utility industry, since they provide value to buyers, making their search and choice easier. Some marketplaces have a wide variety of general-interest products that cater to almost all consumer needs. Others are specific to some product categories or customer segments.

In the utility sector, U.S. companies have pioneered the adoption of digital marketplaces to empower their energy-efficiency programs and simplify the rebates process for customers. For example, Con Edison has deployed two marketplaces, one specific for B2B and one for B2C. Another good example is the SDG&E Marketplace, which enables customers to browse and compare a vast variety of products across an array of consumer electronics, home appliances, heating, ventilating and air-conditioning (HVAC) systems, smart home devices and lighting. The marketplace does not sell them — it points customers to places where these products can be purchased.

In Europe, energy retailers have also started introducing marketplaces to transform their relationships with customers. E.ON in the U.K., EDF in France and Enel in Italy are just some examples.

According to IDC's 2018 top 10 predictions for utilities: "In 2018, in targeting Millennials, gas and electricity suppliers will dedicate 50 percent of their customer-experience–related IT budgets to digital channels, product marketplaces and personalized services, leading to gains of up to two points in their customer effort scores."

What are the Benefits for Utilities?

To transform their relationships with customers, utilities are looking for opportunities to provide valuable and relevant information. They want to advise their customers on how to become more energy efficient; they want to provide value-added services and products. Marketplaces are acquisition and engagement platforms — a way to generate new revenues, win new customers and reduce churn. They enrich relationships and make it easier for consumers to search, filter and ultimately, decide.

Marketplaces are a source of new revenues for utilities. Affiliate fee programs (and cost-per-click programs) from sellers generate payments for each customer that purchases from having used a marketplace. If the platform is credible and engaging for the consumer (resulting in high traffic figures), there are also opportunities for advertising and brand sponsorship revenues.

Marketplaces enable energy retailers to become advisors. By suggesting energy-efficient home appliances, for instance, energy retailers enable consumers to make sustainable choices, transform their relationships and prove their value as advisors. It is not easy for consumers to buy energy-efficient products; most products now score A+ and better, but these labels can be confusing, and most importantly, they do not make it easy for consumers to understand the financial impact of their choices. Current labeling does not provide accessible and relevant information for consumers on the cost of ownership; at best, it restricts consumers to making a good choice rather than the best choice.

Marketplaces are a way to transform the traditional transactional relationship that utilities have with their customers (i.e., you consume, we bill you) into a meaningful relationship beyond the commodity (i.e., we understand your life, let us advise you). Innovative and personalized content along with a unique shopping experience creates an opportunity to engage previously hard-to-reach customers. Marketplace users appreciate the service. Meanwhile, utilities that have a marketplace see improvements in their brand perception.

Marketplaces attract customers to utilities' websites and accustom customers to consider them as a source of value. This also helps costumers move toward digital interactions, and in doing so, reducing the cost of service. Additionally, increasing levels of traffic and interaction in the marketplace make it easier — and cheaper — for energy retailers to reach out to their customers.

Marketplaces are also a powerful tool for energy retailers to get to know their customers better. Gathering visitors' data and understanding their online behavior opens up new opportunities to improve and predict consumer choice, and to design, adopt and refine myriad suitable and effective initiatives.

Bring customers to your digital marketplace

From a business perspective, the major risk is that the customers ignore or do not visit and revisit the energy retailer's marketplace. Two key questions need to be answered:

- How do you drive today's online shoppers to an energy retailer's marketplace, and how do you ensure they return?
- How can an energy retailer encourage non-online customers to leverage its marketplace?

To be successful, the launch of a new marketplace needs to be complemented by a targeted marketing campaign. Display campaigns can be designed using products that are most trendy. It has been demonstrated that social media influences online shoppers. Email marketing is both a cheap and effective solution to attract customers. For instance, it is possible to send info about new products, sales and promos. Mails can be sent to clients that haven't been active in awhile with original content, such as editorial buying guides, price updates and saved searches to drive revisits. Paper bills are also an important moment to encourage consumers to start using digital channels, as a marketplace can represent a good reason to start visiting the energy retailer's website. In all cases, having access to rich product and market data allows the utility to leverage these channels in the most cost-effective and agile way.

A Call to Action

The availability of a products and appliances marketplace is an interesting opportunity for energy retailers to provide new value-adding services and transform their customer relationships.

FIGURE 1
DIGITAL MARKETPLACES: SNAPSHOT

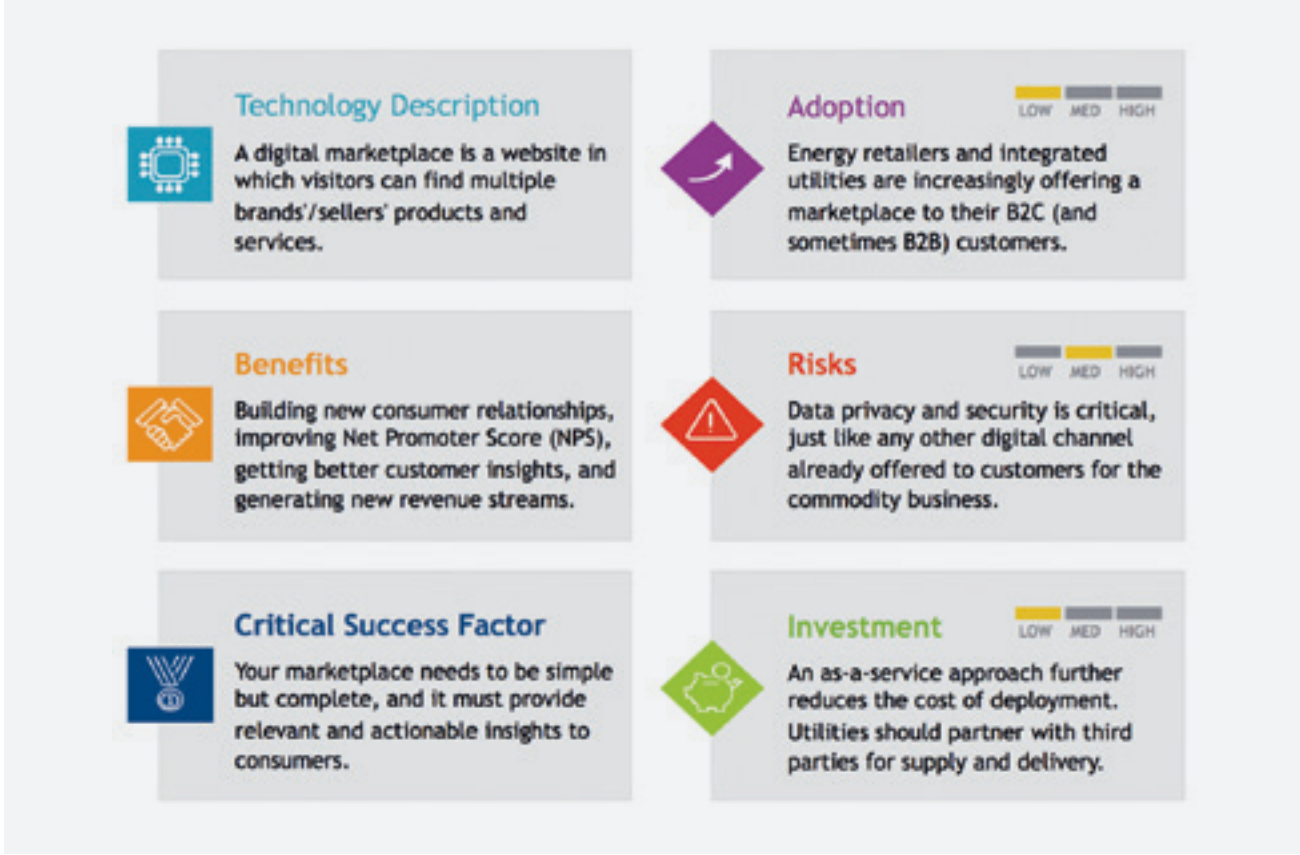

Figure 1: *Source: IDC, 2018*

Utilities that plan to deploy a marketplace should consider the following:

- Have a clear goal in mind. Companies need to understand what they want to achieve with the deployment of a marketplace and plan accordingly. Is it to directly sell products and make money off sales? Is it to influence buying behavior as an energy advisor and make money from affiliated sellers' fees? Directly selling goods and being an advisor may not be compatible options in the eyes of consumers.
- De-risk your choice. If you choose to directly sell products and appliances, be ready to manage not only the positive but also the negative impact that other brands may have on yours, especially if your suggested suite of products is limited. What happens if the product you are selling breaks down? Additionally, be ready to manage the product sales cycle and related fulfillment consistently, at least with the same consistency as the competition.
- Make your marketplace valuable and complete. Regardless of your choice, your marketplace needs to be simple and provide relevant and actionable insights to consumers. If you want consumers to visit your marketplace and not others, it needs to have something highly distinctive and valuable that aids their decision-making process. You also need to offer a wide variety of choices for each product category (even better, all available goods). If you decide to restrict the choice to some brands, you need to consider the risk of consumers querying and judging your choice.
- Decide whether to make or buy. This is the typical old dilemma — should you develop your own custom marketplace, or leverage an available platform as a service and the related capabilities it embeds? If you go for the "make" option, be sure to have the necessary data science, behavioral science and digital marketing capabilities readily available in your organization.
- Do not stop at the ecommerce gate. Energy retailers should make the most of the data coming from the marketplace. If analyzed, navigation and searches (as well as myriad other online behavior around the purchase) can be used to paint a rich picture of each visitor's preferences and behavior and be used to predict future preferences and actions. Energy retailers should not lose this opportunity and leverage this new consumer knowledge while also building new relationships with their customers and the market.

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As vice president for IDC Energy Insights, **Roberta Bigliani** advises both vendors and end-user clients and is responsible for research-based advisory and consulting services for the energy industry. Her main areas of expertise includes business and IT issues relevant to the utilities and oil and gas companies, as well as digital transformation, customer experience, big data and analytics, Internet of Things, IT and operational technologies integration.

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REINVENTING THE ENERGY INDUSTRY

MARC LACROIX

In the coming age of distributed energy resources, domestic power generation, electric vehicles, smart appliances and home automation, the energy industry faces enormous change. Consumers want new and reliable sources of energy solutions, which are easily accessible and sustainable. Utilities will face a reduction in revenues from metered energy, and new sources of income need to be developed. At the same time, unprecedented technology developments bring significant challenges and present tremendous opportunities. Looking towards the future, the energy industry must somehow reinvent itself to adapt to a rapidly shifting market.

During the last century, electrical power and energy took on a larger role in our everyday lives, and our dependency towards electricity has increased steadily. It is the keystone of the digital age. Population growth and economic development have required electricity generation, transmission and distribution systems to adapt to the ever-increasing usages of electricity. As seen in **Figure 1**, the power system was hierarchical, with big generation centers producing the energy transmitted to the customer through transmission and distribution lines.

Figure 2 shows that this system is evolving to a more weblike system with a massive implementation of DER (Distributed Energy Resources) and home generation. The power flow is no longer unidirectional but can flow in any direction from the distribution system. This new topology opens the door to new capabilities such as power exchange between customers, forcing utilities to find new revenue sources. This will largely impact the existing business model of the energy industry. →

FIGURE 1

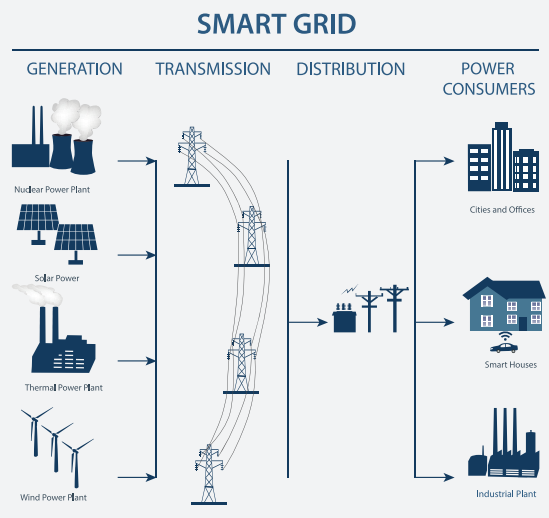

Figure 1: *Traditional Power System Architecture*

FIGURE 2

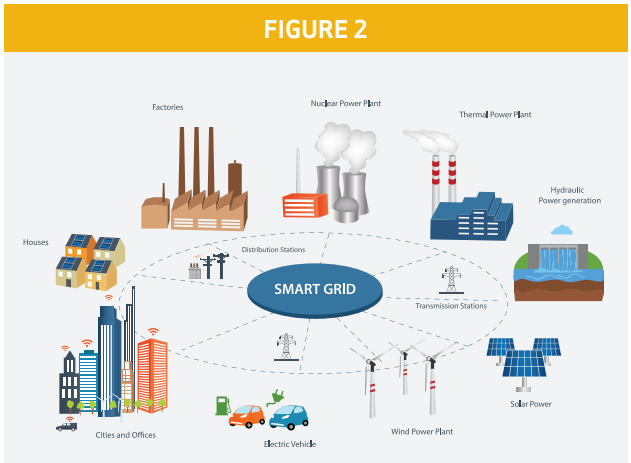

Figure 2: *New Power System Architecture*

During the coming years, the nature of business will change dramatically for the energy sector. It will be affected by different challenges such as disruptive technologies, aging infrastructure, aging workforce and a new generation of customers. Digitization, distributed generation, renewable integration and domestic generation will all affect different aspects of this business model.

Luckily, the new technologies present tremendous opportunities for the industry to redefine a new business model. In this article, we will explore the challenges with new technology and how the business model can be redefined.

The Threats

The electric industry will be challenged as never before in many facets of its business. Technical, societal and human changes all affect the industry. These factors cannot be considered independently since they also impact each other.

Impact on Revenues

On the business side, it will be difficult to continue to have revenues based on once-a-month meter reading. Home generation, transactive energy, battery storage, and new types of load, such as electric vehicles, will change the nature of how the customer consumes energy. The EPRI net-zero homes program has proven it is possible to build houses that are energy self-sufficient. Moreover, they are able to sell excess energy back to the provider. The industry should develop new sources of revenue to support and maintain their assets.

Operating and Controlling the Network

Massive implementation of DER and home generation will impact the behavior of the load, making not only the load hard to predict but also making real-time demand-response hard to maintain or adjust, due to the dynamic behavior of the load. This will also impact operator software tools such as state estimator and load flow.

We can see in **Figure 3**, a typical load pattern of a power system that shows a small peak demand in the morning and a higher one at the end of the day. One curve for each day is shown in the figure, and we can see that from day-to-day, the load pattern is quite the same. Using mathematical tools, it is easy to forecast the future load, knowing the load of previous days and the future weather forecast. The utility can then dispatch the generating units to connect to the system to meet the demand.

Figure 4 shows the load pattern for California. The green curve shows the total load, and we can see it looks like the one in **Figure 3**. Due to the solar generation, the situation is more complex. The blue curve shows the solar generation

FIGURE 3
DAILY LOAD - NEW ENGLAND - 15 -19 OCT 2012

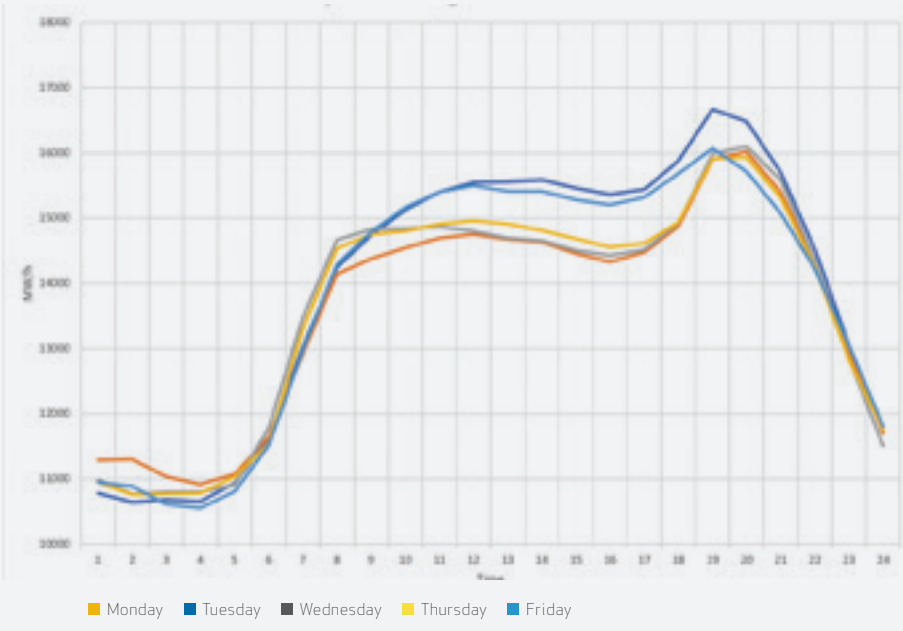

Figure 3: *New England Daily Load (Data from NE ISO)*

FIGURE 4
CALIFORNIA LOAD CURVE

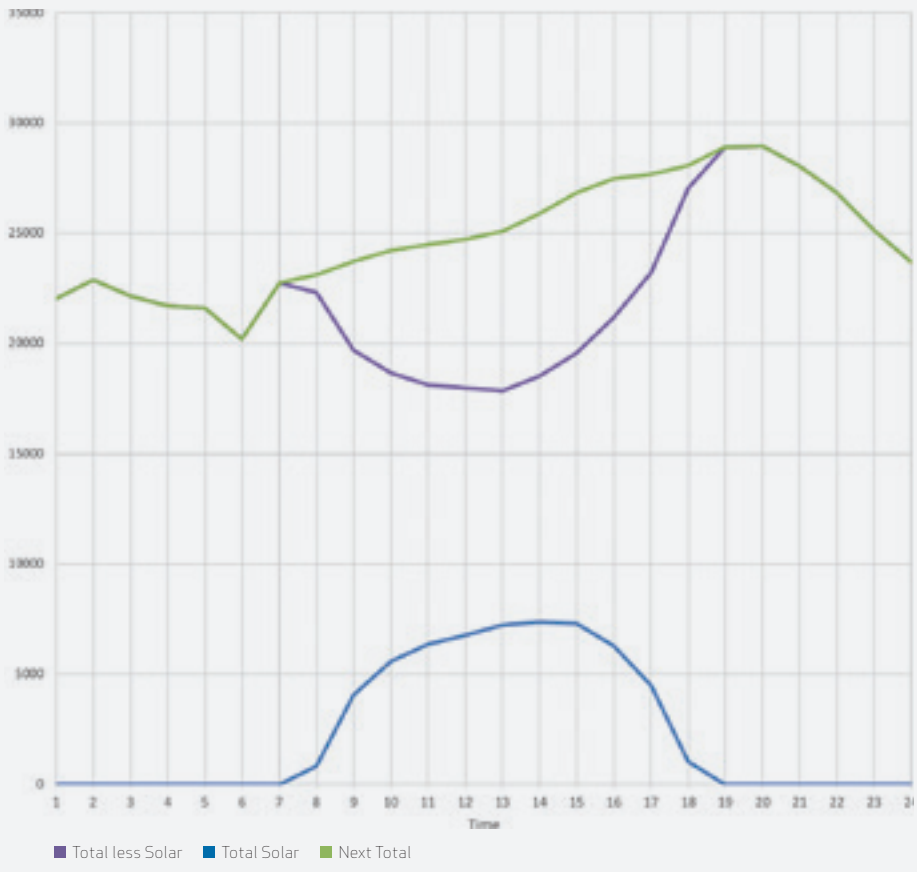

Figure 4: *California Daily Load*

and the purple one, also known as the duck curve, shows the generation that the utility must supply. The increase in energy demand from the utility is very high at sunset, and this situation is hard to manage since many generating units must be connected to the power system in a short period of time. In addition, the solar generation may vary a lot during the day, due to cloudy conditions and power system operators must react in real-time to these changes.

In the future, it will be more difficult to operate the power system with the venue of domestic battery storage, that will change the load pattern drastically. Moreover, to keep the power system balance reliable, the operators will need to control the generation and the load.

Asset Management

Asset management will also be a huge challenge. Due to the nature of the business, utilities have invested a lot of money in their infrastructure to ensure stable and reliable energy to their customer. Most of the critical infrastructure is doubled in a redundant scheme to avoid any loss of service, due to the failure of one piece of equipment. This secure system configuration has required a lot of capital investment. Now, in North America, a large part of this infrastructure has reached the end of its life expectancy. Utilities are facing the question of investing to replace these assets or to extend the lifetime.

Climate Change

Climate change is another important issue that impacts the utilities. The increased frequency and severity of weather events cause extensive damages to utilities since their transmission and distribution lines cross large territories and are more exposed. As a result, their customers are experiencing longer power outages. Climate change will also modify consumers' habits, due to higher/lower temperature that can last many days. →

Societal Change

Society is also changing, with more people working from their homes and needing reliable energy supplies. This is challenging for the utilities because now they have to improve the reliability of their system in peri-urban and rural zones.

The younger generation also poses a challenge to the industry, since they are more likely to interact with their environment and would like to do the same with their energy supply. More and more intelligent devices and IoTs are installed in the home, and the smart home is now a reality. The household consumption of energy-hungry appliances can be coordinated to minimize the power demand.

Social acceptance of new major power system infrastructure and construction of new lines also challenges the industry. It is complicated to add new equipment to meet the load demand.

Human Factor

The industry is also facing many aspects of human factor challenges. Internally, it faces an aging workforce, and many workers will retire during the coming years. Loss of expertise is expected in the industry, and programs are in place to preserve this information electronically. Younger workers have new interests and, contrary to their older colleagues, they master the new technologies quickly. Communicating through social media is their way of life.

Cybersecurity Risks

Cybersecurity is a major concern in our technological society. We have seen, over the last few years, major attacks in Ukraine, causing a six-hour loss of power for 100K people. The power system is increasingly exposed, due to its multiple connections with distributed devices. Cyber techniques exist to improve reliability and privacy in communication and databases, but still, risks due to social engineering, such as phishing, are hard to prevent.

Moreover, connecting home devices to the utility communication system can augment the threat risk because many homeowners don't have the skills for configuring their IoTs for security. Remote control of smart homes by malicious actors can cause instability of the power system and, ultimately, cause a blackout.

Emerging Technologies

Emerging technologies will help the industry to develop a new business model. The keystone of emerging technologies is digitization, which is the process of transforming information into a digital format that can be handled by computers. Many industries have been transformed by the digitization of their products, such as the music and photography industries, with good results, more or less. The energy industry is now experiencing the same phenomena with the installation of smart meters that can send energy consumption information in digital form. Moreover, all the connected devices in the home can publish or subscribe digitalized information that can be of interest to the industry.

Real-time Analytics (Big Data)

Big data processing will be important in the future to process the information from millions of devices. Big data, in the power system context, can provide valuable information to system operators, such as accurate load forecasting. This new analytic approach can process different types of information from various sources. Big data analysis can also give customer behavior information and help elaborate marketing strategies.

Transactive Energy

Transactive energy covers both aspects of control and economics of energy exchange between distributed devices. These devices connected to a network can communicate with each other to provide or get energy from other devices. The transactions can be done behind the meter or with surrounding neighbors. Two-way meters are required to monitor and record the power flow, and the transactions can be logged using novel approaches such as blockchain.

Blockchain

Blockchain is a secure technique to record transactions, agreed between two parties, in distributed ledgers. It was first used to record financial transactions, and blocks of energy can be processed in the same way. For each transaction, a record called a "block" is created and added to a list of blocks. All the blocks are linked, and cryptographic techniques are used to protect the whole list of blocks and once recorded, a transaction cannot be modified.

IoT Devices

It is expected that more than 50 billion IoT devices will be in operation by 2020. IoTs are characterized by their capability to communicate with each other and the physical world by means of sensors and actuators. In the intelligent houses, these devices will perform operations/functions in multiple application domains such as home security, health, entertainment and energy management.

These IoTs have heterogeneous environments, different communication and processing capabilities. For the homeowner, he/she can have advanced control of the different devices for a global energy management. The utility can also take advantage of the communication capabilities of these devices in order to remotely control the load in collaboration with the homeowner. However, interoperability and cybersecurity issues need to be addressed.

Domestic Generation

The price of domestic generation has decreased a lot since a few years ago, and now generation from solar panels costs $0.48 per watt. It is more affordable for domestic generation, and in combination with more affordable battery storage devices, consumers now have the choice to consume their energy in real-time or later, as desired.

Battery Storage

Battery storage is used to store extra energy produced by domestic generation. On a sunny day, the energy produced by the solar panels may exceed the energy consumed in the house and can be sold to the energy provider or the neighbors, or stored for future use. Information systems can inform the customer with the most economical approach in their decision to sell or store.

Electric Vehicles

During the last decades, interest in electric vehicles has risen, due to climate change and pressure to reduce fossil fuel use. For most people, the electric vehicle will be charged during the night. This type of load presents a lot of interest because its charging can be modulated in time. The energy provider can use this feature for demand-response programs. It is possible to fast charge the vehicle up to a certain level, in order to have the vehicle available for emergency use, and then continue with slow charging.

Reinventing the Industry

Despite the fact of all the challenges faced by the energy companies, it is the perfect time to review their business plans. Other industries have faced the digitization challenge in the past, some with success (banks and telecoms), and some with difficulty (music and photographic film industries). The new technologies can present threats to the utility, but they can also present opportunities. The utilities should design their new business model to include these technologies, in order to build a customer-centric business. The four pillars of this new business are connected customers, loyalty programs, real-time analytics and cybersecurity. →

FIGURE 5

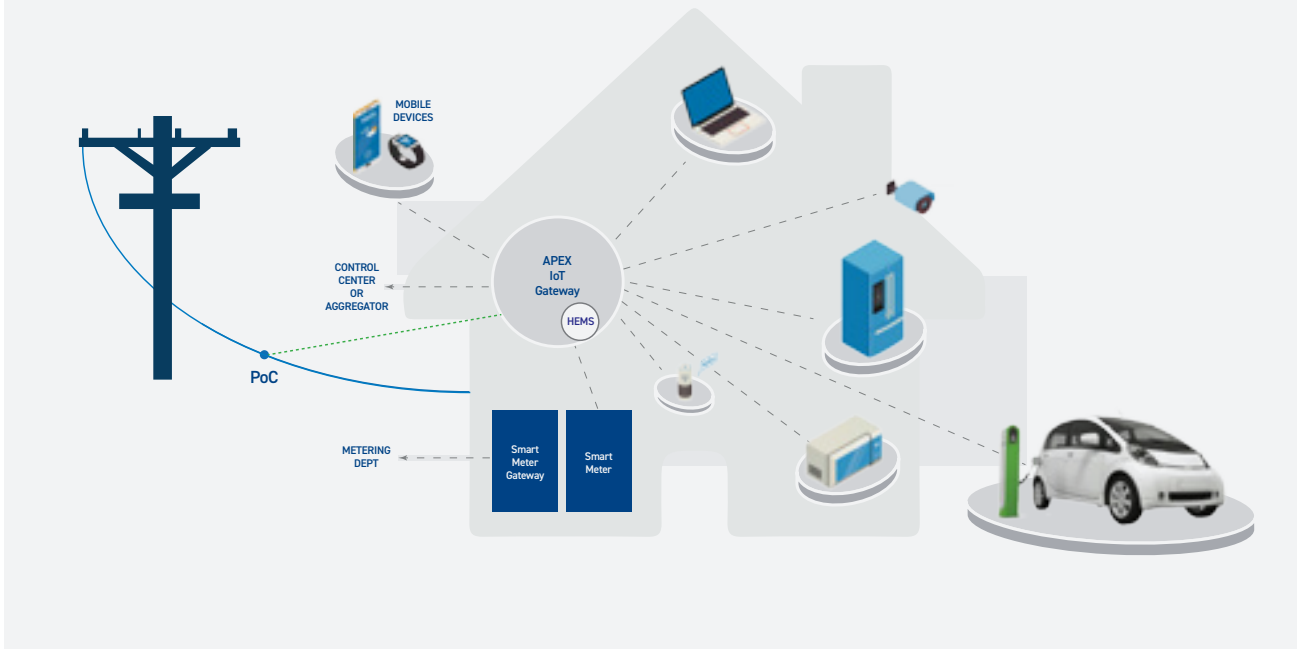

Figure 5: *Connected Home*

The utilities shall connect to their customer and get real-time data from them. The customers must also be able to interact with the utilities. One way to connect with the customer is with connected-home programs. The utilities can provide value-added services to their customer, such as a strategy to connect their electric vehicle or how to choose appliances. The utilities should offer home gateways that connect the IoTs inside the house to the utility. As shown in **Figure 5**, the IoT gateway connects to the IoTs, supporting various communication protocols. It communicates with the utility sending the IoTs' data or processing received control or setpoint.

Both the consumer and the utility can use this gateway to manage the energy use inside the house. The home gateway includes a Home Energy Management System (HEMS), which orchestrates and dispatches the operation of the appliance in order to limit the power demand or to smooth out the energy load profile. The HEMS includes analytic functions for precise forecasting of energy use and cost. The consumer will benefit from reduced energy bills and increased home comfort. The utility will have the possibility of controlling home energy consumption, in order to implement a demand-response program. The gateway can also ensure the cybersecurity by filtering and blocking messages to or from the house.

The loyalty program is another key element for building customer engagement. The utility can interact in real time with customers to propose reward schemes in exchange for reducing their energy consumption, for example. This marketing tool can be used to help operate the power system and to balance generation and load. Moreover, with real-time analytic tools, it enables the utilities to analyze customer behavior, find patterns in data with powerful data visualization and react faster to new opportunities.

Real-time analytics, based on big data analysis, bring together disparate data for a clearer view of the customer experience. This information comes from the customer, their habits, from the IoTs inside the house or from external databases such as Google traffic or weather forecasts. In creating a baseline of customer behavior, utilities can forecast precisely the load for the coming hours and can also predict what customers are going to do.

The success of this new business model must be secured by a good cybersecurity program. The power system is more and more exposed to threat, due to its multiple connections with distributed devices. Cybersecurity must be addressed at the IoT, gateway and enterprise levels with security objectives for each level. The IoT must contain a software agent to manage the connectivity with the network, validate the integrity of its data and manage security keys and certificates. The gateway should ensure that no untrusted devices could connect to the network, detect abnormal conditions and maintain a list of active and revoked keys. At the enterprise level, a system must be responsible for managing certificates, monitor the IoTs behavior (firmware version, hardware version) and assess the whole system reliability compiling statistics and detect malicious actor's activities.

Finally, the industry can review the way risk analysis is performed. This analysis should include the customer and their ability to face power failures. Taking into account the resilience of their customers to power failures, the industry can thus avoid installing costly primary equipment in reducing their redundancy requirements.

Conclusion

Utilities need to develop a new business model to maintain their business in today's tough global market. This new model must be customer-centric and include interactions with them to increase customer loyalty. Continuing efforts should be made to improve the customer experience, offering personalized services and connected-home programs. Data analytics will help increase the customer experience and will also help the system operation with better load forecast. Cybersecurity programs should be developed to ensure security inside and at the edge of the system. The industry should extend their risk analysis studies to include costumer resilience in order to reduce major investments in equipment replacement. Finally, the digitization process will build an attractive industry for talented people and a better ecosystem for the skilled younger workers.

ABOUT THE AUTHOR:

Marc Lacroix Is responsible for the energy sector development at eMcREY. He worked at Hydro-Québec from 1980 to 2013. Lacroix has developed a unique expertise related to transmission, generation and smartgrid automation and operation. From this expertise and his participation in setting international standards, he has developed a visionary viewpoint of the future of power systems. Lacroix received a master's degree in electrical engineering (1995) from École Polytechnique de Montréal. He is an IEEE senior member and is active in IEC Smart Grid SyC and TC58 working groups 10, 15 and 17.

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ALIGNING DEMAND RESPONSE CAPABILITIES

WITH APPROPRIATE APPLICATIONS

JEREMY LAUNDERGAN

For more than 100 years, electrical generation, transmission and distribution have been built to meet expected expansion in customer demand. However, this historical pattern is changing. Due to more efficient use of energy and conservation, load growth is decreasing or flatlining, and peak periods are shifting, due to societal behavioral changes (e.g., dual income households) and the emergence of distributed energy resources (DER). To adjust to the changing times, multiple industry efforts are underway, including grid modernization to make better use of technology and communication systems, to upgrade infrastructure to enable DER, to increase reliability and resilience, and to improve power quality. Demand Response (DR) is a component of these initiatives, with the intent of interacting with customers to adjust their energy usage in the never-ending challenge to balance electricity supply and demand.

DR dispatches essentially request that customers deviate from their normal electricity usage pattern. This can range from a minor or even unnoticeable inconvenience, such as automatically or manually dimming lights and adjusting thermostat set points, to more substantial changes, such as deferring an industrial process. For example, I previously worked for Boeing Space Systems, engineering carbon fiber Delta rocket components. We had a large electric autoclave and were enrolled in an interruptible DR program. The interruptible program would incur a penalty if electricity demand was not curtailed down to a specified baseline during a DR event. Sometimes we could simply run the autoclave during the night shift when a DR event was called during the day. Other times, the delay would cost more than the DR program penalty, and we had to proceed with business as usual.

Demand response dispatch has essentially two catalysts: reliability and economic (or market) forces. DR has been utilized as a reliability resource for decades (e.g., overfrequency load shed) with programs like direct load control and interruptible load, as illustrated in the autoclave example. These programs were developed to respond and mitigate system conditions (such as capacity constraints) that could result in an outage. The intent of reliability DR is to minimize impacts to the broader base of customers through the incentivized DR actions of participating customers.

However, these programs offered little feedback on resource performance, and grid operators were typically appreciative of any load relief to mitigate system interruption. The more recent economic and market approach to DR was catalyzed by the Federal Energy Regulatory Commission (FERC) Orders 719 (Wholesale Competition in Regions With Organized Electric Markets, 2008) and 745 (Demand Response Compensation in Organized Wholesale Energy Markets, 2011). Subsequently, wholesale electricity markets – both independent system operators (ISOs) and regional transmission organizations (RTOs) – have been working for years to integrate DR resources as competitive alternatives to generation resources. Typically, market dispatch is triggered by market prices, or in some instances, contingency or reliability conditions. →

Delta Rocket with Payload Fairing (nose)
Created in Electric Autoclave

More recently, the industry has been exploring a market approach, with a distribution system operator (DSO) utilizing DER non-wires alternatives (NWA), including DR, through competitive solicitation to compare overall costs and grid services with traditional distribution approaches like reconductoring to increase capacity.

The idea behind FERC Orders 719 and 745 is that electricity is a commodity. Commodity markets work when demand for the commodity varies according to the supply cost. For example, if corn has a bumper crop which results in increasing supply, the prices drop and the cost of ethanol, corn syrup, livestock feed and corn for dinner decreases. Fundamentally, the need for DR relates to the fact that electricity demand today is inelastic. The price of electricity consumption is known to be relatively constant by customers, and electricity use is not influenced by the real-time cost of supply (generation) unless there is real-time pricing (RTP). Even with RTP, customers' desire to alter usage is limited. Typically, the price to customers does not vary with the cost of supply (although DR pricing tariffs like time of use [TOU] pricing align with "peak" demand, and critical peak pricing [CPP] align with the highest annual peak demand). In fact, customers have no visibility into their usage or cost until the bill arrives (although Smart Meter Texas and some other programs are exceptions).

Grid modernization initiatives are expanding sensing and control capabilities within the distribution system. These capabilities provide more awareness of grid conditions and visibility into how distributed generation variability can alter voltage along a distribution feeder when the distributed generation and electricity demand on that feeder are not balanced. In fact, the need for grid modernization is in part prompted by the increasing adoption and proliferation of DER. Variable output from distributed generation like solar, combined with changing electricity demand, results in an even more challenging task for a utility, ISO or RTO to balance electricity supply and demand in real-time. Fortunately, DR provides an opportunity to adjust demand to align with supply, making DR a potentially significant component in an evolving portfolio of DER including advanced inverters, energy storage and secondary VAR controllers.

To meet the needs of this more complex and variable balancing act between electricity supply and demand, DR must be able to achieve the following:

- Flexibility to respond quickly with the ability to either curtail or increase demand
- Precision with predictable and accurate performance, because imprecise DR that doesn't respond as expected necessitates that other resources adjust to compensate
- Cost competitiveness to provide an alternative to generation when supply cost is high

Achieving all three criteria is not a trivial pursuit. For example, the challenge of precision is compounded by imprecise measurement and verification through DR baselines. Multiple studies have been performed on the inadequacy of DR baselines, and more studies have noted that the baselines are also insufficient for battery energy storage.

To develop successful DR programs, the business need and context for the DR resources must be understood. Developing DR to be a viable alternative to generation resources and competitive with other NWA resources depends on the investment required to enable DR program participation by customers. The economic overlay of ISO and RTO locational marginal pricing (LMP) can help determine the economic viability of DR investment, and the NWA solicitations provide insight into required capabilities and price competitiveness. DR program implementation and administration costs, as well as customer compensation for providing DR, can determine the bid price for DR resources in the ISO and RTO markets and proposals for DR as an NWA. However, the total of these DR costs may or may not result in a competitive resource compared to central generation, energy storage and other NWA.

ABOUT THE AUTHOR:

Jeremy Laundergan is EnerNex's vice president of Consulting Services and assists EnerNex's clients with strategy development, project planning, regulatory engagement, economic analysis, lifecycle management and technology assessment including considerations for renewable generation and distributed energy resource integration. Laundergan is an award-winning project management professional (PMP) with more than 25 years of experience and a master's degree in engineering management. He is a member of the Peak Load Management Alliance (PMLA).

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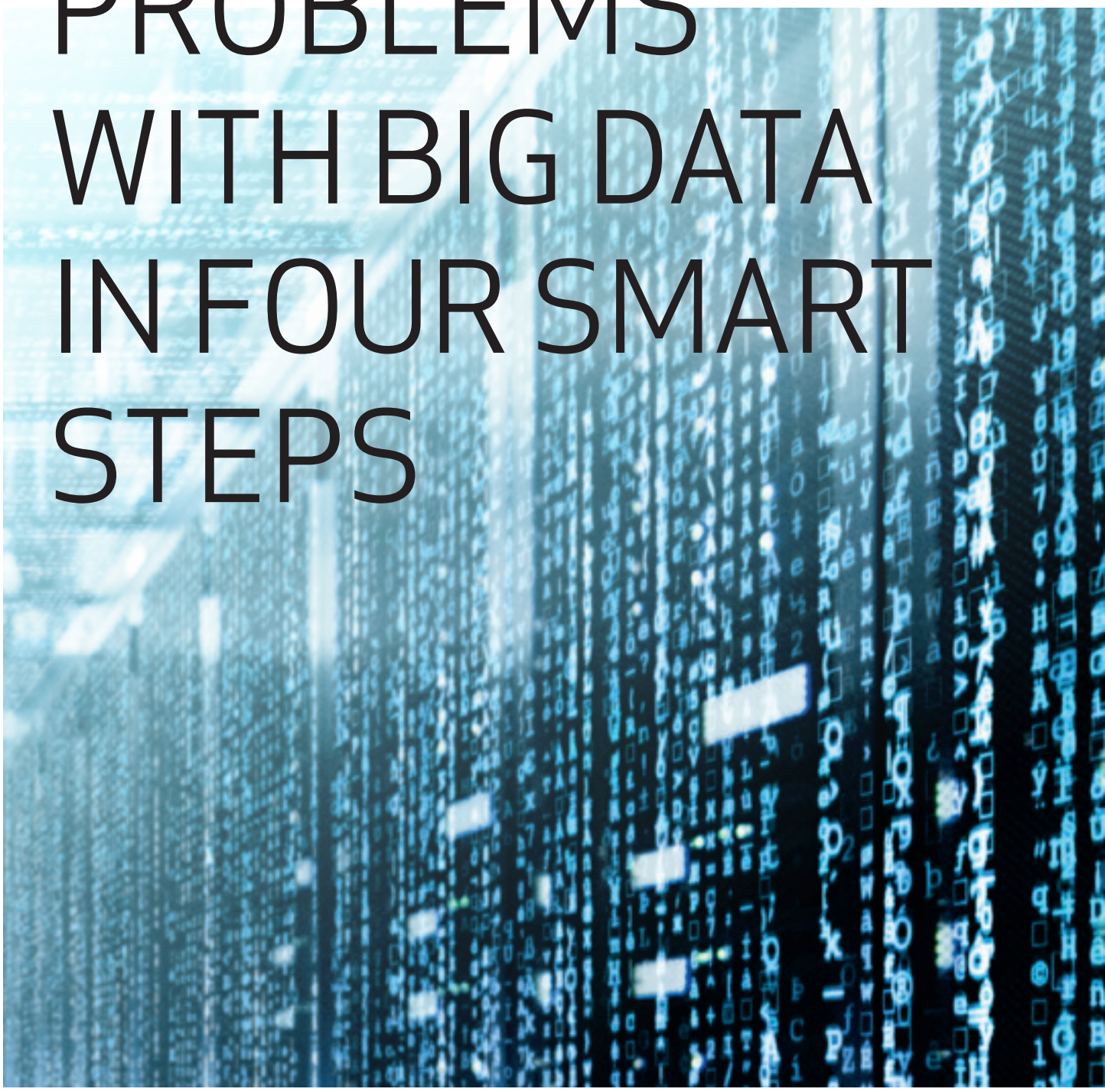

DON WOODS

It's a fact of business in the investor-owned energy industry today that you need to rely on big data to run your company as efficiently as possible. According to a December 2016 report by McKinsey & Company, big data's potential keeps growing, and companies must integrate an effective analytics strategy to their corporate vision to make better and faster decisions.

Even when focusing on just one part of your company's operation, such as your company's fleet of vehicles, data can be overwhelming. In a given year, a fleet of just 300 vehicles can generate up to 1,200 transactional data points from maintenance alone with another 30,000 from fuel transactions and a massive 15 million from telematics.

The trick is to not get lost in the numbers.

In the fleet industry and industries across the board, more companies are entering the big data game in an effort to yield valuable insights about how their operation flows and what they can change to make it more efficient.

Here are four smart steps for creating a tactical plan to harness the power of Big data.

1. **Define clear business objectives**

As your company prepares to begin collecting and analyzing data, you must first define clear business objectives. What are your goals and what parts of your operation should you monitor to help you achieve those goals? Focusing on collecting the right data will allow you to make better and faster decisions that align with your strategic vision. Also, consider the quality of the data. Many companies struggle with their ability to achieve their goals due to poor data quality. →

2. **Set realistic, achievable goals**

From the outset, make sure you set achievable goals. Organizations see great potential in the data and want to realize the full benefit of their investment. Ultimately, success hinges on the ability to evolve your big data strategy, and not bite off more than you can chew, when you are just getting started.

3. **Generate clear and specific reasons why higher costs are occurring**

Why is fuel spend increasing? Why are maintenance costs higher in one division than another? Why should drivers stick to the assigned preventive maintenance schedule?

As big data has evolved, fleets have shifted from trying to find meaning in an ocean of information to vehicle-focused data. The next generation of fleet management software is successfully deploying expertly designed statistical analyses that go beyond big data reports and are able to generate clear and specific reasons why higher costs are occurring. Today's software makes it easier than ever to identify the outliers in terms of cost and speed up the ability to take corrective action.

4. **Determine what will likely happen next**

Even more impactful than its ability to provide accurate insight, technology can make data genuinely impactful through predictive analysis – the ability to determine what will likely happen next based on the past.

Predictive analysis solutions are empowering companies to do deep dives into their data easily, analyzing current maintenance data along with the vehicle's history to determine how likely a vehicle is to fail. This opportunity to take the analysis a step further allows companies to more accurately predict and manage future costs. Companies are starting to use predictive data to inform which vehicles they purchase and when to replace older vehicles before maintenance costs grow.

Big data can produce a potentially overwhelming amount of information that generalizes what is going on in a fleet, but that usually results in more questions and more headaches. But by developing an effective analytics strategy, establishing goals, taking quick action and managing outliers, a fleet can quickly transform into an efficient and less costly operation.

ABOUT THE AUTHOR:

Don Woods currently serves as director of client information systems, and is responsible for developing comprehensive IT strategies that align with the needs of ARI's wide range of clients. Woods joined the company in 2011 and has held a variety of roles throughout ARI's IT and innovation groups. A veteran of the IT industry, Woods has spent more than 25 years with leading organizations across the banking, pharmaceutical and automotive sectors. He earned his Bachelor's degree from Boston College and also holds a Master of Arts in mathematics from Villanova University.

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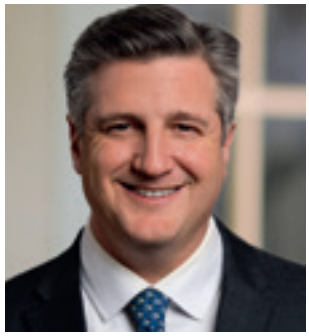


GLENN S. BENSON

On Sept. 29, 2017, the U.S. Department of Energy (DOE) submitted a Proposed Rule on Grid Reliability and Resilience Pricing (Proposed Rule) to the Federal Energy Regulatory Commission (FERC), proposing that FERC use its authority under Sections 205 and 206 of the Federal Power Act to issue new regulations assuring certain coal and nuclear power plants' recovery of their full cost of providing service, including a fair return on equity. Eligibility for the proposed revenue guarantee was to be limited to "fuel secure" plants that have a 90-day supply of fuel on-site and are located in the footprint of a Regional Transmission Operator (RTO) or Independent System Operation (ISO) that administers a forward capacity market. While that initiative has stalled, at least for now, with FERC having declined to go forward with the Proposed Rule, the commission is undertaking a broader, holistic examination of the resiliency issue to determine the appropriate course of action. Those expecting FERC to throw a life preserver to struggling coal and nuclear power plants en masse had best not hold their breath.

Few would dispute the importance of the nation having a resilient bulk power system. However, opinions differ widely on what "resilience" means, how much different levels of resilience are worth, what measures would best help achieve a desirable level of resilience, and whether any new regulatory measures are even necessary. There are no simple answers to these questions, and each region is different. Increasing reliance on intermittent variable energy resources, principally wind and solar, and a number of other factors, have posed numerous challenges to ensuring the reliability of the bulk power system, and the FERC and the nation's RTOs and ISOs are nowhere near resolving all of them. Addressing very important resiliency concerns, without doing more harm than good, will require great care and a balancing of many conflicting interests. →

Concerns about the impact of power plant retirements on the reliability, as opposed to resiliency of the bulk power system, are nothing new. RTO and ISO forward capacity markets were established to ensure the adequacy of capacity to reliably meet load, and FERC has long approved of capacity market rule changes designed to advance that objective while ensuring just and reasonable rates. In recent years, ISO New England and PJM have received FERC approval for reforms to their capacity markets to improve the performance of capacity resources and address fuel supply issues that arise during periods of system stress.

Additionally, RTOs and ISOs have long been authorized by FERC to enter into reliability-must-run (RMR) agreements and similar contracts requiring plants to keep operating for a specified period of time beyond the date on which they otherwise would have retired in return for guaranteed recovery of the plant's "going forward costs," i.e., its costs of continued operation with no return on equity. For example, the Midcontinent Independent System Operator (MISO) has the power to impose System Support Resource agreements on generators that plan to retire, but that MISO determines are needed to maintain system reliability. PJM's RMR tariff procedures allow generation resources to either elect a "going forward" compensation system or file a rate case. Most recently, ISO New England announced plans to seek FERC authorization to block Exelon Generation from retiring its 1,998 MW Mystic power plant in Charlestown, MA, on grounds that it is needed for reliability.

Are the capacity markets, as currently administered, and the ability of RTOs and ISOs to forestall closures on a case-by-case basis, sufficient to maintain a desirable level of resilience going forward? A flood of low-cost shale gas from the combination of hydraulic fracturing and horizontal drilling has led to a surge in combined-cycle gas turbine plant development, which, coupled with state policies subsidizing nontraditional resources, and most recently, certain nuclear plants, has placed coal and other nuclear baseload generation units on life support. At this time, ISO New England reports that 4,600 MW, or about 16 percent of the region's non-gas-generating capacity, will have retired by 2021, and another 5,000 MW of coal- and oil-fired generation is at risk for retirement in coming years. PJM reports that it has received owner requests for the deactivation of 13,300 MW of capacity by 2021.

DOE's Proposed Rule sought to stem the wave of retirements by offering guaranteed profitability to plants with 90 days of fuel supply on grounds that such plants are needed to ensure resiliency. DOE pointed to resiliency problems exposed by the 2014 polar vortex and a growing recognition that the organized markets fail to compensate resources for all the attributes they contribute to the grid, including resilience.

FERC responded to the DOE Notice of Proposed Rulemaking by promptly establishing a rulemaking proceeding to consider the Proposed Rule and soliciting comments and information from interested parties. After reviewing the numerous comments received, FERC issued a decision on Jan. 8, 2018, terminating the rulemaking proceeding and initiating an administrative proceeding instead in which FERC will examine the issue of resilience in RTO and ISO markets holistically. The FERC-stated goals for this proceeding are to 1) develop a common understanding among the FERC industry and others of what resilience means and requires; 2) understand how each RTO and ISO assesses resilience; and 3) use this information to evaluate whether actions are needed. To that end, FERC posed a series of questions to the RTOs and ISOs and required them to submit responses by March 9, 2018.

The RTO and ISO responses reveal the complexity of these issues and provide little indication that any are prepared to move forward with major reforms in the near term. Alone among the organized markets, ISO New England acknowledged significant resilience concerns, reporting that energy shortfalls due to inadequate fuel supply would occur with almost every fuel-mix scenario, beginning in the winter of 2024-25. However, ISO New England also indicated that this gap could be filled by increased levels of imports, liquefied natural gas and renewables. PJM called on FERC to direct all RTOs, ISOs and jurisdictional transmission providers in non-RTO regions to propose market reforms and related compensation mechanisms to address resilience concerns within nine to 12 months of the issuance of a final FERC order. Reply comments of other interested parties in response to the RTO and ISO filings are due on May 9, 2018.

As both FERC and each of the RTOs and ISOs have recognized, the first and most fundamental issue that must be addressed with respect to resiliency is how "resilience" is to be defined. FERC has proposed to define resilience as "[t]he ability to withstand and reduce the magnitude and/or duration of disruptive events, which includes the capability to anticipate, absorb, adapt to, and/or rapidly recover from such an event." While the RTOs and ISOs have suggested important refinements to this definition, it is important to note that the generality of the definition could pose challenges to any effort to secure new regulations or market rules that effectively pick winners and losers. Virtually, all resources and transmission facilities help support the resilience of the grid under FERC's broad proposed definition. Therefore, any attempt to throw dollars at certain generation plants in the name of resilience, but not at other resources and facilities that provide the same or other resilience benefits, may be vulnerable to legal challenge.

The answer seems to lie in identifying specific attributes that are needed for the resiliency of the grid and adopting mechanisms to ensure that all resources and facilities contributing such attributes are compensated for them in a manner that is proportional to the value they provide. The markets already do this to some extent, with FERC imprimatur. By rewarding good performance and penalizing poor, the current designs of the ISO New England and PJM capacity market seek to compensate resources based on the value of their respective capacity.

The ancillary service markets already reward generators, based on certain other attributes their plants provide to the grid, including their capabilities to provide regulation service, black start, frequency response, reactive power and spinning and nonspinning reserves. For example, under FERC Order 784, generators are compensated not just for the amount of regulation services they provide, but also for providing a more rapid response time or greater accuracy following a regulation signal. In addition, the MISO and California Independent System Operator (CAISO) have adopted ramp capability products that reward generators for the ramping capability they provide to the market. CAISO has also adopted a Flexible Resource Adequacy product to help it retain sufficient levels of flexible capacity resources to meet the state's renewable resource objectives without harming reliability.

On the other hand, there are a number of resource attributes that are beneficial to reliability and resilience but that are not specifically reflected in compensation in some or all RTOs and ISOs. For example, the grid needs dispatchable resources to match generation with load continuously, but the level of compensation paid to resources does not generally reflect their relative dispatchability. Similarly, the amount of compensation paid to resources typically does not reflect the relative security of a resource's fuel supply. Other examples of generally uncompensated resource attributes include start times, ramp rates, inertia, minimum load level and proximity to load.

Determining which of these and other attributes merit special compensation for purposes of assuring resiliency will require modeling of countless scenarios involving a wide array of high-impact, low-frequency events to identify the attributes critical to achieving or maintaining a desirable level of resilience at an acceptable cost. An RTO or ISO proposing a market product to compensate such attributes will need to be able to show why that attribute's contribution to resilience should be reflected in resource compensation while other attributes' contributions continue to go uncompensated.

Assuming such a showing can be successfully made, additional challenges will remain. How will the amount of compensation for a necessary attribute be determined?

ABOUT THE AUTHOR:

Glenn S. Benson is a partner with national law firm BakerHostetler. Based in Washington, DC, Benson is one of the country's leading representatives of onshore and offshore oil and gas producers on regulatory matters He has more than 24 years of experience and an uncommon familiarity with the Federal Energy Regulatory Commission (FERC). He counsels clients across the energy industry on tariff and contract disputes before FERC, regulatory compliance and enforcement, and the negotiation of commercial transactions, including power purchase agreements, interconnection agreements, pipeline precedent agreements, asset management agreements, and oil and gas purchase and sale agreements.

Will resources with the important attribute be assured recovery of their entire cost of service, including a reasonable rate of return, as DOE's Proposed Rule contemplated? If not, will resources be compensated for the costs associated with their resource-specific capability, or only for actual utilization of this capability? Will all resources with the attribute be entitled to such compensation or only resources in a certain part of the ISO/RTO footprint? How will the costs of this compensation be allocated by the RTO or ISO? How often will resilience and the attribute be re-evaluated to determine whether the attribute merits continued compensatory treatment in light of resources' additions and other relevant changes, or perhaps greater compensation in the event the compensation scheme proves inadequate to stem retirements? These are just some of the many questions with which the RTOs and ISOs will need to grapple, and any proposals will have to be accepted by FERC and survive all-but-certain legal challenges.

In short, by declining to adopt DOE's Proposed Rule and opting instead to approach resilience holistically, FERC has required that the RTOs and ISOs weave a tangled web to formulate and push through any major market reforms to promote resiliency. For power plants teetering on the precipice of retirement, restorative action may not come soon enough, if at all.

The views expressed in this article are those of the authors and not necessarily those of BakerHostetler or its clients.

POWHERFUL FORCES

JULIET SHAVIT

PRESIDENT AND CEO OF SMARTMARK COMMUNICATIONS

Juliet Shavit is not an engineer, but that doesn't prevent her from being the recipient of titles like "Queen of the Smartgrid," "Woman of Power," or from being featured in magazines like *EE T&D*. Because she grew up in a family of engineers, Shavit understands how they think and speak. What's more, she is a deft communicator, who asks the right questions and is able to translate the thought processes of both engineers and everyday day consumers. As Shavit explained, "Even though I'm not an engineer, I spend a lot of time wondering how and why things work The primary difference between myself and engineers is that I focus on another dimension as well—what is that thing's impact on *me*."

It helped that Shavit grew up around engineers, but her willingness to take risks and her desire never to be bored has pushed her to do even more with her communication skills. After working at *The New Yorker* after college, Shavit left to become a marketing writer for a telecom company. From there, she joined a former colleague at his telecommunications billing company. Witnessing the struggles that came with technology adoption made it clear to her there was a critical need for better communication between telecom providers and their end-users. Deciding it was time to enable that communication, Shavit founded SmartMark Communications in 1999. SmartMark is a communications, strategy and new media company, where Shavit and her team serve as a bridge between marketing communications departments and engineers and technologists. They also help technology-focused companies and industries understand how to communicate these benefits to customers.

When utilities first began deploying AMI, while leveraging their network communications, Shavit was approached to assist with decoding the benefits of this new technology for industry partners and consumers alike. While she had not worked with energy clients, Shavit found the parallels between the telecommunications sector and that of the energy sector rather striking. "I had just lived through the technology transformation in the telecom industry. I have an appreciation for how those networks transform businesses. I definitely can hold my own in a room full of technologists on the energy side. I also have a business appreciation for how that technology works, because not only did I see and understand what was happening on a technology level during the telecom transformation, but it was also my job to understand the business value proposition of that technology. It is the same with energy."

Since founding SmartMark, Shavit has established herself as an expert in translating tech-speak, while conveying to technologists the importance of engaging customers and eliciting their buy-in. Shavit has also been instrumental in changing the perception of customer value in utility business cases—something she is passionate about. This has made her popular with regulators and utilities alike—particularly now, in the age of grid modernization and large scale utility technology investment.

Her comfort level with engineers and industry acronyms, combined with her capacity for connecting with all levels of utilities and stakeholders, has earned her speaking opportunities with the likes of the Institute of International and European Affairs (IIEA), GridComms, Digital Transformation World and TIA Jam.

As new technology emerges, and as more utilities migrate towards grid modernization, Shavit sees a tremendous need for a greater customer education effort. In response to this need, Shavit launched SmartEnergy IP, a research and consulting organization within SmartMark Communications that is focused on helping utilities understand how the smart grid benefits their customers. Shavit uses SmartEnergy IP's findings to ensure effective communication between companies and their stakeholders. More important, she draws upon the information to stress the importance of the customer's role.

"I'm really passionate and very excited about how tech companies are paying more attention to the consumer on so many levels," said Shavit, "whether it's making the customers' lives easier, addressing data privacy or including them in conversations on the roadmap of where this technology is headed."

In spite of her optimism, Shavit cautions utilities to keep in mind that at the end of the day, they're serving customers and not ratepayers. *"We're on this journey together,"* said Shavit.

"Our lives have become more digital, and businesses are trying to wrap their head around the impact digital will have on the customer experience. Companies need to use customer responses as a barometer when budgeting for and plotting their technology roadmap. If utilities can harness what that means and optimize this new customer/utility dynamic, they will see success. If we exclude customers from that discussion, I would not be too optimistic about these technology investments working out."

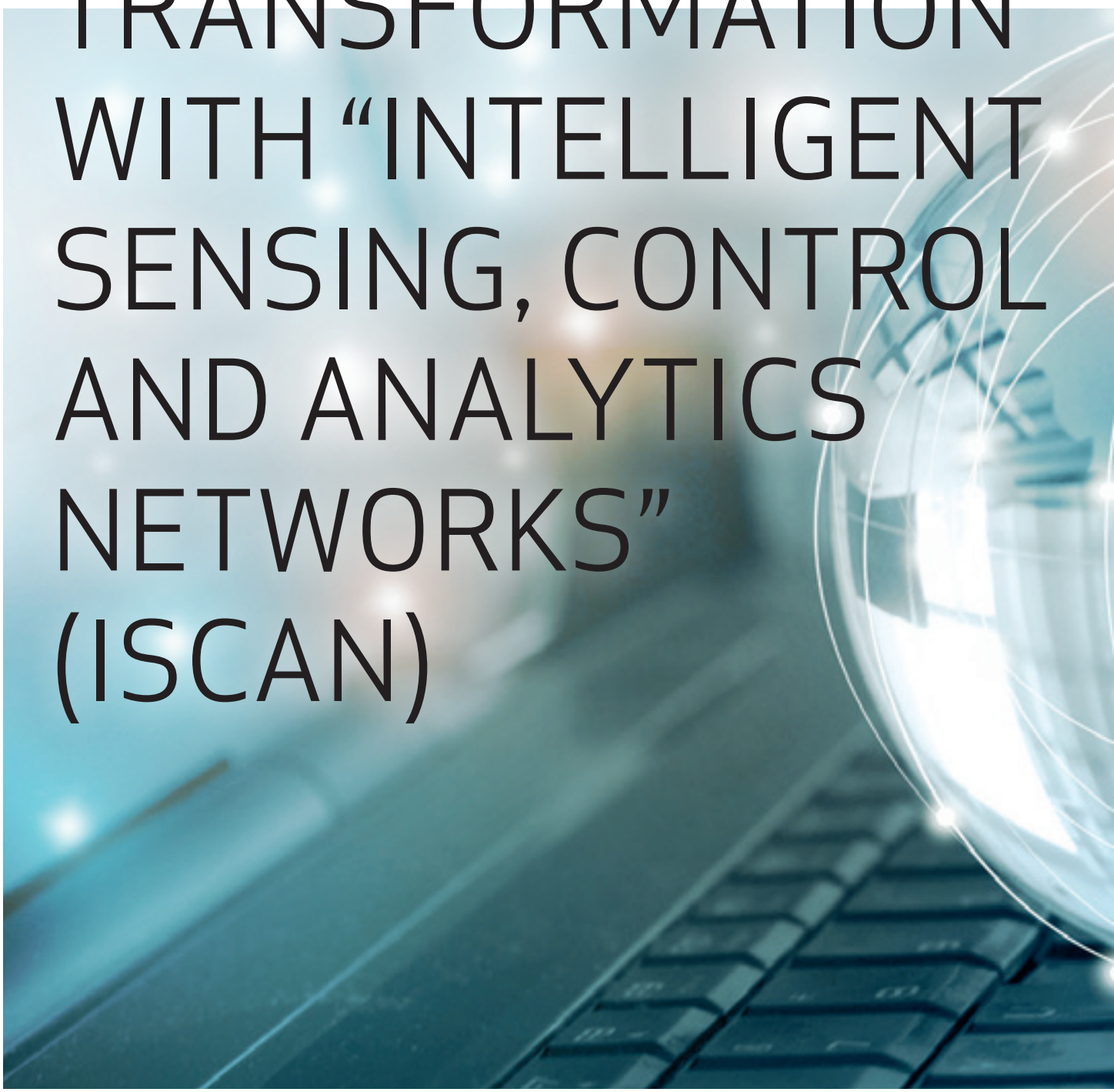
If you are looking to establish a stronger communication channel, you may wonder how to get the conversation started between utilities, stakeholders and consumers. On the SmartMark Communications' website (www.smartmarkglobal.com), visitors can find links to Shavit's presentations she has given at industry events, as well as interviews in publications where she explains the role of the consumers in smart grid modernization.

ABOUT JULIET SHAVIT:

Juliet Shavit is president and CEO of SmartMark Communications, and a world- renowned leader in strategic communications and customer experience. She has been called the "Smart Grid Queen" by *European Communications* for her pioneering work in defining the role of customer in smart grid deployments. She's also been lauded as a "Woman of Power" by *Mobile Europe* for her active role in helping the communications industry monetize IoT.

Shavit started SmartMark Communications in 1999, helping it move from a public relations firm into an award winning, global full-service communications agency serving government organizations, as well as Fortune 500, public and private companies in a variety of industries. Today the company is transforming even further, actively moving into emerging technology applications and innovation for improved customer experience.

ENABLING GRID TRANSFORMATION WITH "INTELLIGENT SENSING, CONTROL AND ANALYTICS NETWORKS" (ISCAN)



JIM KEENER

The electrical distribution grid has been slow to evolve since its inception in the early 20th Century. The introduction of SCADA (Supervisory Control and Data Acquisition) systems in the 1960s and 1970s gave utility engineers their first real opportunity to understand and improve the health and performance of the distribution grid. This was quickly followed by the introduction of the Distribution Management System (DMS) and the Outage Management System (OMS) in the 1980s and 1990s. These tools allowed system dispatchers to oversee the entire distribution grid from a central operations and dispatch center. The mid-2000s brought the advent of smart meters and Advanced Metering Infrastructure (AMI) network. This opened up a new set of data and information that enabled utility operators to better understand and react to customer concerns and issues. The evolution of software enterprise systems coupled with the increased capability of data storage and management drove the acceleration of big data analysis and helped create the "data lake" concept.

Although these advances in hardware and software technology have led to some improvements in overall performance over the past 30 years, grid capability and design have not evolved to the levels achieved by the communication and transportation industries. Public Service Commissions continue to pressure utilities and electrical energy suppliers to improve reliability, performance and power quality while maintaining or reducing operating costs. These pressures, combined with aging grid infrastructure and the proliferation of distributed generation are the primary drivers for fundamental change in both the capability and performance of the distribution grid. However, the integration of technology and grid automation will simply not be sufficient to address current and future consumer needs. →

Minding the Grid Information Gap

Technology has produced many components and partial solutions focused on distribution grid transformation. Grid edge devices and data-analytics programs continue to support grid automation and often offer improvement for targeted areas. Currently, there is significant data and information available at both the source (substation SCADA and DMS) and the load (smart meters and AMI network). SCADA systems provide detailed data capture from the bulk generators up to and including substations. AMI networks now give complete customer information regarding delivery, usage and performance. Although this information is necessary and valuable, it is incomplete and not capable of being the sole support for an interactive grid.

The 21st Century "thinking grid" requires an infrastructure layer, that combined with SCADA and AMI networks, will enable complete and accurate data flow and intelligence throughout the entire distribution grid. This will not happen as long as there remains an information gap on the entire network and connecting infrastructure between substation and customer meter, which, at six million miles in North America alone, is the largest, most costly and most vulnerable part of the grid. The 21st Century intelligent distribution grid must address all current and future issues regarding grid performance along the entire power delivery value chain, distributed generation, aging infrastructure and the full integration of all systems and data.

The Missing Link - Intelligent Sensing Control and Analysis Networks (ISCAN)

Today's electrical power delivery chain depends primarily on centralized bulk generation with rapid growth in distributed generation. The majority of critical information available today is captured through SCADA systems, substation and grid device monitoring, and AMI networks. This information is used to generate, calibrate and correct the network models and provides inputs to control and management systems such as the EMS, OMS and (A)DMS. Currently, these models limit the ability to operate and maintain the grid at optimum performance and do not meet the expectations and requirements of today's utilities or their customers.

Detailed information from generation to/and including the distribution substation is available through SCADA and other monitoring devices, while pertinent customer usage and information are now available through AMI networks. SCADA systems changed the way the industry approached control and monitoring of the electrical systems and led to increased reliability and performance. They also helped lower both capital and operating costs.

The AMI networks have given insight into customer usage and trends. This has helped to improve performance and has begun to enable predictive maintenance at the grid edge.

The current information gap and primary limitation to an accurate network model centers around the distribution grid itself. Limitations and inaccuracy of the model limit the effectiveness of control and management systems. This creates sub-optimal grid reliability and performance. In its current state, the distribution grid is not capable of meeting today's requirements.

Shortfalls include:

1. Inability to immediately locate faults and the cause of an outage
2. Inability to detect a non-outage disturbance
3. Inability to detect load shifts, load imbalances and other power quality issues at the feeder and lateral levels
4. Inability to identify abnormalities and predict potential faults and outages
5. Inability to meet requirements necessary to address new challenges created by the rapid increase in microgrids and distributed generation
6. Inability to integrate grid edge control devices into the overall grid control

In order to have a complete and accurate model of the electrical power delivery chain, utilities must have a thorough understanding of current activity and condition of the distribution grid. This requires a network of intelligent data/information gathering devices with or without control capability. Intelligent Sensing Control and Analysis Network (ISCAN) fills the void currently left by SCADA and AMI networks and provides a real-time, complete network model that enables both preventive and prescriptive analytics so the grid performance limitations listed above can now be addressed.

ISCAN is a straightforward and basic concept, which will enable true grid transformation and have a significant and positive effect on grid performance in the areas of safety, reliability, power quality, cost control and lifecycle extension. There is a strong set of requirements for a complete and effective ISCAN network that creates significant challenges, constraints and technical obstacles. Network requirements include both sensing elements (Field End Devices) and Enterprise Software.

FIGURE 1

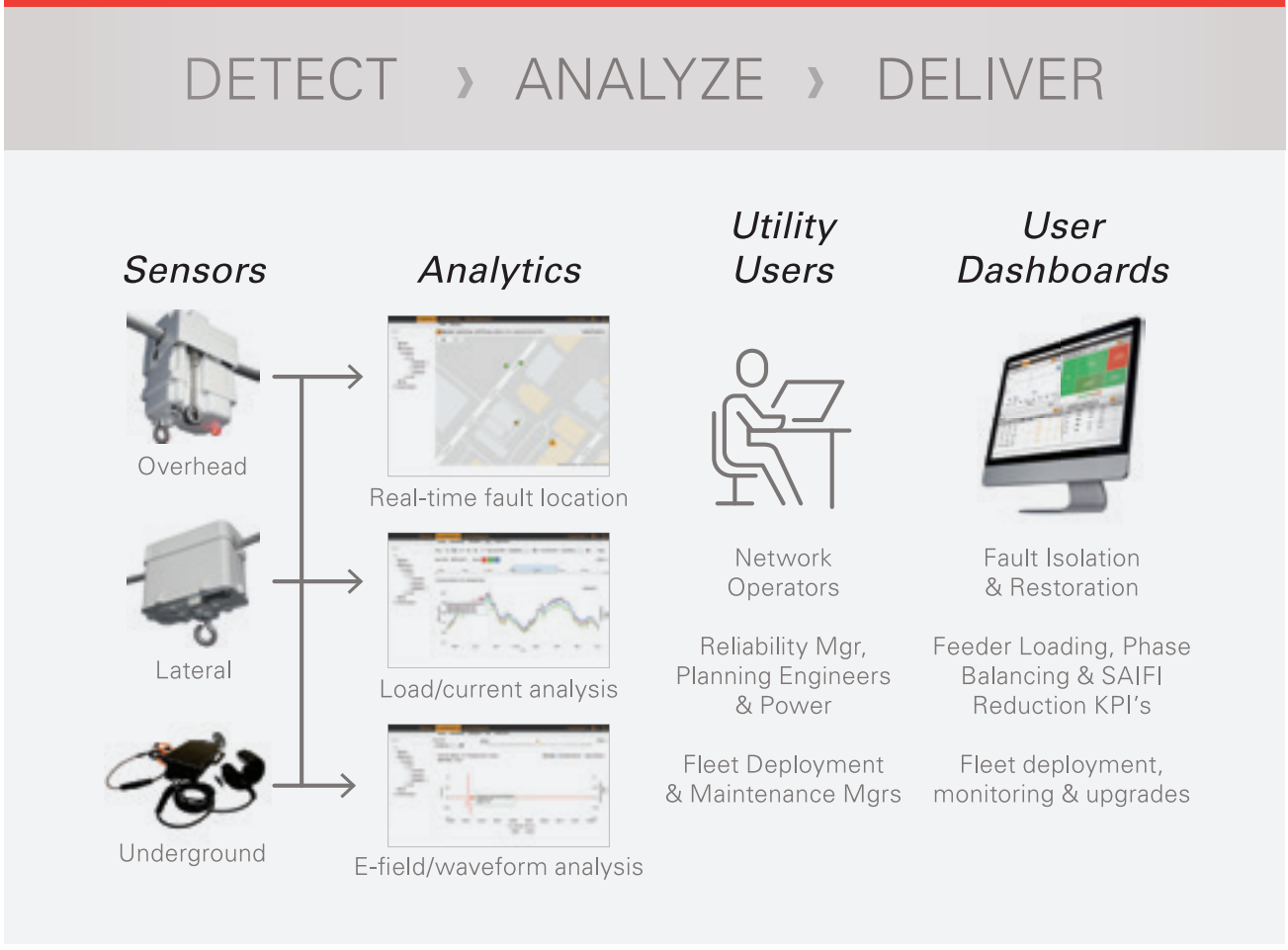


Figure 1: *Intelligent Sensing, Control & Analytics Network for Distribution* Grid

ISCAN Sensing Element Requirements:

1. Must be ubiquitous; reach all overhead and underground circuits
2. Must be multi-communications capable; working through multiple diverse communication networks
3. Must be environmentally capable of all grid environments and conditions
4. Must have highest signal capture fidelity to support all Grid needs, including Predictive Analytics and Distributed Generation
5. Must have strong analytics and storage capability
6. Must be able to integrate with any ADMS

Note: Field testing has shown that some field disturbances and abnormalities are only detected at the 15th harmonics or higher.

ISCAN Enterprise Software Requirements:

1. Must be capable of managing 20K to 100K devices
2. Must meet all security requirements
3. Must be on-premise or cloud capable
4. Must be capable of integrating multiple communication protocols
5. Must be capable of integrating multiple types of field sensing elements; underground, overhead, low/ high current, voltage, etc.
6. Must be capable of housing/enabling libraries of waveforms sustained faults, momentaries, disturbances, load changes, maintenance activities (capacitive switching)
7. Must be capable of integrating with multiple utility OT systems; ADMS, Historian, EMS, OMS, etc. →

Benefits and Capabilities

Though the requirements of an Intelligent Sensing Control and Analysis Network are quite rigorous, with numerous technological challenges, the benefits towards grid performance can be game-changing. Reliability and power quality will go up substantially while cost should decrease dramatically.

Benefits include:

1. Lifecycle extension and improved system planning through optimum phase balancing, load and line management and an accurate connectivity view
2. SAIDI reduction due to immediate fault location detection
3. Pre-fault sensing and prediction (vegetation issues, device pre-failure, etc. detection)
4. Load direction, power quality monitoring and improvement recommendations necessary to meet distributed generation needs
5. Sustained fault, momentary fault and disturbance waveform libraries used for planning and improvement purposes (Load change and maintenance waveforms may be included)
6. Connectivity and proper phasing identification
7. Advanced analytics; Disturbance management, high impedance detection, etc. (to address safety concern, wire down)

Disturbance Management – Advancing Beyond SAIDI and CAIDI Reduction

Disturbance management leverages the high-resolution oscillography required in an advanced sensing network and provides analytics tools, software visualization and integration with operational utility systems. Grid disturbances are both normal and abnormal events (deviations from the steady-state power flow) that occur on utility networks every day. Some examples are sustained and momentary faults and voltage anomalies that are managed by ADMS or other systems controlling substation equipment and distribution line capacitors. Other examples include non-fault and load anomalies that typically go undetected today due to the limited amount of sensing equipment between the substation and the customer meter, as well as the lower resolution of data captured by today's control and monitoring equipment. In many cases, non-fault disturbance anomalies are precursors to new sustained faults, momentary faults and power quality events. Ubiquitous sensing at the feeder, lateral and underground level is required to detect these anomalies.

By leveraging network models provided by the sensing network, an ADMS can pinpoint the source of the anomaly so that mitigation can be performed by maintenance crews. Overhead feeder level sensing, alone, has limitations in detecting and pinpointing disturbances since many of these anomalies originate at locations that are a considerable distance downstream from the feeder-level sensors on overhead laterals, or underground

FIGURE 2
ISCAN PLUGS IN THE GAP FEEDING INFO TO OMS & DMS, ADMS, DERMS AND UTILITY DATA LAKE

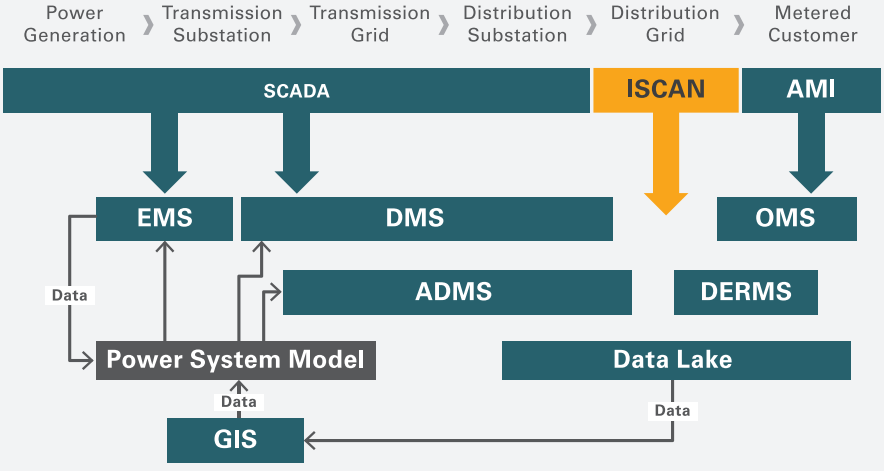


Figure 2: Intelligent Sensors, Advanced Analytics and Integration with Multiple Systems Provides Substantial Reliability and Power Quality Benefits

cables and equipment. By leveraging sensors across the various levels of the distribution grid, ISCAN, enabled by disturbance management, will provide the tools necessary to reduce the frequency of sustained and momentary outages that is required for utilities to achieve greater benefits by reducing the frequency of outages with proactive detection, and the pinpointing and mitigation of pre-fault disturbances. Disturbance management will enable ISCAN to go beyond benefits associated with SAIDI and CAIDI reductions by utilizing the capabilities of an advanced intelligent sensing network.

Ultimately, the goal of disturbance management is to detect the "pre-fault signatures" associated with sustained and momentary faults that are caused today by failing overhead and underground equipment, vegetation and other issues that occur at any level of the network. The tools and processes to develop these signatures have been challenging due to the limited number of sensing locations and the accuracy level of these sensors. However, this limitation is being addressed, and sensors are now available for the entire grid to provide the level of accuracy required to detect and analyze low-level disturbances. ISCAN can now be enabled to support utility efforts to identify grid anomalies, which, if not addressed, will continue to cause new sustained and momentary outages. Disturbance management provides an incremental approach to achieving the ultimate goal of classifying non-fault disturbances with pre-fault signatures (cause codes).

Evolution and Adoption of ISCAN-Level Technology

CFCI (Communicating Fault Current Indictor) has been around for a decade. Many have claimed to be or have been mistaken for intelligent sensors. Most lack the robustness, fidelity, communication flexibility and computational capability to support ISCAN. The reality is that the industry is at a tipping point and remains at the introductory stage of this evolution. Early adopters are beginning to see the benefits and are positioning themselves to remain leaders in performance, cost and reliability. There are few technologies that have reached the ISCAN level, and they have proven themselves in many areas. Adoption of this technology has been slow to date but has now reached the fast-follower stage and is approaching mainstream acceptance. Advanced analytics, waveform libraries, disturbance detection, disturbance management and predictive analytics, though in their early stages, are a reality and are already proving effective.

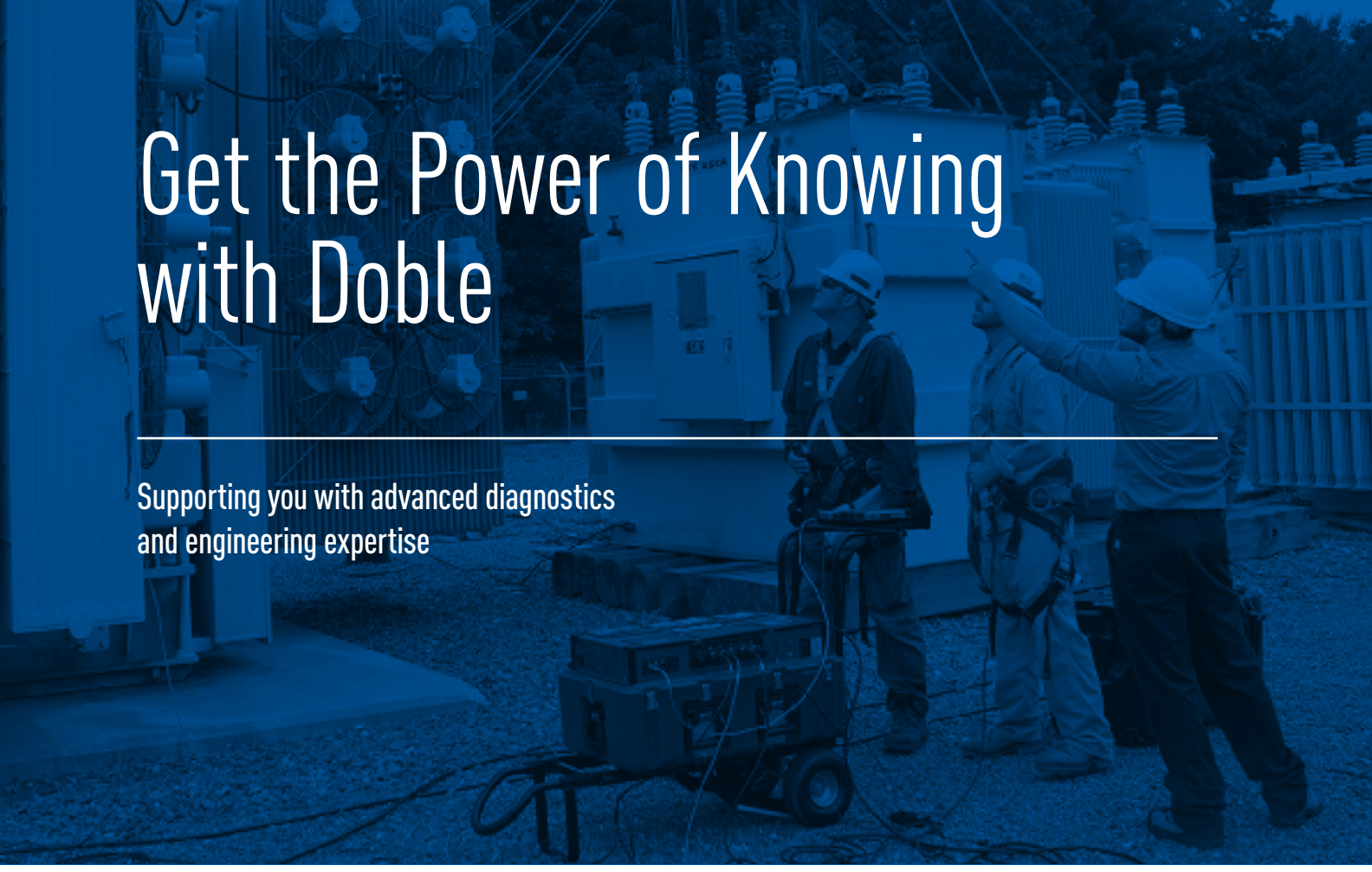
Grid transformation is a reality and a necessity. It is upon the industry now and will continue to accelerate rapidly. Pressure from regulators, the onset of distributed generation and aging infrastructure will accelerate the rate of transformation. ISCAN is the missing link for a complete and accurate network model required to meet new and ongoing needs. Technology will continue to improve. ISCAN adoption will accelerate, integration with ADMS will become a requirement and performance will improve.

ISCAN will evolve and with it the grid. Disturbance management will be the norm, not the exception, and the ADMS will be able to see and touch all parts of the grid with a highly-accurate model.

ABOUT THE AUTHOR:

James "Jim" Keener joined Sentient Energy in 2014 as Chief Executive Officer. Before joining Sentient Energy, he was vice president, technical services for the Power Generation Division of NextEra Energy, Inc., where he was responsible for all technical and engineering activities associated with NextEra Energy's non-nuclear assets worldwide. In his most recent role at NextEra Energy, Keener served as Florida Power & Light Company's vice president of transmission & substations and was responsible for overseeing the delivery of electricity from all generating sources to the distribution network, and to wholesale customers through FPL's transmission system. Keener was a part of the effort that resulted in FPL receiving the first Deming prize awarded to a non-Japanese company.

Keener earned a Bachelor of Science degree in electrical engineering from the University of Florida, Master of Business Administration from Nova Southeastern University and is a graduate of the Program for Management Development at Harvard University. He holds U.S. patents for Dispatchable Renewable Energy Generation, Control, & Storage Facility and System & Methods for Air Intake Filter Assemblies. He has authored and presented for industry groups for Power Generation and Combustion Turbine Technology. Keener was named "2015 Smart Grid Pioneer" by Smart Grid Today.



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